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Editorial

It is a matter of both honor and pleasure for us to put forth the thirteenth issue of BIJT; the BVICAM's International Journal of Information Technology. It presents a compilation of twelve papers that span a broad variety of research topics in various emerging areas of Information Technology and Computer Science. Some application oriented papers, having novelty in application, have also been included in this issue, hoping that usage of these would further enrich the knowledge base and facilitate the overall economic growth. This issue again shows our commitment in realizing our vision "to achieve a standard comparable to the best in the field and finally become a symbol of quality".

As a matter of policy of the Journal, all the manuscripts received and considered for the Journal, by the editorial board, are double blind peer reviewed independently by at-least two referees. Our panel of expert referees posses a sound academic background and have a rich publication record in various prestigious journals representing Universities, Research Laboratories and other institutions of repute, which, we intend to further augment from time to time. Finalizing the constitution of the panel of referees, for double blind peer review(s) of the considered manuscripts, was a painstaking process, but it helped us to ensure that the best of the considered manuscripts are showcased and that too after undergoing multiple cycles of review, as required.

The twelve papers, that were finally published, were chosen out of eighty nine papers that we received from all over the world for this issue. We understand that the confirmation of final acceptance, to the authors / contributors, sometime is delayed, but we also hope that you concur with us in the fact that quality review is a time taking process and is further delayed if the reviewers are senior researchers in their respective fields and hence, are hard pressed for time.

We further take pride in informing our authors, contributors, subscribers and reviewers that the journal has been indexed with some of the world's leading indexing / bibliographic agencies like **INSPEC** of **IET** (UK) formerly **IEE** (UK), **Index Copernicus International** (Poland) with **IC Value 4.75**, **ProQuest** (UK), **EBSCO** (USA), **Open J-Gate** (USA), **DOAJ** (Sweden), **Google Scholar**, **WorldCat** (USA), **Cabell's Directory** of Computer Science and Business Information System (USA), **Academic Journals Database**, **Open Science Directory**, **Indian Citation Index**, etc. and listed in the libraries of the world's leading Universities like **Stanford University**, **Florida Institute of Technology**, **University of South Australia**, **University of Zurich**, etc. Related links are available at <http://www.bvicam.ac.in/bijit/indexing.asp>. Based upon the papers published in the year 2012, its **Impact Factor** was found to be **0.605**. These encouraging results will certainly further increase the citations of the papers published in this journal thereby enhancing the overall research impact.

We wish to express our sincere gratitude to our panel of experts in steering the considered manuscripts through multiple cycles of review and bringing out the best from the contributing authors. We thank our esteemed authors for having shown confidence in **BIJIT** and considering it a platform to showcase and share their original research work. We would also wish to thank the authors whose papers were not published in this issue of the Journal, probably because of the minor shortcomings. However, we would like to encourage them to actively contribute for the forthcoming issues.

The undertaken Quality Assurance Process involved a series of well defined activities that, we hope, went a long way in ensuring the quality of the publication. Still, there is always a scope for improvement, and so, we request the contributors and readers to kindly mail us their criticism, suggestions and feedback at bijit@bvicam.ac.in and help us in further enhancing the quality of forthcoming issues.

Editors

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Health Management in Crowded Events: Hajj and Kumbh

Mohammad Yamin

Submitted in April, 2014; Accepted in December, 2014

Abstract - Reoccurrence of life threatening communicable diseases like EBOLA, HIV Aids, SARS, MERS in various regions of the globe have made management large crowds challenging. These viruses and the associated diseases can spread at an alarming rate and cause havoc in societies. Crowd managers need to firstly take adequate steps to control the infiltration of infected people into the crowds and secondly to have in place a management regime of effectively treating the infected people, if found. Failing to manage deadly viruses and diseases in crowds can bring catastrophes of large magnitude not witnessed in the modern times. In this article we provide an overview of managing large crowds from health point of view. Our framework of health management for crowded events will be presented in the cases of Hajj (an annual pilgrimage to Mecca) and Kumbh Mela (a periodic religious gathering in India), both of which are known to be very complex and highly crowded events.

Index Terms – Crowd, Health, Management, Viruses, Hajj, Kumbh

1.0 INTRODUCTION

Recent outbreak of EBOLA [1, 2 and 3] in some West African nations has seriously challenged medical fertility in the world. Despite many efforts by the World Health Organisation (WHO) and some developed nations, EBOLA continues to claim many human lives. During the last decade we have witnessed other kinds of dangerous outbreaks like Severe Acute Respiratory Syndrome (SARC) [4]. Currently, some countries of the Middle East, including Saudi Arabia, are battling with the Middle East Respiratory Syndrome (MERS) also known as corona-virus [5 and 6]. There are already ongoing problems of HIV virus in large part of the world.

While spread of these and other contagious viruses and diseases is not checked, events with large crowds run a risk of catastrophic loss of human lives if they are not organised properly. Many crowded events take place time to time. Some are well defined and occur regularly where there are others which are one off gatherings. Historically, crowded events have witnessed stampedes, fires, drowning and mismanagement resulting in the loss of thousands of human lives. An account of the people killed in the last decade during various crowded events in the world can be found from multiple sources including [7, 8 and 9]. In this article we are mainly concerned with the health issues of the participants of crowded events, and propose solutions to deal with health risks and make the

events safer. In particular we will deal with the cases arising from the communicable viruses and diseases. Our study uses two of the most crowded events which occur regularly, the Hajj [7, 8 and 10] also see Pic 1 [19], an annual pilgrimage in Saudi Arabia and Kumbh [11], also see Pic 2 [20], a periodic pilgrimage in Allahabad and other cities of India. Ironically both of these events are religious in nature. Incidentally, the most crowded events of world are religious in nature. First we will provide a description of the Hajj and the Kumbh from organisational point of view.

1.1 The Hajj

The Hajj is an annual pilgrimage to Makkah (Mecca) in Saudi Arabia. Anybody belonging to the Islamic faith, irrespective of their geographical location, can apply to perform Hajj through travel agents in the country of their residence. It takes place every year during 8th-12th Dhulhijja, a month of Islamic calendar. Being lunar, Islamic calendar is shorter than a Gregorian calendar by 10-12 days depending on the year, hence it completes a full cycle of all seasons in about thirty three years. Every year about three millions out of an estimated ten million applicants are granted permission to perform the Hajj. Main rituals of the Hajj are performed during four days. However, limitation of international transportation and other reasons, many pilgrims spend about a month in Saudi Arabia. During this extended period of their stay, they perform pilgrimage at the prophet's mosque, built by Mohammed - the prophet of Islam in Madinah, the second most sacred mosque in the world, at a distance of about four hundred kilometres from Makkah. One of the most complex Hajj operations is the transportation of more than three million pilgrims from the tent city Mina to a short but congested journey to and from the Valley of Mount Arafat. Some of the rituals, infrastructure, management problems and other issues of the Hajj can be found in [7, 8 and 10].

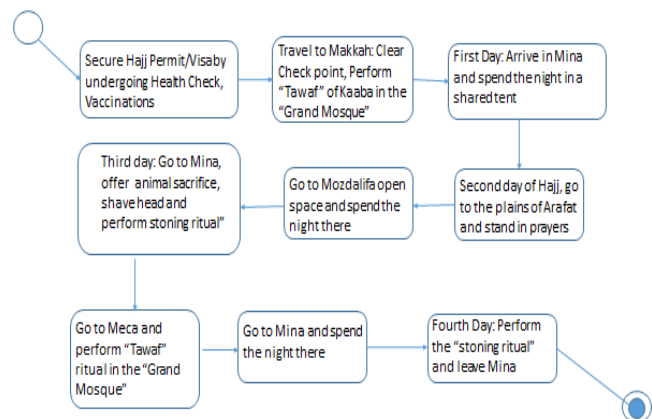


Figure 1: Hajj Rituals

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1.2 The Kumbh Mela

Kumbh Mela is a pilgrimage, a festival and a fair which is the largest gathering of people in the world. In 2013 an estimated one hundred million pilgrims visited Kumbh (Kumbh Mela)

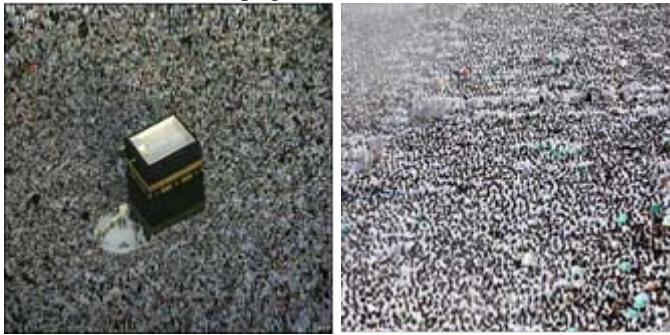


Figure 2: Hajj Gatherings

[11]. Kumbh is organised periodically every three years in four different cities of India along the banks of sacred rivers namely, Ganga (Ganges) in Haridwar and Allahabad, Yamuna (Jamuna) and Saraswati in Allahabad, Godawari at Nasik and Shipra in Ujjain. The largest of the Kumbh Mela, known as full Kumbh takes place every twelve years in Allahabad and the Ardha Kumbh (Half Kumbh) takes place every six years in Haridwar. The duration of Kumbh is about six weeks during which pilgrims come and go back after performing their pilgrimage for a few days. One of the main rituals of Kumbh is a dip in the sacred river wherever it takes place. The pinnacle of the rituals is known as Shahi Snanam on a particular day known as Mauni Amavasya when a large number of pilgrims dip in the river. In 2014 Kumbh at Allahabad about thirty million pilgrims made it to Shahi Snanam. Most of the Kumbh pilgrims come from within India itself. The event does, however, welcomes and facilitates pilgrims from any country. Focus of the management is local population which usually travels with land routes including rail, road and on foot.

2.0 AN OVERVIEW CROWD MANAGEMENT ISSUES

One of the most worrying aspects of the Hajj and Kumbh managements is to control the number of pilgrims. The number of permits issued every year for performing Hajj is less than two million. However, the number of unauthorised pilgrims in some years had nearly equalled the number of authorised pilgrims. For example, during 2012 Hajj, more than 3.65 million people performed Hajj [7]. As for the Kumbh, there are no restrictions on the number of pilgrims as long as they comply with very basic health checks and undergo required vaccinations. To minimise the chances of spread of diseases and other catastrophes like stampedes, drowning and fires, the size of crowds must be contained to manageable limits. For, it is desirable to have some binding international standards for limiting the number of people which should be permitted to gather in a specified space or area. Organisation of crowded events, in particular of those having millions of participants like Hajj and Kumbh, would become relatively easier to administer if such standards were agreed upon and

implemented. In the last decade or so, many technological advances have produced tools and gadgets which can be utilised to remarkably improve the crowd management's abilities to respond to emergencies. In particular sensor and



Figure 3: Kumbh Gatherings

biometric technology, tools and gadgets can be immensely helpful in improving the crowd management. Some of the intensely crowded events like the Hajj and Kumbh often involve simultaneous on-foot movement of very large congregations, which creates possibilities of stampedes and contamination of contagious viruses and diseases. In such situations, tracking, accessibility and identification of pilgrims is critically important. Many of the sensor and wireless devices available today, including Radio Frequency Identification (RFID) as shown in Pic 3, also see [12, 13, 14 and 15], can be used for controlling and monitoring the movement of crowds. These technologies are already proving to be very beneficial in securing and managing various aspects of daily life. A description of ubiquitous technologies including RFID, sensor networks, biometric and scanning devices can be found in [14].

3.0 CROWDS AND HEALTH RISKS

Recent spread of EBOLA and other highly contagious viruses and diseases has served an alarm to the crowd managers around the world. Various Strands of flu viruses have already caused havocs in various societies in the recent years. Re-emergence of these viruses has discouraged many people from participating in crowded events like Hajj and Kumbh. In Saudi Arabia, the country where the Hajj pilgrimage takes place, has been working very hard to contain the spread of the Middle Eastern Respiratory Syndrome (MERS), which has taken hundreds of lives in the Middle East. Fortunately, this virus hasn't so far affected the Hajj pilgrims. However, the Hajj and Kumbh pilgrims suffer from various other health issues due to unhygienic conditions as a result of crowding and mismanagement. Usually, the lack of cleaning results in the growth of dangerous bacteria, which has already been witnessed in some cases [16 and 17]. Another serious health risk is from the inability of preventing infected illegal pilgrims from entering to the crowded events like the Hajj and Kumbh. Due to intense crowding and lack of infrastructure, it is not feasible to check and process all pilgrims within realistic timeframe. The Hajj procedures, as can be seen in Fig 1, require pilgrims to undergo a medical check-up, which is a

precondition to the grant of hajj permit. As for the illegal pilgrims, borders of Makkah can be sealed off to prevent the entry of illegal pilgrims. The biometric scans at all the major air and sea ports of Saudi Arabia are capable of identifying



Figure 4: RFID Tags and Bands

pilgrims with forged documents. The problem however still remains to check the local pilgrims from Makkah region and prevent unauthorised ones from performing the Hajj. But in case of Kumbh, it is difficult to ensure that pilgrims do not carry dangerous viruses into the event as there is no system in place of granting a permit on the basis of full health check-up. Another aspect is that it is difficult to ensure that the health examinations carried out in all countries are not compromised. Thus there are real possibilities of some pilgrims carrying contagious viruses and diseases into the Hajj and Kumbh.

4.0 RECONILIATION WITH INFECTED PILGRIMS

Both Hajj and Kumbh are religious events and the aspirants of performing these events would want to be there with a hope of washing off their sins before leaving this world. A terminally ill person would feel more urge to fulfil his or her religious obligation. Socially, it is a challenging job for the governments and hence the organisers to deny the aspirants a chance of a lifetime pilgrimage. On the other hand, in many states, medical reports can be compromised and infected people may succeed to secure a false certificate of health. So,

- (1) it is almost impossible to ensure that no pilgrims with communicable diseases would enter the crowded event, and
- (2) it is socially not a good idea to prevent dying people from performing the pilgrimage

That being the case, the organisers of religious events like the Hajj and Kumbh should seriously revise their policies on sick people and seriously consider allowing them to perform the pilgrimage. However, for it to be accomplished, the organisers must make separate arrangements for the sick, infected and terminally ill people to perform their pilgrimages. A huge advantage of this would be that the people with health risk to others will not try to gain permission by unfair or illegal means. Key to successful organisations of crowded events is to know the kind of participants and plan for their management accordingly. Not having basic knowledge about the pilgrims, in particular the health information, the organisers would not be able to take precautions and hence would not be able to safeguard the health of masses in the crowded events. Spread of a communicable disease in a crowded event may have devastating results. However, all of these considerations and concessions shouldn't apply in cases of diseases like EBOLA

which are difficult to contain, until a satisfactory way of preventing their spread is available. However, people infected with HIV and Hepatitis viruses are capable of being managed and hence could be allowed under supervision. The management shouldn't neglect disabled and elderly pilgrims and should make adequate arrangements for their well being during their participation in the event.

5.0 DEALING WITH HEALTH RISK PILGRIMS

Despite the best efforts from crowd managers, it is probable that some pilgrims would carry HIV, SARS, MARS and other bacteria or virus with them into Hajj and Kumbh. Naturally such pilgrims wouldn't be known to the management and hence would be living and moving with other pilgrims. These pilgrims would pose a serious risk of infecting other pilgrims. To detect and manage such pilgrims, event organisers should have pilgrim workflow architecture like the Hajj pilgrim workflow architecture shown in Fig 2, see [7]. Event organisers must also have adequate and easy access to health facilities on the sites of the event. If any of these people become ill, they should be isolated and treated promptly. If such patients were not identified in time and not treated accordingly, the bacteria might spread into a large number of participants. The Hajj is a highly organised event but still needs to refine and articulate its operations. The Kumbh is not a highly organised event because of the huge number of participants with open borders to the rest of country. Also in the Kumbh, an overwhelming number of participants come from within India. There are no visa requirements which would otherwise provide an automatic capture and storing data like in the case of the Hajj. It is recommended that the organisers of the Kumbh introduce a permit system based on health and security. Here are some guidelines which the event managers could follow:

1. Introduce the system of ID base entry permit to the event
2. Make through health check-up mandatory as a precondition for an entry to the event
3. Manage and control health check-up centres around the globe with the help of established health organisations and healthcare providers
4. Introduce RFID enabled wrist or waist bands, as shown in Pic 3 [21], to be worn by all pilgrims
5. Capture all personal and health data into the pilgrim tag
6. Make adequate arrangements for isolation of pilgrims found to be carrying communicable diseases
7. Introduce mandatory health awareness classes in all countries with the help of local authorities to be sponsored by tour operators of the event
8. Punish tour operators for noncompliance of health procedures

If the health risk pilgrims remain undetected, there is very little that event organisers could do. Crowd managers should use the latest technology to track, identify and treat ill participants. For managing the health and wellbeing of the pilgrims, including those infected with contagious bacteria, the RFID technology can play a very significant role [18].

6.0 CONCLUSIONS

We do not want spread of life threatening diseases into masses. So far the Hajj and the Kumbh have not caused large scale infections. However, there is no assurance that this would always be the case. Some viruses like EBOLA and SARS can

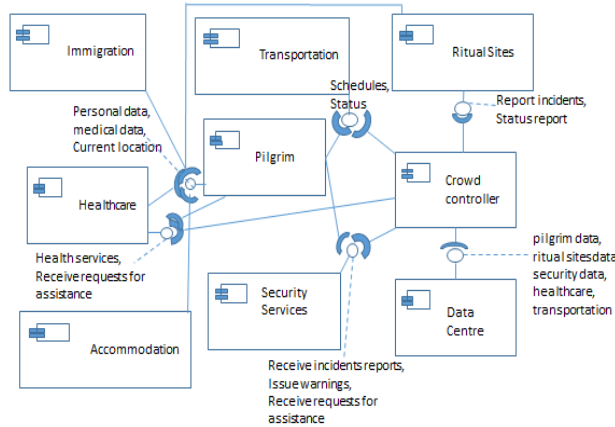


Figure 5: Hajj Pilgrim Workflow Architecture

spread like a fire. The organisers of the Hajj, Kumbh and other crowded events must revise their procedures and action plans to prevent and contain these viruses from spreading on a larger scale. National and international bodies should actively play their role in helping to streamline the organisers to ensure the safety and wellbeing of the participants of crowded events where monitoring and controlling the participants are not easy. Crowd management should consider using various tracking and identification devices like RFID as well as biometric technology. Indeed the infected pilgrims must be isolated from the rest of the pilgrims. In this paper we present and analyse a number of problems of Hajj management, and offer some solutions including architecture for improving the management. These solutions can indeed be applied in many other and similar crowded events such as Kumbh.

7.0 ACKNOWLEDGEMENT

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Adopting SCRUM Agile Project Management for Managing Academic Institutions

Abdullah Basahel

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Abstract - Managing academic institutions can be challenging and different than managing other organizations. This is because the staffs are highly qualified and may even be at the same and sometimes even higher academic level than their managers. An autocratic style of leadership may lead to tensions and be problematic for the organization. Therefore, a more democratic approach is required. SCRUM is an agile project management method, mainly used in IT domain. SCRUM teams have no manager and rely on the team to control its members. This paper will attempt to illustrate, how the SCRUM methodology can be used to manage an academic institution.

Index Terms – Academic Institution Management, Agile Project Management, SCRUM

1.0 INTRODUCTION

Academic Institutions differentiate in plethora ways from other organizations, as they are dealing with educating their students and conducting scientific research [1]. Managing such institutions can be different than managing other types of organizations and it requires different management approaches. This is because, usually the human resources to be managed are highly qualified and highly respected and maybe at the same of even higher academic level than their managers, for example it is not uncommon for a head of department to be at the academic rank of an Assistant Professor and some of his staff to hold the rank of Professor, with more teaching experience, research contribution and even influence within the department. An autocratic style of management may lead to tensions in the organization and possible have negative impact. In effect, a more flat and democratic style maybe seem more appropriate [2].

SCRUM is an agile project management methodology mainly used in the IT sector [3]. SCRUM has a more flat management [4] and like all agile project management methods, tend to focus more on activities that add value directly to an organization rather that supportive activities [5]. Members of SCRUM teams are equal and have no manager. Instead of a manager, they use the influence of the team to motivate or push the team members to complete their tasks [6].

This paper proposes the use of SCRUM agile project management methodology for managing academic institutions.

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The question that arises is if SCRUM can be applied outside the IT domain, in different teams across different hierarchy levels that needs to work together in a top down approach. This paper will attempt to answer this question by illustrating how SCRUM can be used to manage academic institutions.

2.0 AN OVERVIEW OF SCRUM

SCRUM is an agile project management method, mainly used by software development teams [7], however, it can be used to manage projects and activities in different areas as well. SCRUM teams are self-organized and self-managed, effectively there is no need for a manager [6]. The key idea behind this flat hierarchy, is to engage the people who will actually do the job, they know much better how to do it and how much time it will to accomplish it rather than their managers who may not even be relevant to the field. Like all agile methodologies that follow the agile manifesto [5], and as it can be deduced from it, SCRUM favors activities that add value directly to the organization over other supportive activities such as documentation. This does not mean there is no value on supportive activities, but it means that SCRUM favors actions over plans. SCRUM also promotes resources sharing over dedicated use of people and equipment. In such a way it has limited division of roles in a team like: the Product owner, the SCRUM master and member(s). Briefly, the product owner is responsible for representing the client and clarifying the requirements. The SCRUM master is the coach of the team, organizing the team's activities, meetings and helping the team members to overcome various difficulties that may appear during a project. Neither the Product Owner nor the SCRUM master are managers. Everybody in the team is a team member and all of them work together to achieve the organization's goals and objectives, set by the business and introduced by the Product Owner. The SCRUM teams usually have six to eight members. All the decisions about the team are made, reviewed and enforced by the team in a democratic style of management.

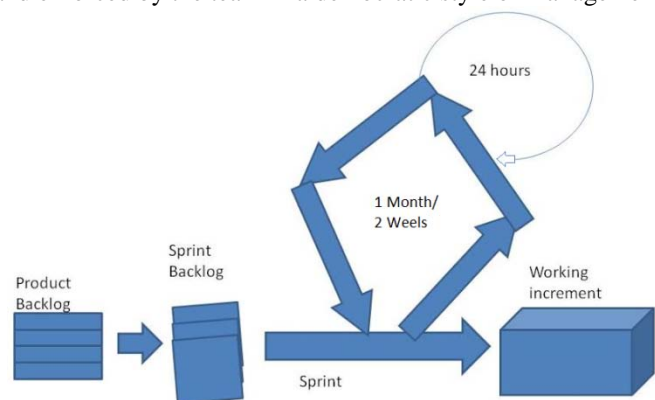


Figure 1: SCRUM overview

Figure 1, explains the process of SCRUM agile methodology. At the beginning of the project, a draft task list is generated by the business in collaboration with the Product Owner. These tasks may change during the project, due to changes in the business environment, or for other reasons. These tasks are prioritised and divided to releases forming the Product Backlog.

SCRUM delivers products or services that add value in incremental releases, called ‘Sprints’. Usually, each release has duration of 2 weeks to 1 month, but this can change to fit the project needs. Each release must produce product/services or complete a number of tasks that add value to the organization. The Sprint starts with the Sprint meeting. In this meeting, the Product Owner brings the prioritized tasks, desired to be included in the next release. These tasks are called Stories, and are organizational requirements. During the Sprint meeting, the team will review each story and estimate it, by using an agile estimation approach, for example, story points [8] and initially, assign it to a team member. Later on during the Sprint, a story may be reassigned to another member, in case that the original owner of the story is overloaded with tasks while other members have still capacity to take more, or if another member is more qualified for this task. If the team is overloaded with stories, they may refuse to take on stories with lower organizational value. On the other side, if they still have capacity, they may ask for more stories. So stories original intended for a release, may be moved to another release. At the end of the Sprint meeting, the Sprint Backlog will be created.

During the Sprint, the SCRUM master will call for daily Stand-Up meetings. These meetings are five to fifteen minutes long. During the meeting, the SCRUM master will ask every member three questions;

- *What they did yesterday?*
An overview of the work completed over the last working day.
- *If there are any problems?*
If they are still any problems that impended the progress. In case of a positive response to this question, the SCRUM master should help the team members to solve the problem, either directly or by associating the member with the required resources for solving the problem.
- *What they will do today?*
Tasks, actions that they will do today.

During the meeting, the members are expected to provide a brief overview, avoiding including too many technical details. Engaging discussions during the meeting is not recommended as this is intended to be a progress report meeting that will monitor and motivate the team members and not a resolution meeting. In case of any problems, the SCRUM master can follow up with the involved parties after the meeting.

SCRUM promotes good communication and teamwork [6]. During the project, the Product Owner, is available for clarifying related requirements to the team. The team members work together, helping each other to complete the tasks. The

productivity of the team, is usually measured by the ‘Velocity’ (how many stories they completed/time); calculated based on the total productivity of the team and not individual productivity. The key idea behind self-managed teams is that that if a team member does not perform well, then the team will put pressure and provide assistance to bring this team member up to speed. This SCRUM dependence towards the team is also its biggest drawback, because if they majority of the team members are focused on the benefits of the organization the team will fail. Aligning all the team members that may also have their personal agenda can be proven a big challenge for their SCRUM Master. However, once a team starts, it is like a well-oiled machine. Another, potential drawback of the method lies within the principles of the agile manifesto [5]. Because the team, focuses of the tasks that have add value directly, they may pay less attention to supportive activities such as documentation. This may lead to future problems, in terms of maintainability and extensibility of the system or process. This however, does not mean that if there is a high priority story for producing documentation or any support document, it will be ignored. Instead, it will be treated like any other story. According to the author this is the best way for inserting this type of activities to a Sprint. The next section will show, how SCRUM can be applied for managing academic institutions.

3.0 ORGANISATIONAL STRUCTURE OF A COLLEGE

This section will illustrate how the process of SCRUM can be adopted and optimized for managing an academic institution at a college level. Focus is given on this level because it is more close to the main function of the institution but the same approach can be extended to cover the whole organization. Figure 2, shows a generic organizational structure of a college. The aim of this structure is aid the illustration of SCRUM, however the same logic can be applied to colleges with small variations in their organizational structure.

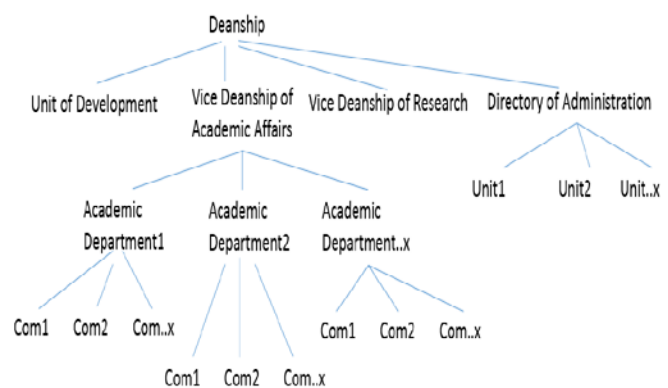


Figure 2: College Organizational Chart

As it can be seen from Figure 2, The Deanship is the leading the organization. Under it, there are two Vice Deanships, the Unit of Development and the Director of Administration. The Unit of Development, has responsibilities regarding to quality assurance, implementation of standards and similar activities. In this example, its size is a team of six to eight people, but in

some other cases it may vary, depending on the size of the college. The Vice Deanship of Academic Affairs is responsible for the academic issues of the college and the academic departments. Each academic department has a number of committees, for example committee for curriculum development, examination committee and so on. Each committee has six to eight academics from the department. The Vice Deanship of Research is responsible for managing the research activities of the college. The Directory of Administration, is responsible for the various units within the college. For example maintenance and IT support. Management entities are managed by council/committee that consist of the head and a secretary from the entity, and the head of the heads of the entities that are under this entity in the organizational structure. For example the Vice Deanship of Academic Affairs is managed by the Vice Dean of Academic Affairs and the Head of the Departments. Each Department is managed by the head of the committees accordingly.

4.0 APPLYING SCRUM TO ACADEMIC INSTITUTION MANAGEMENT

The key idea behind applying SCRUM for managing academic institutions is that each management entity will be considered as a SCRUM team. The head of the management unit will be the Product Owner, and the secretary or one of the other members the SCRUM master. Any member of the team can be a SCRUM master as long as fulfils the criteria and is willing to do it. However, due to the workload involved, it is recommended that secretary can be appointed for this role. The Stand-Up meetings can be replaced by daily conference calls, where each member has to answer, what it was done the day before, if there were any problems and what it will be done today. An electronic version of the Story Board will be required for managing the team. The members of each team will be also the Product Owners of their teams. So the Head of the Departments, will be members of the Vice Deanship of Academic affairs, team but they will also be Product Owners, in their Departments. The committee members of each department, will be members in the Department council team but Product Owners in their Committees. At the beginning of the Sprint, the Product Owner of a management entity will bring the tasks that need to be completed during this sprint, like any Sprint Meeting. During the meeting, the tasks are estimated, accepted and allocated to different members. However, unlike a normal SCRUM team, the tasks are not going to be completed by the individual person but by the member's team. The member as a Product Owner in his own team, will be responsible for breaking down the work to be done in prioritized stories and supply these stories to its own team, in their Sprint meeting. After the end of the Sprint Meeting, the member will take all these tasks to its own team, where the member will now be the Product Owner. The same process will be repeated until tasks reach individual persons. It is worth to be noted that the tasks are not going to be the same. The teams closer to the leadership, will have higher level goals and objectives, while the teams at the bottom of the organizational

structure, will have less complex but precise tasks. It is the belief of the author that by using this type of recursive approach, SCRUM but be used to manage an academic institution.

5.0 LIMITATIONS

Applying this approach for managing the institution, may be difficult at the beginning as the Heads and Chairmen, may feel that applying the SCRUM methodology aims to take away their powers. This maybe be true in some extent, but the real aim of applying the approach is to create a high performance, less bureaucratic working environment [9]. In order to manage their resistance, they can be allowed to keep their titles, for example, Head of the IT support unit and so on, as long as they do the tasks required by the role of the Product Owner. The second limitation is that it adds some complexity to the management process as the members will be involved with more than one teams. They will be members in one team and Product Owners in the other team, so daily they have to attend two Stand-Up meetings. In general, more close to the bottom of the organizational structure, there is a need for daily meetings. However, teams at a more high level in the organizational structure may not be required to have daily Stand-Up meetings. Instead, they could limit them to two times per week. Also the duration of the Sprint could be adopted accordingly as long as it does not cause co-ordination problems between various teams.

6.0 CONCLUSION AND FUTURE SCOPE

This paper illustrated how the SCRUM methodology can be used to manage academic institutions. The method was applied to "generic Organizational Structure" of a college. While this structure may not be the same with some academic institutions, the author believes that the method presented in this paper, can be easily tailored to map most academic institutions. The key idea, is that each managing entity will be considered as a SCRUM team. The head of the entity will be the Product Owner, the secretary the SCRUM master and rest of the team will be the members. Each member of a team will be the Product Owner of its own team, so recursively the tasks will be passed to the teams, lower in the organizational structure. Further to the main limitations of applying SCRUM to manage academic institutions is that people who hold manager positions may feel threaten if their title is changed to Product Owner. The approach allows them to keep their current titles as long as they also deal with the tasks of the Product Owner. Another limitation of this approach is that it adds some overhead, as some members will belong to two teams and may not even be in the same locality. To solve this problem, Story Boards can be replaced with electronic boards and Stand-Up meetings with conference calls. The frequency of the Stand-Up meetings can be also be reduced and the duration of the Sprint can be modified to fit the organizational needs. Following this approach, this paper demonstrated how SCRUM can be used to manage academic institutions.

7.0 ACKNOWLEDGEMENT

This work would have not been possible with the support of King Abdulaziz University and the Faculty of Economics and Management.

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Design of a GSM Based Electronic Voting Machine with Voter Tracking

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Abstract – This paper presents the design of a GSM based electronic voting machine with voter tracking. The design presented here follows a GSM based approach to send the polling results to a base station via mobile network. Infrared sensors have been used for tracking the information regarding the voters. After the voting process has been over, the results are sent to the base station for various analyses and declaring the verdict. This system is more secured and chances of tampering the results are reduced. The simulation of the system is done on Proteus Professional Software v8.0. The design presented in this paper is more secured and appropriate according to modern day requirements.

Index Terms – Infrared Sensor, GSM, Microcontroller, Security, Voting.

1.0 INTRODUCTION

Voting is the most pivotal process which is carried out to reveal the opinion of the people in selecting government or in any issue that is under consideration. So the conventional voting systems based on paper voting are being replaced by electronic voting machines. Voting is a decision making mechanism in a society and security is indeed an essential part of voting. The term “electronic voting” represents the practice of electronic means in voting to safeguard the security, reliability, and transparency. The crucial role in determining the result of an election, electronic voting systems should be developed with the greatest responsibility and security. Electronic voting machines aid blind users by reading off the instructions using headphones and also provide essential tools to help people with disabilities. Voting machines are the combination of mechanical and electronic equipments which are needed for casting votes and displaying the election results. The main proposal for using the voting machines was given in 1838 [1]. There are large number of smart systems present which employ microcontrollers for their operation [2-4] and several other voting systems have been developed for ensuring a secured vote casting process [5-7]. The design presented in [8] incorporates voter information facility for getting the information about the number of voters at a place. In this paper, GSM based design of an electronic voting machine has been presented for sending the polling results to a monitoring station via mobile network. This system is fully secured and chances of digital tampering are also avoided [9-10].

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Number of voters at the polling place can be tracked by using infrared sensors. The functions performed by the proposed voting machine includes:

- a. To cast votes to the candidates
- b. Voter Tracking
- c. Vote Rejection option available
- d. Results are sent to monitoring station via GSM

This paper is organized as: Section 2 describes the GSM modem, Section 3 shows the block diagram of the system, Section 4 describes the power supply schematic, Section 5 shows the development tools used, Section 6 shows the circuit simulation, Section 7 describes the results and conclusions and Section 8 discusses the future scope.

2.0 GSM MODEM

A GSM modem is a specialized kind of modulator-demodulator in which a SIM card is accepted and it can be operated over a subscription to the mobile operator. GSM module is used when a communication between a computer and a GSM system is required. In many countries it is used as architecture for mobile communication. GSM module consists of a GSM modem and communication interfaces like RS-232, USB along with a power supply circuit for computer. GSM modem communicates over the mobile network when connected to a computer [11-12]. GSM modems are also used to send and receive SMS and MMS messages. A GSM can be easily interfaced with the microcontroller system and uses serial communication for data transfer. Fig. 1 shows a GSM module:

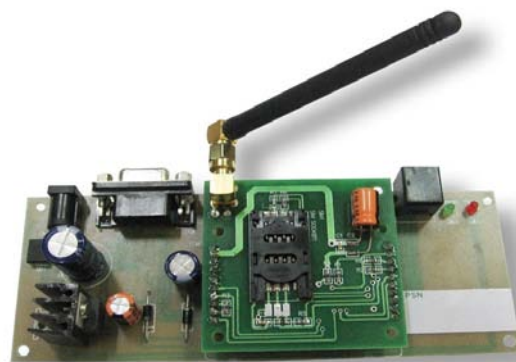


Figure 1: GSM Module

GSM Module is used to accomplish the following functions:

- a. To receive and send messages.
- b. To make, receive and reject a voice call.

3.0 BLOCK DIAGRAM OF THE SYSTEM

For the development of the system, PIC16F877A microcontroller based on the modified Harvard architecture developed by microchip technology has been used. Fig.2 shows the block diagram of the system. Various sensors and devices interfaced with the microcontroller are shown. The machine design consists of:

The machine design consists of:

3.1. Crystal Oscillator

It is an oscillator circuit that deploys the property of mechanical resonance of the piezoelectric crystals for creating an accurate electrical signal. The frequency of the crystal by keeping a track of time, provides clock signal to the microcontroller. Quartz crystal of frequency 4 MHz is used in the proposed system. Quartz crystals are used in wrist watches, calculators, counters, signal generators, and oscilloscopes.

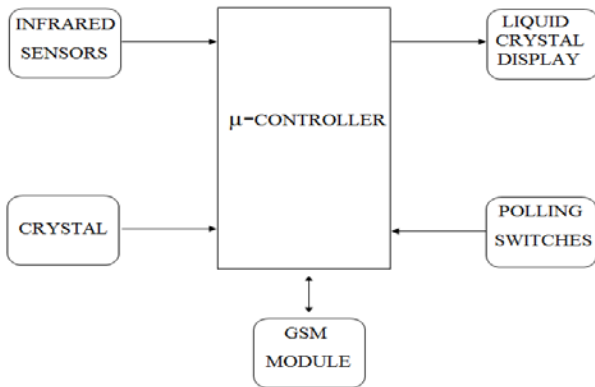


Figure 2: Block Diagram of the System

3.2. Infrared Sensors

Infrared (IR) sensor is an electronic device consisting of transmitter and receiver LED. The transmitter LED continuously emits IR rays and when an object is close to the sensor, the rays bounce off the object and received into the receiver LED. Infrared sensors are generally used in IR imaging devices, gas analyzers, and radiation thermometers. IR sensors are used in this system to track the voter count which is used at later stage for analysis of polling results.

3.3. Liquid Crystal Display

A Liquid Crystal Display is dot matrix display that displays alphanumeric characters and symbols. Liquid crystal displays are used in battery-powered devices, such as digital watches, calculators, digital thermometers etc. 16X2 LCD has been used in the modeled system to display the candidate information and polling results.

3.4. Polling Switches

Polling Switches are used in the system to cast votes to the candidates. By pressing the switch, vote can be given to the desired candidate. Six switches have been used in modeled system to cast votes and one switch is for vote rejection. The polling results are displayed by pressing the last switch after

entering the correct password, thus making the system more secured and less prone to mistakes.

3.5. GSM Module

GSM Module is used in the system to send the polling results to the monitoring station via mobile network. In this way a more secured system is presented and the chances of anomalies are reduced.

4.0 POWER SUPPLY

Five volts power supply w.r.t ground is required for the operation of the microcontroller. Fig. 3 shows the circuit for the power supply used in the system.

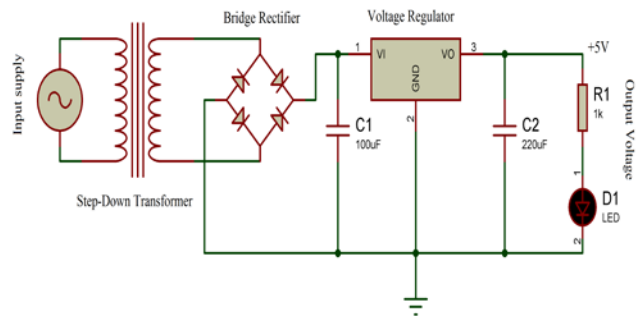


Figure 3: Power Supply

The step down transformer steps down the ac supply from the mains and bridge rectifier converts it into dc. This dc is passed through filter circuit to get a more smoothed waveform. Voltage regulator produces a fixed output voltage that remains constant irrespective of changes in its input voltage and load conditions. 7805 voltage regulator is used here, which gives +5 V output which is then given to microcontroller for its operation.

5.0 DEVELOPMENT TOOLS

The software of the machine is written in Embedded C language and the simulation of the system is done on Proteus Professional Software v8.0. MPLAB Integrated Development Environment has been used for programming the microcontroller.

6.0 CIRCUIT SIMULATION

A GSM based design of an electronic voting machine with voter tracking is presented in this paper, Fig. 4 shows the simulation schematic of the machine design and snapshot of voter count is also included (see Fig. 5). To enable the polling results to be displayed, an LCD having two by sixteen display is used. The LCD is connected to the PORT B of the microcontroller which is declared as the output port. The operation of the LCD is shown in Fig. 6.

Polling switches are used to give votes to the candidates. The design is proposed for four candidates representing different

parties, a switch is used to show the polling results after entering the correct password. There is rejection button available in the machine, which is pressed if voter does not want to choose a candidate. Infrared sensors are used for tracking the number of voters at the polling booth. After the voting process has been over, the results are sent to the monitoring station via GSM using mobile network. There is an added advantage of using GSM that the results data cannot be tampered as it is directly sent to the base station for analysis and results declaration. All the data consisting of number of voters present at the polling booth, number of votes rejected and number of votes given to the candidates is also sent to monitoring station for verification. This system is appropriate and the chances of mistakes are reduced. The final results are also displayed on the LCD after entering the correct password, thus making the system highly secured.

7.0 RESULTS AND CONCLUSIONS

A GSM based voting machine design with voter tracking has been proposed in this system which is found to be appropriate. The software of the system has been written in Embedded C language and Proteus Professional Software has been used for simulating the behavior of the machine. The simulation of the machine is working properly under normal conditions. Polling switches are used to give votes to the candidates and infrared sensors have been used to track the voter entries. The count of the voter entries previously stored in the register is matched with the total votes casted and votes rejected to avoid any mistakes thus making the system more protected. After the voting process has been over, the results are displayed on the machine LCD by entering the correct password and sent to the monitoring station via GSM for analysis and the declaration of the final verdict. Table 1 shows the comparative study of different voting systems. The design presented here is cost effective, highly secured and appropriate according to the modern day requirements.

8.0 FUTURE SCOPE

The design of the GSM based electronic voting machine with voter tracking proposed in this paper is accurate and it can be further improved in terms of power consumption using advanced VLSI applications.

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Table 1: Comparative study with existing voting systems

Parameters	Other Systems	Our System
Control Unit	Microcontroller	Microcontroller
Security	Less secured	More Secured
Accuracy	Comparatively less accurate	More accurate
Cost	High Cost	Low Cost

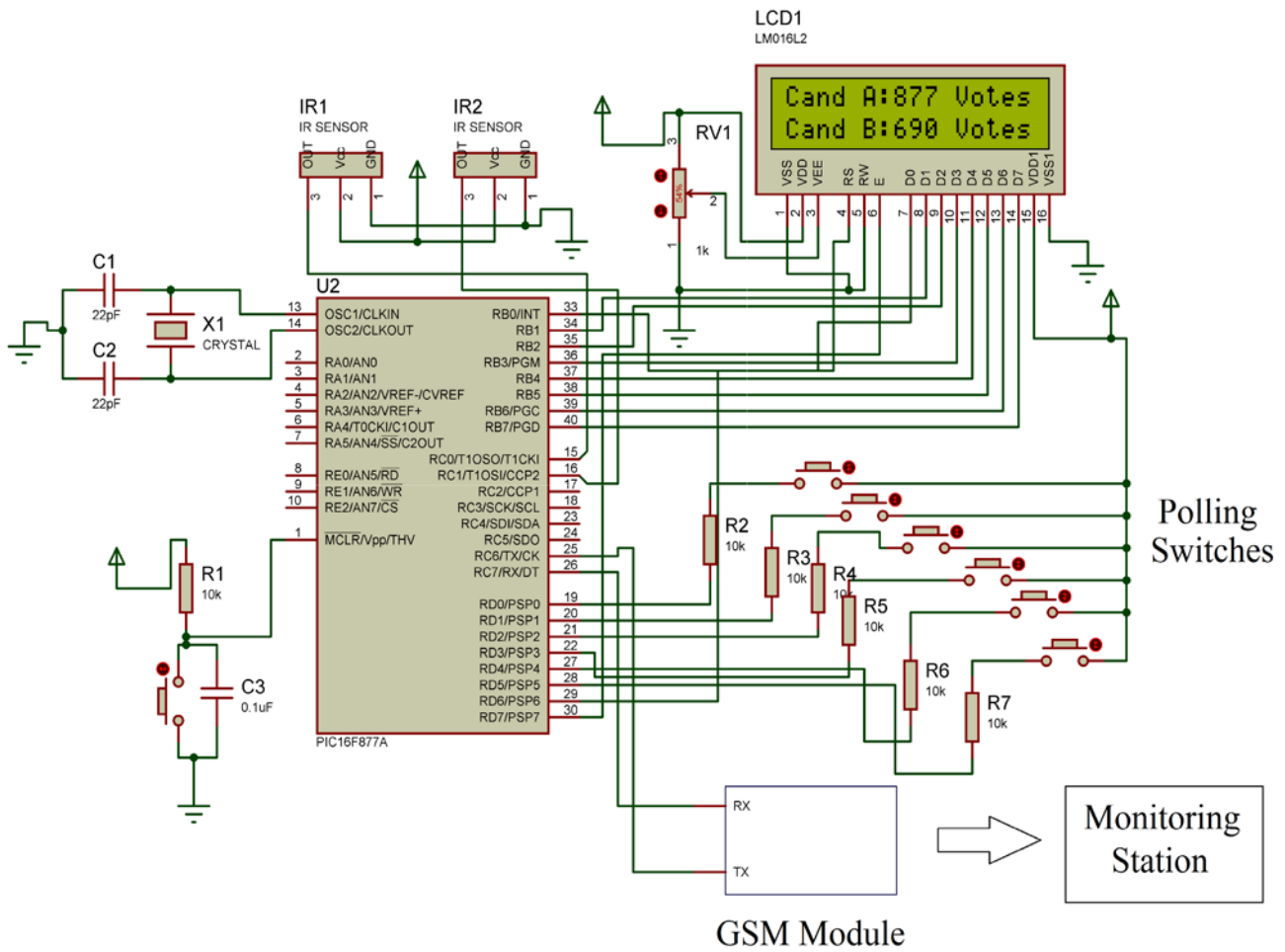


Figure 4: Simulation of the Machine

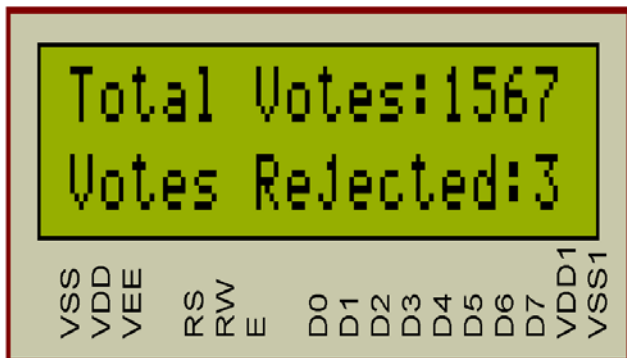


Figure 5: Snapshot of Counted Votes

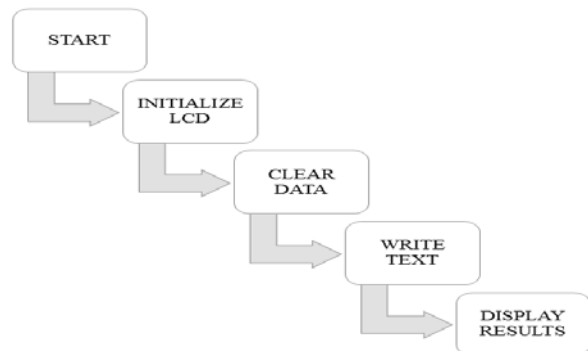


Figure 6: LCD Operation

SMITHA: Scalable Modular Interconnect for Three Dimensional High Performance Applications - A New 3D Topology for NoC Based Systems

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Abstract - Today we are in an era of green computing wherein the devices are high performing, occupies smaller chip die area, and consumes low power. These systems are designed and implemented using multi core architectures. Network on chip is establishing itself as interconnect for this high performance multi core systems. Currently the systems are realized using two dimensional topologies like mesh, torus etc. Research outcome in fabrication technology is reducing the feature size of silicon processes which enables more logic to be implanted on silicon. This was well complemented with improvement in packaging technology which led to vertical stacking of logic to form of three dimensional structures. This paper introduces a new three dimensional topology SMITHA (Scalable Modular Interconnect for Three dimensional High performance Applications). The paper discusses the two dimensional base topology along with routing algorithms and performance parameters and its extension to three dimension. Performance parameters for both cases are also discussed.

Index Terms – Network On Chip, Design, SMITHA

1.0 INTRODUCTION

One of the biggest inventions of the last century is semiconductor devices. These devices allowed design and implementation of systems in every domain ranging from consumer electronics to industrial or defense applications. In the initial days these systems were implemented using common bus architecture. The different processing modules shared a traditional bus to communicate and pass information between them. As the complexity of the systems increased, common bus posed a serious problem in terms of performance which led to usage of parallel or multi bus structures. These prevailed in design for decades which always saw performance bottleneck. To overcome these performance issues, Network On Chip (NoC), a new paradigm in design was introduced [1,2]. The idea was to implant the techniques of data communication network on chip. In this the modules are interconnected using topologies like mesh, torus and packets were exchanged for purpose of communication.

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Today we are in an era of mobile computing running multiple applications. These devices being hand held running in batteries also had additional constraints in term of power consumption also. The present popular topologies namely mesh and torus when scaled poses a problem in terms of performance which in term affects the power consumption of the systems. This paper discusses a new topology for network on chip based systems SMITHA (Scalable Modular Interconnect for Three dimensional High performance Applications). The paper also discusses the performance / area parameters of the same and compares with popular topologies namely mesh and torus. It is observed that the proposed topology performs better with lesser area requirement.

2.0 PROPOSED ARCHITECTURE

The discussion about the proposed architecture is done as two sections. The section below discusses the two dimension topology along with the performance parameters followed by its extension into three dimension.

2.1 Two Dimensional Base Topology

The proposed architecture is obtained by deleting the base node and by interconnecting the neighboring nodes along the level of a complete binary tree. This depicted in the figure below (Fig 1).

The topology is identified by the number of layers, numbered from 1 to K where K is the number of layers in the configuration. A node n in layer K is linked to its neighboring nodes 2n and 2n +1 in layer K + 1. The topology becomes bigger with the number of layer with an increment of nodes in power of two starting with two nodes in layer one to 2^K nodes in layer K. The number of nodes in a configuration of K layer

$$N_{s(1,K)} = \sum_{i=1}^K 2^i$$

2.2 Addressing

The nodes are being addressed depending on the layer which they are and position within it. The nodes start its address from zero to 2K and one to k for layers.

2.3 Routing Algorithm

This section brings out an optimal routing algorithm for routing packets in the same level. All the packets are routed through the shortest path between any source destination pairs.

Step 0: Check destination address. Initialize current_src as current node address and current_dest as destination address.

Case 1: current_src and current_dest in same layer.

1. Compute the minimum hop count between current_src and current_dest. If it is greater than 3, set current_src and current_dest as their parent nodes respectively in the adjacent layer below.
2. Repeat Step 1 till minimum hop count is greater than 3.
3. Move to the next node from current_src towards current_dest. Set the current_src as the next node.
4. Repeat Step 3 until current_src is equal to current_dest.
5. Consider a complete binary tree with top right node of the current_src as root. If destination node lies in the tree, mark the right node as set current_src else mark the sibling of the left node as current_src. Move to the current_src.
6. Repeat Step 5 until current_src is equal to destination address.

Case 2: When destination node is in a layer above that of the source node

1. Move one step at a time from the current_dest to the layer below until layer of the current_src is reached. Set current_dest as the node obtained in the layer of the source.
2. Repeat the steps as in Case 1.
3. Repeat Step 5 and 6 of Case 1.

Case 3: when destination node is in a layer below that of the source node

1. Move one step at a time from current_src to the layer below until the layer of current_dest is reached. Set current_src as the node obtained.
2. Repeat the procedure as in case 1.

The algorithm presented above can be explained as follows. Case 1 represents when the source and destination are in the same level. If they differ by three or less positions then the packet is just transferred to them directly else it is routed downward to the layers below and then it moves to the destination.

Case 2 in the algorithm explains when the destination node is above that of the source node. In this case, the routing logic finds the parent node of the destination in the layer of the source. Now both the source and destination is the same layer and will use Case 1 to route the packet to the intermediate node and then the packet moves upward destination.

Case 3 expresses when the destination node is below than the source node. In this case, the packet moves to the root of the source node in the layer of the destination. Now Case 1 hold goods as the source and destination is in same layer.

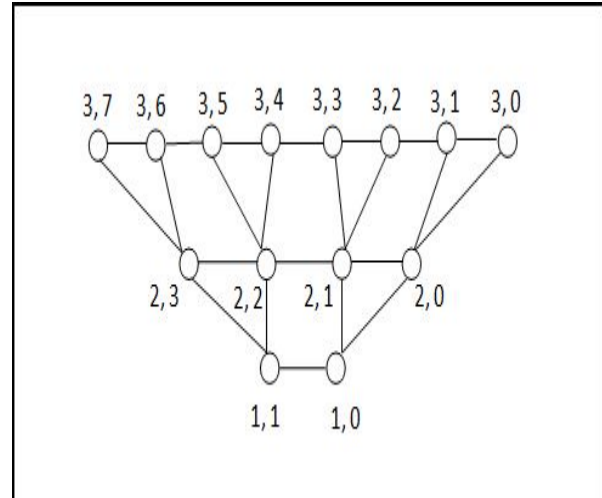


Figure 1: Proposed Topology With Three Layers In Two Dimension

2.4 Performance Parameters

This section deals with the various performance parameters of the proposed topology in two dimension. The performance and area parameter are discussed below.

2.4.1 Maximum & Average Hop: This parameter brings out the performance of the system. Consider a configuration of K layers, we tabulate the number of hop required through the shortest route between every source and destination pair. The maximum value thus obtained in the set is called as maximum hop for a configuration of K layers. The mean value of the set is called as average hop. Maximum hop brings out the time taken for a packet to reach any source destination pair for a given configuration. Higher the value, more will the time taken to reach the destination thereby reduces the performance of the system. Average hop also reflects the performance of the system by considering a cumulative effect of all source destination pair. The maximum hop for a configuration of n nodes is expressed as

$$HC_{(Max)}(1,n) = 2\log_2(n+2) - 3 \approx 2\log_2(n+2).$$

The table (Table 1) below depicts average hop for a single level. From the equation and table quantified above, it should be noted that both the parameters of the proposed topology grows gradually as the topology scales.

2.4.2 Number of Wire Segments & Wirelength: This parameter brings out the area needed by the circuit and the power consumption of the system to an extent. The parameter number of wire segments brings out to the number of interconnection wire segments used to produce the topology. Similarly considering unit length of wire between every pair of nodes, we calculate the wirelength requirement of the system. These parameters also indicate the level of difficulty for the CAD tool to generate the design and complete its process. These parameters for a configuration of n nodes in two dimension is expressed as

$$W_s(1,n) = WL_s(1,n) = 2n - \log_2(n+2) - 1 \approx 2n$$

3.0 Three Dimension Topology

The proposed three dimension topology is made by placing the above discussed base substrate one over the other and by interconnecting the adjacent levels as follows.

- The interconnections between odd level and an even are done by interconnecting the even layers through the right and odd layers through the left. For example interconnection between level one and two.
- Similarly the connections between even level and an odd are done by connecting the odd layers through the right and even layers through the left. For example interconnection between level two and three.

This way makes the proposed topology more scalable by placing one layer over the other. The interconnection discussed above is depicted in the figure (Fig 2) below for a configuration of three levels and each level having three layers.

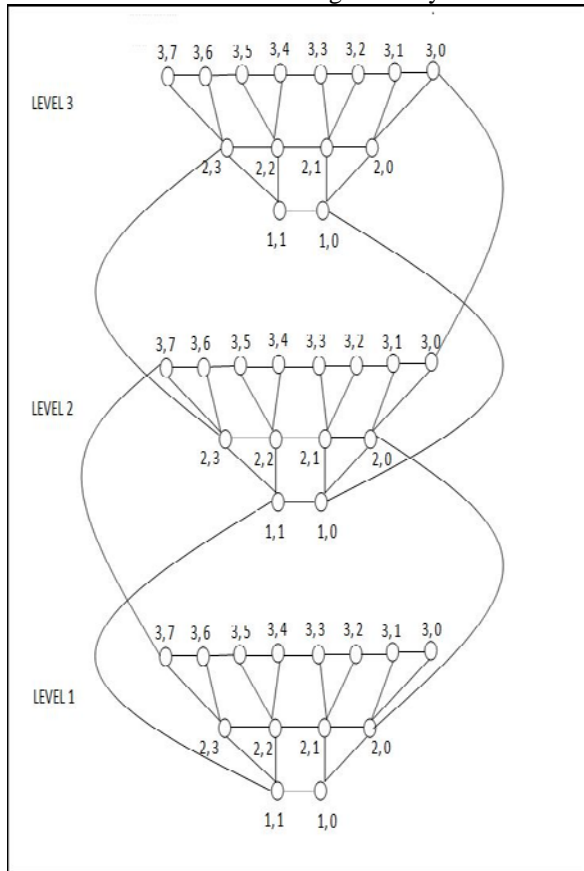


Figure 2: Figure Depicting The Proposed Topology In Three Dimension For A Configuration Of Three Levels And Each Level Having Three Layers

3.1 Addressing

The nodes are placed and are addressed relative to the level, layer within that level and node position along the layer to which the node belongs. For example a node who has an

address (1, 2, 0) represents a node in level one layer two and position zero. This is depicted in the figure (Fig 2)

3.2 Routing Algorithm

This section presents a routing algorithm for the proposed topology in three dimension. Whenever the source and destination nodes are in the same level, the routing algorithm presented in case of two dimension applies. The algorithm presented below routes a packet which is in two distinct levels. For clarity in explanation and understandability, we divide the topology vertically into two as shown in the figure (Fig 3)

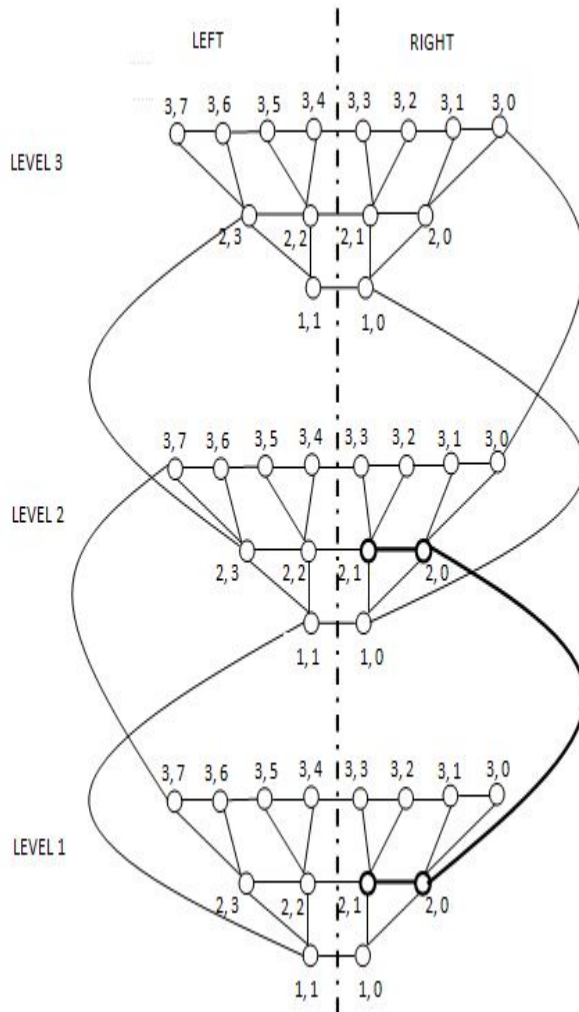


Figure 3: Figure Illustrating the Routing Algorithm

- Step 0: Check destination address.
- Step 1: Check node number of destination and current node address
- Step 2: Check layer of the destination and current node address
- Case 1: Current node and destination on the left
 - Step 3: Move left when current node and destination is in the same layer

- Step 4: Move top left when destination is greater than current node
- Step 5: Move down when destination is less than current node

$$\begin{aligned}
 HC_{s(\text{Max})}(L,n) &= HC_{s(\text{Max})}(1,n) + (L - 1) + HC_{s(\text{Max})}(1,n) \\
 &= 2 * HC_{s(\text{Max})}(1,n) + (L - 1) \\
 &= 2 * \{ 2\log_2(n+2) - 3 \} + (L - 1)
 \end{aligned}$$

- Case 2: Current node on the left and destination on the right
 - Step 3: Move right when current node and destination is in the same layer or when the current node is greater than the destination
 - Step 4: Move down when destination is less than current node

where L is the number of levels and $HC_{s(\text{Max})}(1,n)$ is the maximum hop in case of two dimension topology with n nodes.

- Case 3: Current node and destination on the right
 - Step 3: Move right when current node and destination is in the same layer
 - Step 4: Move top right when destination is greater than current node
 - Step 5: Move down when destination is less than current node

Similarly maximum hop for all source and destination was tabulated and simple arithmetic mean for recorded. The effect was the same as observed in the case of two dimension.

- Case 4: Current node on the right and destination on the left
 - Step 3: Move left when current node and destination is in the same layer or when the current node is greater than the destination
 - Step 4: Move down when destination is less than current node

3.3.2 Number of Wire Segments & Wire length: In case of the three dimensional structure, the wires used to interconnect within layers and between the different levels contribute to the wire length and number of wire segments. Considering a unit length of wire for interconnecting the node within the layer and between the layers, the parameters can be expressed as

$$W_s(L,n) = WL_s(L,n) = L(2n - \log_2(n+2) - 1) + (L - 1)(\log_2(n+2) - 1)$$

The current node checks the destination address in the packet. The next node of transit is decided by the routing algorithm depending on the position of destination and current node. The routing algorithm routes the packet to the nearest node towards the periphery in the same level of the current node and then to the level of the destination node. Now the packet is in same level as destination node, will follows the two dimensional routing algorithm to reach the destination node. For example, consider a packet currently in node (1,2,1) to be transferred to (2,2,1). Since both the nodes are on the right topology, the packet is routed towards the periphery through the right to (1,2,0), then to the level of the destination to (2,2,0) and then to the destination (2,2,1). Similarly the proposed routing algorithm routes packet to all source destination pairs.

Where n is the number of nodes in each level and L is the number of levels. The first term quantifies the parameters for interconnecting nodes in single level and the second term quantifies the same for interconnecting two successive levels. It should be noted that as the number of levels increases, the parameters for interconnecting the successive levels increases only in logarithmic order. This is very advantageous in case of the proposed three dimension topology.

3.3 Performance Parameters

This session discusses the different parameters in case of the proposed three dimension topology. The parameters discussed are same as those of two dimension.

4.0 COMPARISON OF PERFORMANCE PARAMETERS WITH EXISTING TOPOLOGIES

This session compares the above discussed performance parameters with two dimensional and three dimensional mesh and torus, the popular existing topologies in this concept.

3.3.1 Maximum & Average Hop: As discussed in the case of two dimensional, the performance of the systems will be given by this parameter. As per the routing algorithm presented above, the packet moves towards the node at the periphery which is at most $HC_{s(\text{Max})}(1,n)$. Then it should travel vertically up through (L - 1) nodes to reach the level of the destination node. Now it takes another $HC_{s(\text{Max})}(1,n)$ to reach the destination node. Summing the values above, the parameter can be bounded as

4.1 Comparison with Two Dimension Topologies:

This session compares the performance parameters in case of two dimension with popular existing topologies – mesh and torus

The tables (Table 2,3) below tabulate the parameter maximum hop and average hop for different number of nodes per layer for levels one, two and three

From the tables 2 and 3, it is quite evident that the maximum hop and average hop parameters are good for the proposed topology when it is compared to mesh and torus. Also it should be noted that the performance parameters for the proposed topology when scaled does not grow drastically when compared with mesh and torus This implies that the packets reach the destination in less time and the output generation is faster increasing the throughput of the system in the proposed topology and a system implemented using the proposed topology in any dimension performs better. This has an implication of power consumption also.

The following tables (Table 4,5) quantify the parameters related to area of the systems. The tables below tabulate number of wire segments and wire length for the same.

From the above tables, it is quite clear that the area requirement for the proposed is almost same in lower configuration / levels but as the system scales to higher levels the wire requirement is comparatively very high when compared to the proposed topology. This effect is not only on the area requirement but also on the power dissipation of the system. Summing the above two results it is evident and clear that the proposed architecture performs better with lesser area / power requirement. Apart from the analysis above, the proposed topology was subjected to real time scenarios under different buffer and load / traffic conditions to test the strength of the topology which also gave positive results.

5.0 CONCLUSION

This paper introduces a new three dimensional topology SMITHA (Scalable Modular Interconnect for Three dimensional High performance Applications). The discussion starts with the two dimension variant and extends it to three dimension. The proposed architecture is structured and scalable. The paper quantifies the different performance / area parameters namely maximum hop, average hop, wirelength, number of wire segments in both two / three. dimension. This is compared with those of the current popular topologies namely mesh and torus. The growth of these parameters is found to be slow in case of the proposed topology implying that a system implemented performs better with smaller die area / power consumption.

Patent Information

The architecture discussed in this paper is applied for patent with the following details

Type : India
 Number : 1598/CHE/2014
 Date : 26/03/2014

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Table 1: Depicting Average Hop For A Single Level

Number of Layers	1	2	3	4	5	6	7	8	9	10
Number of Nodes	2	6	14	30	62	126	252	510	1022	2046
Average Hop	.5	1.2	2.17	3.29	4.65	6.21	7.9	9.75	11.64	13.5

Table 2: Table Quantifying The Parameter Maximum Hop

No Of Nodes	Topology Number of Levels								
	Mesh 1	Torus 1	SMITHA 1	Mesh 2	Torus 2	SMITHA 2	Mesh 3	Torus 3	SMITHA 3
4	2	2	1	3	3	3	4	4	5
8	4	3	3	5	4	4	6	5	6
16	6	4	5	7	5	6	8	6	8
32	10	6	7	11	7	8	12	8	10
64	14	8	9	15	9	10	16	10	12
128	22	12	11	23	13	12	24	14	14
256	30	16	13	31	17	14	32	18	16
512	46	24	15	47	25	16	48	26	18
1024	62	32	17	63	33	18	64	34	20
2048	94	48	19	95	49	20	96	49	22

Table 3: Table Quantifying The Parameter Average Hop

No Of Nodes	Topology Number of Levels								
	Mesh 1	Torus 1	SMITHA 1	Mesh 2	Torus 2	SMITHA 2	Mesh 3	Torus 3	SMITHA 3
4	1.00	1.00	0.50	6.00	6.00	1.25	17.00	15.00	1.94
8	1.75	1.50	1.20	9.00	8.00	2.03	23.75	19.50	2.65
16	2.50	2.00	2.17	12.00	10.00	3.06	30.50	24.00	3.71
32	3.87	3.00	3.29	17.50	14.00	4.35	42.88	33.00	5.05
64	5.25	4.00	4.65	23.00	18.00	5.87	55.25	42.00	6.61
128	7.93	6.00	6.21	33.75	26.00	7.55	79.44	60.00	8.33
256	10.63	8.00	7.90	44.50	34.00	9.35	103.63	78.00	10.16
512	15.96	12.00	9.75	65.88	50.00	11.23	151.72	114.00	12.06
1024	21.31	16.00	11.64	87.25	66.00	13.16	199.81	150.00	14.00
2048	31.98	24.00	13.50	129.94	98.00	15.12	295.86	222.00	15.96

Table 4: Table Quantifying the Parameter Number Of Wire Segments

No Of Nodes	Topology Number of Levels								
	Mesh 1	Torus 1	SMITHA 1	Mesh 2	Torus 2	SMITHA 2	Mesh 3	Torus 3	SMITHA 3
4	4	8	1	12	24	3	20	36	5
8	10	16	8	28	48	18	46	72	28
16	24	32	23	64	96	49	104	144	75
32	52	64	54	136	192	112	220	288	170
64	112	128	117	288	384	239	464	576	361

No Of Nodes	Topology								
	Number of Levels								
	Mesh 1	Torus 1	SMITHA 1	Mesh 2	Torus 2	SMITHA 2	Mesh 3	Torus 3	SMITHA 3
128	232	256	244	592	768	494	952	1152	744
256	480	512	499	1216	1536	1005	1952	2304	1511
512	976	1024	1010	2464	3072	2028	3952	4608	3046
1024	1984	2048	2033	4992	6144	4075	8000	9216	6117
2048	4000	4096	4080	10048	12288	8170	16096	18432	12260

Table 5: Table Quantifying the Parameter Wirelength

No Of Nodes	Topology								
	Number of Levels								
	Mesh 1	Torus 1	SMITHA 1	Mesh 2	Torus 2	SMITHA 2	Mesh 3	Torus 3	SMITHA 3
4	4	8	1	12	48	3	20	72	5
8	10	20	8	28	96	18	46	144	28
16	24	48	23	64	192	49	104	288	75
32	52	104	54	136	384	112	220	576	170
64	112	224	117	288	768	239	464	1152	361
128	232	464	244	592	1536	494	952	2304	744
256	480	960	499	1216	3072	1005	1952	4608	1511
512	976	1952	1010	2464	6144	2028	3952	9216	3046
1024	1984	3968	2033	4992	12288	4075	8000	18432	6117
2048	4000	8000	4080	10048	24576	8170	16096	36864	12260

A Compendium Over Cloud Computing Cryptographic Algorithms and Security Issues

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Abstract - Cloud computing is an emerging and revolutionary approach towards the computing and becoming more risk prone than ever before. It is an evolutionary approach of using resources and services on demand and as per need of consumers. Cloud computing providing a platform rose on the Internet for usage of IT services and flexible infrastructure to the consumers and business. Deployment and management of services or resources are maintained by the third party. Whereas there are innumerable advantages to approaching the cloud computing, it also contains various issues such as confidentiality, Integrity, Authenticity and Privacy. One of the prominent barrier to adopt the cloud computing is security. This paper comprises the elaborated study on various security issues allied to cloud computing are presented by consolidating literature reviews on cryptographic algorithms used for data security.

Index Terms – Cloud computing, Cryptographic algorithm, Decryption, Encryption, Security issue.

1.0 INTRODUCTION

Cloud computing proffering us the delivery of computing services over the Web. Cloud services providing the usage of software and hardware that are maintained and deployed by third party to the individuals or business from a remote location. A study conducted by Gartner [1,2] on Cloud Computing is regarded as the first among the top 10 most important technologies and well acknowledged by companies and organizations. Cloud computing encapsulate various services such as web mail, social networking sites, online file storage and different business application. Cloud computing enable users to access services and resources from a configurable shared pool from anywhere where network connection is available. As each users and organizations are transmigrated their information and statistics to the cloud, hence it uses the storage service of cloud deployed by cloud provider. So it is essential to secure data from any illegitimate user access or any other attack such as denial of service, modification and forgery of document etc. Cloud Computing enables ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g.,

networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [2]. There are numerous benedictions to adopt cloud computing but still there are few loop holes that make adoption difficult to adopt. Cloud computing providers must ensure their users for hard security of data and relief from various attacks.

1.1 The following Definition of Cloud computing has been developed by NIST-

Cloud computing is a model for enable convenient on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider inter action. Cloud model promotes availability and is composed of five essential characteristics, four deployment models and three service models.

1.2 Essential Characteristics of Cloud Computing

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

1.3 Cloud Service Models

The three fundamental classifications are often referred to as the "SPI Model" where 'SPI' refers to the Software, Platform or Infrastructure (as a Service), respectively.

1.3.1 Cloud Software as a Service (SaaS): In this type of model complete application is provided to the cloud users. It is mainly accessed through web portal and services oriented architecture (SOA).The Main Consistence Server (MCS) and Domain Consistence Server (DCS)[4].

1.3.2 Cloud Platform as a Service (PaaS):Paas encapsulate environment for the development and provisioning of cloud applications. **Examples:** Force.com, Google App Engine and Microsoft Azure.[4]

1.3.3 Cloud Infrastructure as a Service (IaaS): Infrastructure layer is used to essential IT resources. Examples: Amazon Elastic Cloud, Computing (EC2), Amazon S3 and Go Grid. [4]

1.4 Cloud Deployment Models:

- Public Cloud-Microsoft Azure, Google App Engine [4]
- Private Cloud-Eucalyptus Systems [4]

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- Community Cloud -Face book [4]
- Hybrid Cloud -Amazon Web Services (AWS). [4]

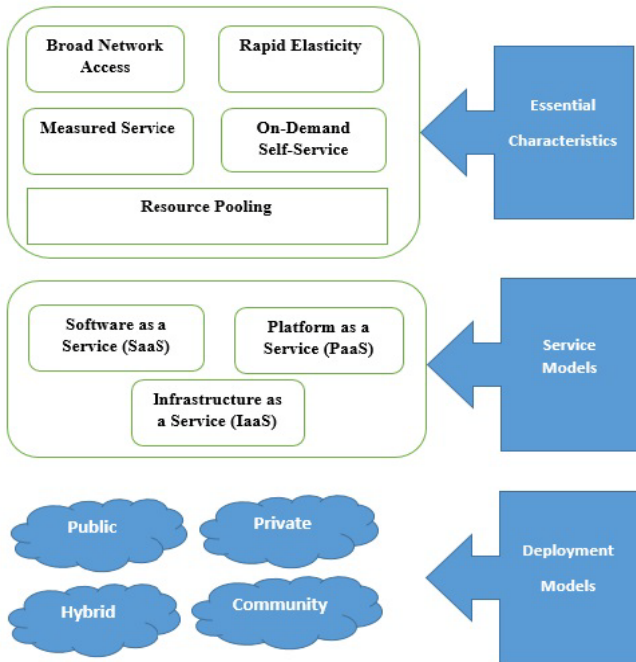


Figure 1: NIST Visual Model of Cloud Computing Definition [4]

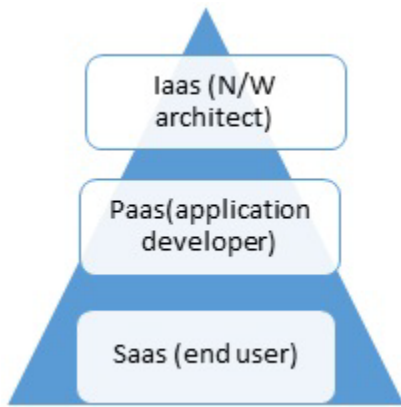


Figure 2: Cloud service model

2.0 SECURITY ISSUES AND THREATS OF CLOUD

Write correct security controls should be implemented according to asset, threat, and vulnerability risk assessment matrices [5]. While cloud security concerns can be grouped into any number of dimensions (Gartner names seven[6] while the Cloud Security Alliance identifies fourteen areas of concern[7]) these dimensions have been aggregated into three general areas: Security and Privacy, Compliance, and Legal or Contractual Issues [8].

2.1 Security concern of cloud users -

2.1.1 Data- Data is main entity of communication and it must be secure enough so that it cannot be hamper by any unauthorized user. Data security should provide to the cloud

users by the cloud providers. Other concern is related to the accessing of data and resources. Cloud provider must keep eye on who is accessing data, from where this activity is taking place and what type of control are applied. Data must be classified for efficient accessing of data.

2.1.2 Training of cloud users-employee or users must be trained so that they can efficiently and properly access data. Employee must be trained to know how to maintain data.

2.1.3 Service Level Agreement (SLA)–SLA is an agreement between the cloud users/business and the cloud service providers to assure which services are used by an individual user. SLA must be unambiguous or clear.

2.2 Basic Security issues for cloud

- Availability
- Data /System Integrity
- Authentication
- Storage, Backup and Recovery of data
- Data Confidentiality and privacy
- Access control

2.3 Different Threats in Cloud Computing [9]

- Account or Service hijacking
- Denial of service
- Data Scavenging
- Data Leakage
- VM escape and hopping
- Customer data manipulation
- Sniffing/Spoofing
- Attack against Web Services
- Man-in-middle attack

3.0 CRYPTOGRAPHIC ALGORITHMS FOR DATA SECURITY

In cloud computing data security is the main concern. For the same different cryptographic algorithms are used. Original text message is known as plaintext and the coded form is known as cipher text. Conversion of plaintext to cipher text is called encryption. Cipher text can be converted back to plain text, this is call decryption. Cryptography comprises the study of encryption and decryption.

3.1 Symmetric encryption is a technique to camouflage the originality of contents of blocks or streams with message file, encryption key and password. Single key is used to encrypt or decrypt data. There are two kinds of symmetric-key encryption algorithms are used to wrap-up the content in a mask i.e. Block cipher and Stream cipher. In block cipher a block of plain text of fixed size is encrypted at a time using key. In stream cipher a bit of stream is encrypted at a time using key. e.g. DES, AES, triple DES, Blowfish etc. are cloud computing algorithms.

3.1.1 DES –DES is a symmetric algorithm for data encryption by using 56 bit key size. It uses balanced feistel structure. It is designed by IBM in 1977. DES uses 64 bit block. Feistel function for this are – expansion, substitution, key mixing and permutation and for the encryption process of DES there are two permutations, one is initial and the other is final permutation and sixteen Feistel rounds are used to generate the key, for each round 48-bit keys generated from the cipher key.[9,10].

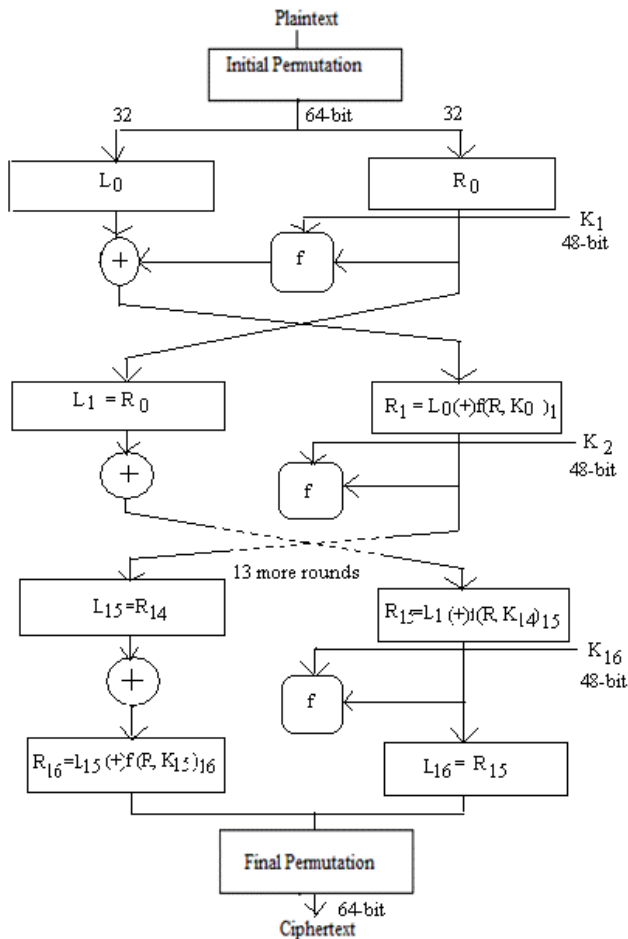


Figure 3: Encryption with DES

3.1.2 3DES- This encryption algorithm is derived from DES. It provides an easy and efficient way of increasing the key size of DES to protect against brute force attack.[9,10]

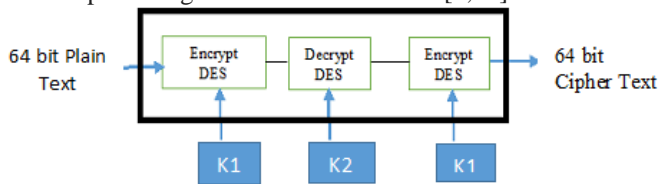


Figure 4: Encryption with 3DES

3.1.3 AES – AES is a symmetric algorithm for data encryption by using 128, 192, 256 bit key. This algorithm is affected by

Brute force attack. Because it uses 128 bit block size it more secure than any other algorithm.[9,10]

3.1.4 RC-5-RC-5 encryption technique is Designed by Ronald Rivest in 1994. This symmetric algorithm uses Keysize of 0-2040bit and uses variable block size (32, 64 or 128 bits), key size (0 to 2040 bits) and number of rounds (0 to 255). It is susceptible to 64-bit blocks differential attack using 2⁴⁴ chosen plaintexts. [9,10]

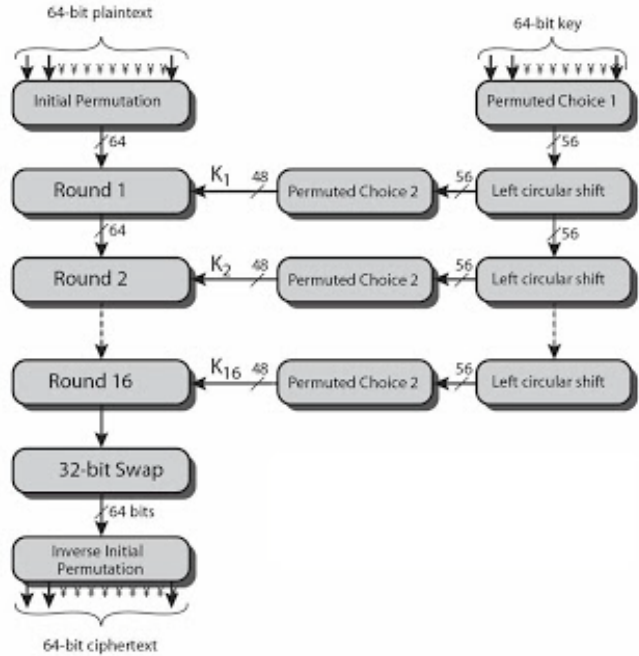


Figure 5: Encryption with AES

3.1.5 IDEA-This block cipher uses 64 bits block of message and 128 bit key. This encryption algorithm suffer from narrow bicliques attack.[9,10]

3.1.6 BLOWFISH-Blowfish is one of the block cipher algorithm for encryption. This encryption technique uses the same secret key to both encryption and decryption of information. Blowfish uses 64 bit block size and variable length key, from 32 bits to 448 bits. Blowfish is appropriate technique for applications where the key is not changed frequently. Over the 32-bit microprocessors it is faster and efficient than other encryption techniques with huge data. It uses 16-round Feistel network.[9,10]

3.2 Asymmetric encryption is used to encrypt small block of data. One key is used to encrypt data or other key is used to decrypt data. Two keys are: Private Key and Public Key. The Public key is used by the sender for the purpose of encryption and the private key is used for the purpose of decryption of data by the receiver. In cloud computing these algorithms are used to generate keys. Some of the common asymmetric-key algorithms for cloud are: RSA, DH and IKE.

3.2.1 RSA- RSA is a public key cryptographic algorithm for data security. This is a most common encryption algorithm used by people to encrypt message with two keys. RSA algorithm encryption and decryption is based on the modular exponential and has two exponents, a and b, where a is used for public and b is used for private. Let the plaintext is M and C is cipher text, then at encryption.[9,10]

$$C = Ma \text{ mod } n$$

And at decryption side

$$M = Cb \text{ mod } n.$$

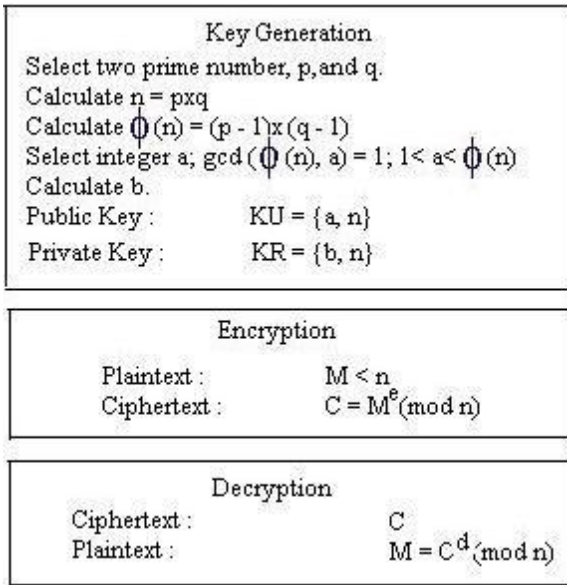


Figure 6: RSA algorithm

3.2.2 Diffie-Helman Key Exchange- This is created by the Whitfield Diffie and Martin Hellman In 1976. This algorithm depends on the complexity of discrete logarithm. Diffi-hellman basically used for key exchange between two users.[9,10].

ALGORITHM:

Q is a prime number and α is a root of q i.e. $\alpha < q$
 Private key X_a , public key $Y_a = \alpha^{X_a} \text{ mod } q, X_a < q$
 Private key X_b , public key $Y_b = \alpha^{X_b} \text{ mod } q, X_b < q$
 secret key by user A:
 $K = (Y_b)^{X_a} \text{ mod } q$
 secret key by user B:
 $K = (Y_a)^{X_b} \text{ mod } q$

3.2.3 ElGamal- This is an asymmetric algorithm used for transmitting digital signatures as well as for key exchange. El Gamal is based on the applicability of discrete logarithms. It is rely on the logarithmic number's characteristics or calculations of these numbers. [9,10]

4.0 COMPARISON AND RESULT

Different symmetric algorithms are compared below on the basis of design feature. Analysis and performance Comparison Table of Asymmetric encryption algorithm-[9,10,12]

Larger the block size means greater security but decreases the encryption/decryption speed. AES has larger block size among the entire algorithms and has greater security capability than other.

Table 1: Comparison of Cryptographic Asymmetric encryption algorithms

DESIGN FEATURE	ASYMMETRIC ALGORITHM			
	RSA	DIFFIE-HELLMAN	ElGamal	ECC
SECURITY	Based on the problem of factoring large Numbers	Vulnerable and secure against eavesdropping	Bases on the discrete logarithm	Based on difficulty to determine secret key k given kP and p
STANDARD	Free for all, Patented only in US	ANSI X9.42	FIPS186-3	IEEE P1363
USAGE	Used for confidentiality and key exchange as well as for digital sign.	Used for Key exchange	Used for both encryption and DSA	Implementing algorithm such as DSA
NO. OF KEYS	2	2	2	2
KEY LENGTH	512 to 15,360	2013,224 bits for q and 2048 bits for p	2048 bit	112 bit to 512 bit
ATTACKS	Brute forced and oracle attack etc.	Denial of service attack	Chosen cipher text and malleability	Timing or simple and differential power attack (side channel or fault)

Larger the key size means greater security but decreases the encryption/decryption speed .Blowfish has larger key length among other algorithm.

No. of rounds, multiple rounds offers greater security. Blowfish has 16 rounds which is typically a standard number of rounds. The most important thing no attack is known to be successful against Blowfish. Hence Blowfish is superior to other algorithms.

Different asymmetric algorithms are compared below on the basis of design feature. Analysis and performance Comparison Table of symmetric encryption algorithm-[9,10,12].

Table 2: Comparison of cryptographic symmetric encryption algorithms

SYMMETRIC ALGORITHM	DESIGN FEATURE					
	BLOCK SIZE	KEY SIZE	NO. OF ROUNDS	NETWORK	ATTACK	POSSIBLE KEYS
AES	128	128,192,256	10,12,14	Non-Feistel	BruteForce	$2^{128}, 2^{192}, 2^{256}$
3DES	64	168,112 or 56	48	Feistel	Theoretical meet-in-the middle attack	$2^{168}, 2^{112}, 2^{56}$
IDEA	64	128	8.5	Lai-massey scheme	Narrow-biclique	2^{128}
RC-5	32,64,128 (64 suggested)	0-2040 (128 suggested)	1-255 (12 suggested)	Feistel	Differential	2^{128}
BLOWFISH	64	Variable length (32-448)	16	Feistel	No attack is known but suffering from weak key	$2^{32}, 2^{448}$

ECC have advantage over RSA i.e.: requirement of less memory and computation time. Advantages of ECC compared to RSA increases abruptly because of length of the key. While RSA need to double its key size, ECC requires few Bit to obtain the same level of security. The RSA currently changes its key size to 2048 Bit and ECC only need to increase its key size to 192 Bit. ECC devices occupies less storage, less power, less memory, and less bandwidth in compare to other systems. Thus ECC has computational advantages with shorter key size than SA. RSA is most widely used algorithm for encryption and key exchange. ElGamal is extended and updated version of DH.

5. 0 CONCLUSION

Cloud computing is an innovative computing trend and many organizations and business are shifting towards the cloud but there are certain barrier to adopt the services. The major reason to avert the usage of cloud is security. There are many cryptographic algorithms that can be deployed over the cloud to provide the security.

DH and ElGamal accept the variants of elliptic curve. RSA is faster in encryption and slower in decryption to ElGmal and half of DH. Hence RSA is efficient among all other asymmetric algorithms.

RSA and Diffie-Hellman Key Exchange both are asymmetric algorithms. In cloud computing both RSA and Diffie-Hellman Key Exchange algorithms generate encryption keys for symmetric algorithms.

DES and AES are frequently used symmetric algorithms. DES algorithm is easy to implement then AES. In terms of Security of data, Flexibility, Memory usage, and performance AES (Rijndael) is best among all.

AES effective in both software and hardware. 3DES and DES are slow in software. Blow fish is more efficient in software. AES is excellent in security rate and execution time than RSA. This paper encompasses a theoretical performance analysis of symmetric or asymmetric encryption algorithm. In the future, our research will be extend by providing implementation of algorithm.

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Comparative Study of Cross Browser Compatibility as Design Issue in Various Websites

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Abstract - In this current era of information technology websites are very important means of communication. Lot of efforts is required by different institutions / organizations to portray complete information on beautifully designed websites. Websites act as an online agent through which a user can get his work done without physically visiting the organizations. Website design is given with a very critical look by the designer so that it can provide users with all the facilities of the concerned institutions / organizations online. To make websites behavior similar in all the different browsers employed by the different categories of the users, the responsibility of the designer and the concerned institutions / organizations increases manifold. In this research paper author developed an online tool using .NET Framework using C# to study cross browser compatibility as Design issue in various categories of the websites like Job portals, Government, educational, Commercial and Social networking. The automated tool developed by author function on the basis of the different standards prescribed in W3C guidelines document UAAG 2.0 [7] and act like a parser and renders the complete code of the website and produces result on basis of the behavior of the websites in five most popular and widely used Browsers like parameters like Internet Explorer[7,8,9], Chrome, Safari, Fire fox. Each Browser is tested on the basis of the five parameters which are included in the parser are Blinking, Active X control, Website Resolution; image Formats, HTML Tag errors. The results obtained after testing five different categories of websites shows that educational and social networking sites shows least compatibility in multiple browsers where as job portals, commercial and government websites shows 100% compliance to the website design standards recommended by W3C w.r.t browser compatibility of different websites on different browsing platform.

Key words: Websites, Browser, Compatibility, Design, .NET, Automated Tool.

1.0 INTRODUCTION

Website is a combination of interlinked and related web pages residing on a single server and served to the user through single domain. There are different categories and wide variety

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of the websites available these days, but the most widely accessible categories of the websites include social networking, Commercial, Government, Educational and job portals. With the advancement in technologies and completions of providing all services to the citizen online, it has become mandatory as well as very important for different organizations (big or small) to develop website for rendering all its services online to the user at global level through networks. In order to provide better services online the websites are increasing in number in a very short span of time. With increase in the number of websites its popularity and cater to the need of all the different categories of the users it becomes mandatory for different organizations to put lot of efforts to design websites carefully so that it can easily be accessible for different services. Number of different websites design issues is there which needs to be kept into designers consideration while designing websites. Browser compatibility is one of the most important issues among all websites design parameters. These days multiple browsers are being practiced by the different users for accessing websites. With the advent of multiple browsers it becomes mandatory for a website to behave similar when open in multiple browsers. There are different organizations which are responsible for development and recommendations of different website design standards. For evaluating website design as per the different standards so that it behave similar in all the different browsers available, the number of different automated tools are available online. Each available online tool test the websites on its own criteria and supply the result accordingly. In order to test the websites design (Browser compatibility) w.r.t. the standards recommended by W3C, the automated tool is design and developed by taking into consideration the parameters which are not tested by any automated tool available online till date. The automated tool, developed shall take website URL as input and then parse the website complete code supplied by the server after submitting the desired request through its interface. The HTML code supplied by the server will be compared with the existing standards recommended by the W3C and embedded in the automated tool for its compliance. The working of the automated tool design and developed by the author is given below in Figure 1. The parser of the automated tool will take website URL as input and send same to the server as request for fetching the websites HTML code. The server within no time sends back the HTML code of the website to the interface of the automated tool for its comparison with the existing standards. The algorithm of the online automated tool developed by the author is given below:
Algorithm 1: To determine browser compatibility of a

website.

Input: Website URL

Output: Compatibility status of website w.r.t different features for various browsers.

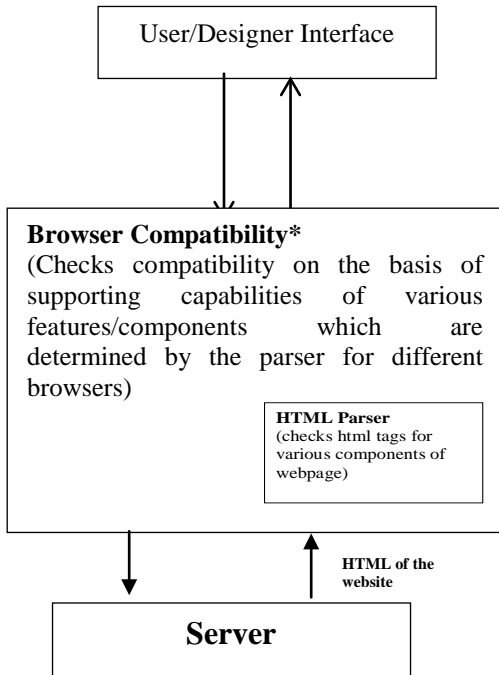


Figure 1: Block diagram of Browser Compatibility Parameter

Method:

Begin

Step I: Generates request for obtaining HTML file of the website by passing url to the server.

Step II: For each feature considered for determining compatibility

Flag=0;

- (i) Check for the presence of the feature in the website by a look out of the HTML file.
- (ii) Determine the compatibility of the feature w.r.t different browsers.

If (feature isn't supported by any browser)

Set flag=1;

Step IV: if (flag==0)

Website is compatible for all browsers

else

Website isn't fully compatible.

End

2.0 LITERATURE SURVEY

All though many people have worked in area of website design and development but still the desired qualities of a website has not been achieved. Still websites fails to deliver the desired goals as is evident from the literature available. A details review of literature regarding the concerned topic of research has been done through different sources of Literature like journals, research papers, books and article with Internet as the major source of this literature. Most designers feel that they should be supporting all or at least as many browsers as they possibly can. But honestly, this is impossible. If there are 5 major browsers, IE has over 7 versions, Fire fox has over 3, Opera has over 9, Safari over 3, and now Chrome has come out. So even if you try to support just the 2 latest versions of each common browser you're looking at 10 browsers, 8 of which you'll have to test on both Macintosh and Windows - so that's 18 tests for every page. And that's not even close to all, or even most, of the browsers available. [1] When there are nearly 100 web browsers available today, [2] each browser parses a web code in a different way. It becomes very difficult for a designer to design websites which shows similar behavior in each browser employed by the user. . If we are using java scripts or AJAX calls for UI functionality, performing security checks or validations then give more stress on browser compatibility testing of our web application [3]. The components of web pages like blinking, active X controls, resolution, image formats and HTML tag error (like video tag), Ajax, Flash, and event-handling for dynamic HTML [4] etc. have a direct effect on the cross browser compatibility of a website. These features are supported to different levels by various types of popularly known web browsers or their versions. E.g. the compatibility of blink tag by various browsers [5] is shown in table 1 below.

Hence to avoid loss of business and reputation it is very important to pay attention to cross browser issues [6]. W3C guidelines document UAAG 2.0 [7] states that web sites must follow the maximum standards to make website behavior similar in all browsing platforms. There are other categories of features that hinder the compatibility of websites over the commonly employed browsers which include Different Browsers, Different Browser Versions, Different Computer Types, Different Screen Sizes, Different Font Sizes, and HTML Errors, Browser Bug, Add-ons and Third Party entities [8]. In near future the different government organizations are going to provide all facilities through web and they are available once the user visited there websites through its browser [9]. Web based applications are extremely helpful in enhancing the success rate of any organization.

The sustenance of High level Process maturity can be achieved by adopting web application technology [10]. As already discussed the technology also plays vital role on making websites compatible with different browsing platforms. Government organizations are putting lots of efforts to provide different services in the Directorate General of Foreign Trade (DGFT): [11] e-licensing, e-BRC, e-tendering,

e-monitoring, e-meeting e-delivery, e-PRC, e-grievance re-addressal etc. regarding the implementation of ICT and different user’s access information from different browsing platforms. The continuous evolution of the Internet has opened unimaginable opportunities and challenges in web based education and learning [12]. Each and every person these days is getting all his work done by the use of web based system which is accessible through one or the other browsing platforms. Only Workplace (office, school, college etc) was found to be the most common place for internet access. Most offices and schools provide internet (broadband) access; therefore people indulge in internet activities at work, only 22% of the respondents did not have internet facility at work [13]. So attention needs to be paid to the design of the websites in order to make uniform behaviors of all the websites in different widely used browsers.

S. No	Web Browsers	Compatibility for Blink Tag
1.	Internet Explorer[7,8,9]	Not Supported
2.	Chrome	Not Supported
3.	Safari	Not Supported
4.	Fire fox	Supported

Table 1: Browsers compatibility with blinking tags

3.0 METHODOLOGY

3.1 Problem Identification

A good web design aims to give a uniform look to the website, viewed from any web browser. Thus, a good website should be viewable in its full functionality on any web browser. Since every webpage is built up of various components with their own characteristics and these characteristics affect the performance of a webpage in different contexts. Like other measures of performance evaluation the browser compatibility feature of websites is also affected by the various components of a webpage either directly or indirectly. It is also dependent on the type of technology used in building websites like AJAX as already discussed in literature review. Different technologies sometimes also create the compatibility problem. So during the design phase of the websites they must be tested rigorously for its compatibility at different browsing platforms. As already discussed in literature review, different components of web pages like blinking, active X controls, resolution, image formats and HTML tag error (like video tag), Ajax, Flash, and event-handling for dynamic HTML etc. have a direct effect on the cross browser compatibility of a website. These features are supported to different levels by various types of popularly known web browsers or their versions. The compatibility of blink tag by various popularly known browsers is already in table discussed in literature review.

Similarly, the other features described above offer different

levels of compatibility conflicts to various levels when websites are opened on distinct web browsers or their versions. These features are the basis for categorizing websites for their cross browser compatibility capabilities.

3.2 Online tool for testing web pages

The automated tool designed and developed by the author for testing various categories of the websites in order to study the deviation from design standards by the designer includes five different parameters. For testing browser compatibility parameter the features (or measures) which are considered by automated tool in determining the compatibility of a website on various commonly used browsers like Internet Explorer, Google Chrome etc. are:

- 1) Blinking
- 2) ActiveX Controls
- 3) Website Resolution
- 4) Image Formats
- 5) HTML Tag Error

The test for various websites is carried out on the basis of the above features to determine compatibility conflicts. This online web diagnostic tool provides a complete statistics of the browser compatibility based on the features which are considered for the purpose.

3.3 Sample Data

The Sample of data undertaken to study Browser compatibility as design and development issue in various websites is given below in table 2. the five different categories of the websites which are widely used and accessed by the users were selected which includes government websites, commercial websites, job portals, social networking and educational websites. The different category of the websites undertaken by the author helps the designer to understand about diversity in website design in a better and efficient way. Total 100 websites belonging to different categories was taken for testing which includes 20 websites from each categories mentioned above. The different websites are designed in consideration with different design constraints and they are applying specifically to each category undertaken for testing. Moreover, it helps a lot to study diverse nature of the website design as far as browser compatibility on different browsing platform is concerned.

3.4 Results and Discussions

The Sample data undertaken to study cross browser compatibility as website design issue in various websites is shown in below given Table 2 and the results obtained are shown by framing the analysis into a graph shown in below given figure A.

Based on the graph shown in fig.(A) above, it can be analyzed that the website categories that have maximum support in percentage for various types of commonly used browsers belong to e-government websites, e-commerce websites and job portals and the websites which shows least compliance to the different browsing platforms belongs to social networking

websites and educational websites.

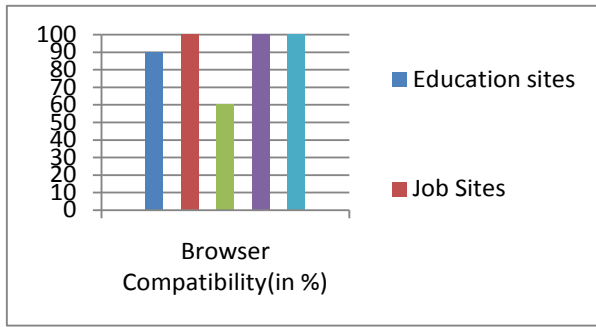


Figure 2: %age for Browser Compatibility

It has been observed from the results obtained that out of the five different categories of the websites taken as a sample data for testing the e-governance, e-commerce and job portals follows the maximum of the standards recommended for the websites design w.r.t. behavior of the websites in different browsing platforms.

4.0 CONCLUSION

Designers cannot assume that their application will run fine and display and work for all the browsers without cross browser testing. The organizations must put lots of efforts in designing websites in order to avoid loss of business and reputation. The analysis carried out on the cross browser compatibility feature of websites above using the online web diagnostic tool Website Design Evaluator clearly indicates that websites are neglecting criteria that otherwise must be considered for complete cross browser compatibility in spite of the web browser employed.

By evaluating the different categories of the websites on the automated tool design and developed by the author it has been observed that websites are not meeting the different standards recommended by the different standard organization (e.g. W3C) for the design and development of various websites such as blink tag for IE_[7,8,9] and Mozilla, video tag for IE₈ and earlier versions etc. The result of this study confirms that the developers of the websites somehow are not able to completely follow the standards recommended. It is clear from the results that more efforts are required to follow websites design standards in order to make websites 100% compatible in different browsing platforms.

5.0 LIMITATIONS

Appendixes, In addition to the features considered for compatibility test, there are also other features for determining browser compatibility that can be included in order to widen the cross compatibility check to better help developers/designers to build websites that have increased compatibility capabilities. The features considered are not quite enough to fully determine the compatibility capabilities of a website. There are other categories of features that hinder the compatibility of websites over the commonly employed browsers e.g.

- a) Different Browsers

- b) Different Browser Versions
- c) Different Computer Types
- d) Different Screen Sizes
- e) Different Font Sizes
- f) HTML Errors
- g) Browser Bug
- h) Add-ons and Third Party entities

6.0 FUTURE SCOPE

In future more number of measures will be added to browser compatibility parameter to help the designers to create page that are more efficient, user centric and follow the standards provided by concerned organizations in a more appropriate way. The parameters that are under consideration to be included in the parameter belong to categories like diversity in web browser versions, other HTML tag errors, screen sizes etc. All these features are under consideration and will be included in the tool to enhance its capability to check websites for more number of design issues regarding cross Browser compatibility problem.

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Table 2: Sample Data

S.No	Govt. Websites	Educational Websites	Commercial Websites	Social Networking Websites	Job Portal Websites
1.	www.mit.gov.in	www.upsc.gov.in	www.bsnl.co.in	www.facebook.com	www.monster.com
2.	www.indianrail.gov.in	www.shiksha.com	www.onlinesbi.com	www.gmail.com	www.careerbuilder.co.in
3.	www.moia.gov.in	www.apple.com	www.airtel.in	www.orkut.com	www.indeed.co.in
4.	www.rajasthan.gov.in	www.schoolcircle.com	www.india.philips.com	www.yahoo.com	www.simplyhired.co.in
5.	www.jkgad.nic.in	www.classteacher.com	www.libertyshoes.com	www.rediffmail.com	www.nakuri.com
6.	www.maharashtra.gov.in	www.jammuuniversity.in	www.bata.in	www.frenzo.com	www.glassdoor.com
7.	www.assam.gov.in	www.kashmiruniversity.net	www.hp.com	www.bebo.com	www.usajobs.gov
8.	www.india.gov.in	www.coeju.com	www.tata.in	www.goibibo.com	www.reed.co.uk
9.	www.aponline.gov.in	www.kashmiruniversity.ac.in	www.godrej.com	www.jakpinch.com	www.monesterindia.com
10.	www.nagaland.nic.in	www.jmi.ac.in	www.hul.co.in	www.myspace.com	www.placementindia.com
11.	www.upsc.gov.in	www.jamiahamdard.edu	www.marutisuzuki.com	www.mycantos.com	www.timesjobs.com
12.	www.petroleum.nic.in	www.smvdu.net.in	www.britannia.co.in	www.friendster.com	www.beyond.com
13.	www.rbi.org.in	www.islamicuniversity.edu.in	www.pg.com	www.viber.com	www.findtherightjob.com

14.	www.dotindia.com	www.du.ac.in	www.colgatepalmolive.com	www.netlog.com	www.bright.com
15.	www.coal.nic.in	www.jnuonline.in	www.hindwarehomes.com	www.flickr.com	www.ziprecruiter.com
16.	www.tn.gov.in	www.amu.ac.in	www.pepejeans.com	www.watsapp.com	www.theladders.com
17.	www.tourismofindia.com	www.skuastkashmir.ac.in	www.ashokleyland.com	www.plus.google.com	www.monester.co.uk
18.	www.upgov.nic.in	www.skuast.org	www.dabur.com	www.tagged.com	www.career.com
19.	www.darpg.gov.in	www.pondiuni.edu.in	www.pepsico.com	www.ning.com	www.tweetmyjobs.com
20.	web.guidelines.gov.in	www.bujhansi.org	www.coca-cola.com	www.pinterest.com	www.smartbrief.com

Framework for Choosing Best Intrusion Detection System

Bilal Maqbool Beigh

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Abstract - As there are many intrusion detection systems available in the market and yet there is not a single guideline framed by any researcher or any organization so that a company or an organization will decide which intrusion detection system is best suited to their company for the purpose of security. Here in this paper, we have proposed a novel guideline in terms of framework for choosing right most intrusion detection system for an organization. The framework needs some security expert so that they can check the equation to be satisfied.

Index Terms – Framework, Guideline, model, IDS, Intrusion.

1.0 INTRODUCTION

The story of the human life started with Stone Age, then agriculture age and now we are in the information technology age, where everything depends upon information and information processing systems. Information ranging from personnel to commercial have been processed and exchanged by these information systems. With the advent of Internet, the convergence of information & communication technologies and today's very complex nature of business environment resulted in myriad trust and information security concerns. The secure functioning of these information systems is the utmost important and foremost concern. Information security is a field of security which ensures the confidentiality, integrity and availability of information and information processing resources. Many security professionals think that developing a completely secure system is almost an impossible task. According to [1] the completely secure system is one that is disconnected from a network, encased in concrete, and lying at the bottom of the ocean. In this networked environment where there are potential number of hackers and adversaries present, security enforcing mechanisms needs to be incorporated in the information systems to with stand with the both deliberate and accidental malicious intents. Hence this tremendous growth in communication technology brings number of good things to human society, but it also makes us re-lay on information systems [2]. As the information is increasing in digital format day by day, the vulnerabilities are also increasing in the form of cyber threats, attacks and mis-identification of trusted users. There are lots of intrusion attacks in today's digital world, according to recent survey by CERT/CC [3], the rate of intrusion attacks almost doubles every year.

The Computer Emergency Response Team (CERT) reported 3734 incidents in 1998, 9859 in 1999 and 8836 in the first 6 months of 2000. In a recent audit of U.S. federal agencies by the GAO [4] investigators were able to pierce security at nearly every system they tested. The cause of these attacks are either complexity of the system itself or increasing number of hackers day by day or market competitors or software development companies itself etc. Therefore along with these tremendous opportunities for sharing important information and resource especially used for some critical operation like military , space, nuclear etc. It has become very much important to protect these special and important resources and information against such attacks [5]. For protecting the same, we have the concept called "Information security" thus we can say that information security is such area which protects our information / resources from theft or misuse. But still this field of research is in its infancy days. This research started in early 90's and so far little has been done in this field. This research field comprises of many subfield such as system side security, network side security etc. One subset of information security that has been the area of much more attention in recent years is intrusion detection system [5]. Therefore intrusion detection system can be defined as the process of monitoring events occurring in a system and signaling responsible parties when interesting (suspicious) activity (compromises the confidentiality, integrity, availability, or to bypass the security mechanisms of a computer or network) occurs [7]. At this instant of time, there are many intrusions detection systems available in market with different features and uses, but it is very difficult for a user or organization to choose best Intrusion detection system for him or for his organization [8][14]. As there is no such guideline provided by any agency/ organization to choose the security policy therefore there is a need of guidelines for the purpose. Here In this research work, we will provide a framework in terms of mathematical equations and steps for choosing best possible intrusion detection system for you and your organization. This part will ensure that the system for intrusion detection should be made in accordance to the model prepared in terms of equations and physical model to be described in the next sections of this paper.

2.0 NEED FOR FRAMEWORK FOR CHOOSING IDS

The intrusion detection system allows us to make the system safe from the most attackers. Thus as described in previous and this chapter, intrusion can be defined as a process of accessing someone's personal property or data or information without proper access or proper authentication cardinalities. As all of us know that today's almost 90 percent of information is available online through websites or computer programs. Although this make very ease and very fast access to the people overall the

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globe, but it also increases the risk to the maximum. According to Symantec report, around 1, 00,000 websites are available online and some of them share the critical information and valuable data. In order to steal the critical data or important and relevant information without having legitimate access to the resources, the person on longer need not to be a hacking gem, just download and run the hacking program, make some settings and you are done [9][16]. In order to secure the companies or individual's data/ information, firewalls are being installed, but they alone do not serve the purpose of defending the data from attacks or intruders. The main aim of the firewall is to filter the traffic but they cannot block all the traffic. Also once the traffic passed through the firewall there is no such mechanism available that traffic will be monitored inside the network for rest processing. Also firewall only detects external traffic coming to it, but doesn't detect the internal attacks. By using intrusion detection system, we can monitor or do the following things:

- Monitors network traffic.
- Continuously monitors servers/ network for misuse actions or abuse policy.
- Attack / breach alerting, response and reporting.
- Countermeasures.

Thus it became very much important for an organization to install both firewall and intrusion detection system to secure their assets / information for hackers / attackers. Also for securing this particular data and information from the attackers, there are lots of intrusion detection mechanisms currently available in the market. Every intrusion detection manufacturing organization highlights his qualities of making secure the information, but none of the organization or research community describes the guidelines for picking the most appropriate and good suitable intrusion detection system for any company or individual. Thus it became very much important to provide some guidelines either through some model or through some mathematical formula to suggest the company which intrusion detection system is most suited for them and under which norms. We have taken a step towards the development of guidelines for choosing the right intrusion detection in accordance to their requirements and importance's. In this chapter we have presented guidelines for choosing right most intrusion detection system for company or individual under required condition. The guidelines will be discussed in next section of this chapter.

3.0 FRAME WORK FOR CHOOSING INTRUSION DETECTION SYSTEM

Choosing an intrusion detection system is a delicate task, as the whole company security responsibility lies on the shoulders of the intrusion detection system i.e.to detect the attack made on the organization system, to mitigate them if possible or to alert the administrator about the attack happened [4]. Currently there are many intrusion detection systems available within the market but it is difficult to choose the best intrusion detection system for an organization[17]. In order to choose the same, we have devised a framework that will help an organization to

choose the best intrusion detection. The framework consists of logical steps and which when followed revealed the desires intrusion detection system. The steps which are involved in choosing best intrusion detection are as:

- Risk Analysis.
- Detection Rate
- False Alarm Rate
- Cost Benefit analysis
- Updates or patches ratio.

When the above mentioned steps are followed in a manner shown in figure below (cc), yield the results based on the mathematical formulas. The accepted criteria must be decided by the security professionals to choose best intrusion detection system.

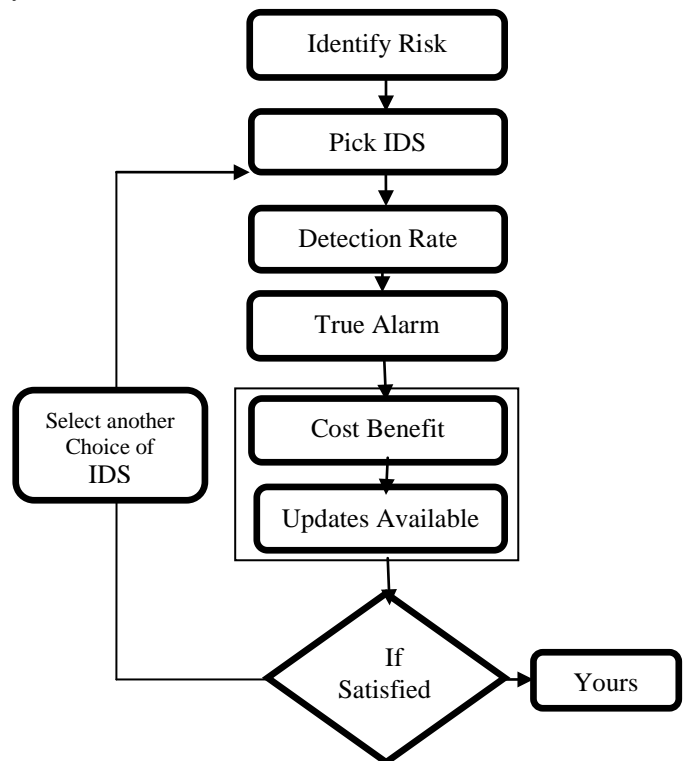


Figure 1: Frame Work for choosing right intrusion detection system

3.1 Risk Analysis

The Risk analysis step is the first step towards the choosing of intrusion detection and prevention system for an individual or an organization. This step is most important and critical towards the picking of right most intrusion detection system. The risk calculation is very big thing to do because it deals with the overall security of the organization. The risk analysis can be considered as a tool for risk management, which is helpful for identifying security issues i.e. vulnerabilities, threats and unauthorized access. Also as per the general definition of risk on different blogs and websites, the risk can be calculated as:

$$\text{“Risk = Threats x Vulnerabilities x Impact”}$$

But we have devised the risk in accordance to our own formulas. The formula will depend upon the following factors.

- i. Summation of threats.
- ii. Value / impact of threats
- iii. Total Impact of assets under risk
- iv. Total assets of the organization.

Before enforcing the formula, The RAG (Risk Analysis Group) will find two important aspects used in making the formula which are [10] [11] [12] [13]:

- Identifying important information and their Values
 - Identifying threats and Vulnerabilities for the assets
- Identifying important information and their Values – Identifying the values of the organization’s important information is the very first step for risk analysis. In this step the risk assessment group will point out / identify the most important assets of organization and will estimate the cost associated and damage resulted if some intrusion/ attack happened on an organization or we can say the group will analyze the loss made by losing the information to some other company. While identifying the assets following things must be kept in consideration.
- Cost of assets/ information that may be lost if intrusion happen.
 - Role and usage of assets / information.

Identifying threats and Vulnerabilities –After pointing out the important information/assets, the responsibility of the group is to identify the vulnerabilities and threats for assets/ important information as identified in the prior step. Also they have to keep an order of threats i.e. which threat may damage/ theft more information according to the percentage of damage done by these threats and vulnerabilities. Thus in general, the RAG will gather the information about the loss of assets / information in total at the initial stage, if not prevented and total threats and vulnerabilities that can cause these losses. After acquiring the above two steps, we have derived a formula which we are going to use to calculate the risk is as under:

$$\begin{aligned} \text{Estimated Risk} &= \sum_{i=1}^n P(\text{Assets affected by threats} \\ &\quad * \text{value of the assets}) \\ &\quad \text{where } P \text{ is probability of} \end{aligned}$$

By calculating the estimated risk, we can have idea about how much it will affect our assets. Therefore the overall percentage of the risk can be calculated with the help of the following formula.

$$\text{Risk} = \frac{\text{Total Assets of the organization} * \text{value of assets}}{\text{Estimated Risk}} * 100$$

After getting the results of assets under risk in percentage, we will move towards the next step of the frame work.

3.2 Picking of IDS

Every organization wants to secure their confidential resources, for that they have to make some selection in terms of firewalls,

IDs etc. Before going for any products, the company should consider all the available resources for basic system operation and maintenance. Thus should be able to pick the appropriate IDS which will meet the needs within the constraints laid down by company. This task is very difficult, As there is no industry standard against which we will compare IDS. Hence there is a need of providing a standard benchmark for IDS. The new product cycle for commercial IDSs is rapid, and information and systems quickly become obsolete. Steven Northcutt recommends the use of product guides that are updated at least monthly. Relatively little objective third party evaluation of IDSs is available, while trade press reports are generally spotty and superficial. Setting up a facility to objectively compare IDSs will be prohibitively expensive for all but the largest potential users, and some third-party or industry sponsored effort is needed. Marketing literature rarely describes how well a given IDS finds intruders and how much work is required to use and maintain that system in a fully functioning network with significant daily traffic. IDS vendors usually specify which prototypical attacks their systems can find, but without access to deployment environments, they cannot describe how well their systems detect real attacks while avoiding false alarms. Edward Amoroso and Richard Kwapniewski recently provided guidance in selecting IDS [14] by making some questionnaires, upon the receiving the answers from the users, they will choose the intrusion detection system. These guidelines have impact of bias towards a particular intrusion detection system. This step is very important, as it is concern with the security of overall system. The step choice based and will not be entertained in the conditions which are going to decide that is the picked intrusion detection system the right most intrusion detection for their organization. The decision of this step lies on the shoulders of the Risk analysis group. They are the security professionals which will decide the most suited as per the threats and vulnerability of the organizations.

3.3 Detection Rate

The step is very much important as the decision is concerned. The detection rate for a particular intrusion detection system will be available in the literature and papers available in different research journals. Let us make an example, in one of our experiment, the snort has detection rate of 99.4 % which means that 99.4% of attacks are being detected by the snort coming towards the system. Similarly all intrusion detection has the documentation, which shows the rate of detection for that intrusion detection system. Rate of detection can be calculated as:

$$\text{DR} = \frac{\text{Detected attacks coming toward the system}}{\text{Total no. of attacks coming toward the system}} * 100$$

Or we can say that the rate of detection can be calculated as:

$$\text{DR} = \frac{\text{TP}}{(\text{TP} + \text{TN})} * 100$$

TP = amount of attack when it actually attack
 TN = amount of normal detect when it actually normal
 Also rate of detection can be calculated using the above formula. The detection rate is very much important as per selection is concerned. It shows the overall rate. If the detection rate is greater than 90 %, the system is partially accepted. Which means the system will be evaluated for the next section. i.e. True alarm Rate .

3.4 True Alarm Rate

The step is much important as per the decision is concerned. As we are calculating the rate of false positive alarm rate which can be calculated as the ratio of in-correct classified intrusions to the total number of normal records. Therefore false positive rate (FPR) can be calculated as:

$$FPR = \frac{\sum \text{FalseAlarm Detected}}{\sum \text{Totalnumberofrecords}} * 100$$

But we have to calculate the True Positive alarm rate which can be derived as from the above formula, which can be derived as below:

$$\text{True Positive Rate} = 100 - \text{false Positive Rate}$$

Let us assume we got the false positive rate as 3.06% , then we can easily get the true positive rate as 96.77% which means that the system is accurately identifying 96.77 % of the intrusions that of total available in the dataset. Upon partial accepted from previous sections. If the true alarm rate is less than 95 %, it is partially accepted.

3.5 Cost Benefit Analysis.

There is a variety of approaches to cost analysis, the suitability of any of which depends upon the purpose of an assessment and the availability of data and other resources. It is rarely possible or necessary to identify and quantify all costs and all benefits (or outcomes), and the units used to quantify these may differ.

Main types of cost analysis include the following.

- Cost-of-illness analysis: a determination of the economic impact of an illness or condition (typically on a given population, region, or country) e.g., of smoking, arthritis or bedsores, including associated treatment costs
- Cost-minimization analysis: a determination of the least costly among alternative interventions that are assumed to produce equivalent outcomes.
- Cost-effectiveness analysis (CEA): a comparison of costs in monetary units with outcomes in quantitative non-monetary units, e.g., reduced mortality or morbidity.
- Cost-utility analysis (CUA): a form of cost-effectiveness analysis that compares costs in monetary units with outcomes in terms of their utility, usually to the patient, measured, e.g., in QALYs.
- Cost-consequence analysis: a form of cost-effectiveness analysis that presents costs and outcomes in discrete categories, without aggregating or weighting them.
- Cost-benefit analysis (CBA): compares costs and benefits, both of which are quantified in common monetary units.

Before a company or an organization decides on exactly which IDS that organization or company should opt, it is very important to perform cost/ benefit analysis. As it is very obvious and important that cost/benefit analysis is very real and important factor in decision making of all the process related to an organization. There funds allocated to the security or other solutions have to have a good reason why such funds are allocated to the said solution. This analysis can be performed effectively once the organizations risk analysis has been performed. This risk analysis will give the organization a very real sense of the costs associated company assets. The estimated cost/ benefit of the company can be evaluated with the following formulas as shown under:

$$\begin{aligned} \text{Cost} = & \text{Basic Cost of IDS(if any)} \\ & + \sum_{i=1}^n \text{Deployment Cost} \\ & + \sum_{i=1}^n \text{cost of Upgradation} \\ & + \sum_{i=1}^n \text{Mointoring Cost} \end{aligned}$$

where n is the number of assets

The equation of cost has been designed to evaluate the total cost of the security solution for an organization. The cost consists of all the man power which can be used to incorporate the security solution in accordance to the requirement of the organization for the purpose of securing the critical data. Also the benefit is as important as determine the cost of security solution. The benefit will give us figures that whether the solution will be beneficial to the company. It will give us the impact of the benefits using the big budget for the security solution. The formula helps us to estimate the benefits from the security solution, which is usually the cost of assets which are currently under threat and future assets. The formulas for benefits are as under:

$$\begin{aligned} \text{Benefits} \\ = & \sum_{i=1}^n \text{CostAssetsbenifitedbySecuritySolution} \\ & + \text{FutureAssetsbenifitedbySecuritySolution} \end{aligned}$$

Where n is the number of Assets

The Net Cost-Benefit will be retrieved from the difference of cost from benefits. The Net-cost benefit analysis will be derived as under:

$$\begin{aligned} \text{NetCost} - \text{BenefitsAnalysis} \\ = \text{Benefits} - \text{Cost} \end{aligned}$$

This section will be critical as far as the decision will be is concerned. If partially accepted from last sections, if the Net-Cost Benefits is greater than Zero (>0), it is again partially accepted.

3.6 Decision Phase

This is one of the most important phases of our framework, if the system is already partially accepted; it will go to the next

phase of detection. The final selection results will be based on the following points:

Name of IDS	Benefits
Snort	62,00,000
Bro	62,00,000
NIDS	62,00,000

1. Highest rate of detection under consideration.
2. Lowest False alarm Rate.
3. Highest Net-Cost Benefit.

It is considered that if the one security solution has high Net Cost-Benefits rate and rest two options are low and other solution have also been partially accepted but does not have Net Cost-Benefits but have very good statistics high in detection rate and true positive rate, the security solutions which have high detection rate and true positive rate will be considered for selection.

4.0 EVALUATION OF FRAMEWORK FOR CHOOSING INTRUSION DETECTION SYSTEM

The evaluation of frame work for choosing Intrusion detection system was done on the statistics provided by the Kashmir university IT&SS department. The department provided the statistics only meant for the research meant in this thesis. The figures provided are as :

Risk Analysis: As per the departmental report, total cost of assets which are under risk (attacks). The risk figures are calculated by using the above mentioned formulas.

$$\text{Risk} = \sum_{i=1}^n \text{No. of Assets} * \text{Cost}$$

Risk = Cost of Results + Cost of pay generation Software + Cost of E-Governance

$$\text{Risk} = 10,00,000 + 2,00,000 + 50,00,000$$

$$\text{Risk} = 62,00,000 \text{ (Approx).}$$

Pick IDS: We have chosen three intrusion detection systems which are open source. The selection of intrusion detection is based on statistics and popularity score in literature available. The intrusion detection systems are:

1. Snort.
2. Bro
3. NIDS.

Detection Rate: As per the literature available, we have collected the detection rate of the all the three intrusion

Name of IDS	Cost
Snort	1,30,000
Bro	1,50,000
NIDS	1,70,000

detection system available. The detection rate is as under:

Table1: Detection Rate for evaluation

Name of IDS	Detection Rate
Snort	98.3 %
Bro	94.4 %
NIDS	97.3%

As per the statistics available in the literature, Snort has highest detection rate while on the second number NIDS is there and Bro is at the third number.

False Rate: As per the literature available, we have collected the respective false rate of the all the three intrusion detection system available mentioned above. The False rate is as under:

Table 2: False alarm Rate for evaluation

Name of IDS	False Rate
Snort	2.3%
Bro	7.5%
NIDS	2.1%

As per the statistics available in the literature, NIDS have least false rate, on second number Snort is there and last is Bro.

Cost-Benefit:

The benefit of all the three is as follows:

Table3: Cost Benefit for evaluation

The costs of all the three are:

Cost of Snort = Cost of Deployment + Cost of updating + Cost Maintenance.

$$\text{Cost of Snort} = 1, 00,000 \text{ (purchasing of Computer)} + 0 + 30,000 \text{ (rule purchasing)}$$

$$= 1, 30,000.$$

Cost of Bro = Cost of Deployment + Cost of updating + Cost Maintenance (Script writing).

Cost of Bro = 1, 00,000(purchasing of Computer) + 10,000 per Month+ 40000(Script Writing)

$$= 1, 50,000.$$

Cost of NIDS= Cost of Deployment + Cost of Updating + Cost of Maintenance

$$\text{Cost of NIDS} = 1, 00,000 \text{ (purchasing of Computer)} + 50,000 \text{ per Month} + 20,000$$

$$\text{Cost of NIDS} = 1, 70,000$$

Table 4: Cost for evaluation

Table5: Net Cost Benefit for evaluation

Net Cost-Benefit = Benefit – Cost

Name of IDS	Net Cost-Benefit
Snort	62,00,000-1,30,000 = 6070000
Bro	62,00,000- 1,50,000 = 6050000
NIDS	62,00,000 -1,70,000 = 6030000

Decision:

As the Net Cost-Benefit analysis for all are almost same, therefore the deciding factor is now detection rate and false alarm rate. As per the calculation Snort has highest detection rate from the three and rate of false alarm rate for snort is 2.3 and NIDS is 2.1. Therefore after seeing the results, the detection rate of Snort is high and false rate is almost same in NIDS and Snort, so we choose **Snort** from all the three intrusion detection system.

4.0 CONCLUSION

The current research is focused on choosing intrusion detection and prevention system. The selection of the Intrusion detection System is a very tough job. The thesis chapter provide framework for choosing best intrusion detection system for an organization. The framework is the form of flow diagram, when followed strictly will yield a solution for choosing best intrusion detection and prevention system for an organization. The steps mentioned in framework appears to be a simple exercise but are basically important/ critical steps for getting best of ID&PS for an organization . But ultimately the choice depends upon company. The researcher had made an attempt to provide certain guidelines in terms of frame work for choosing or selecting right most intrusion detection for an organization.

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A Novel Pruning Approach for Association Rule Mining

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Abstract – The problem of Association rule mining (ARM) can be solved by using Apriori algorithm consisting of 3-steps -Joining, Pruning and Verification. Pruning step plays an important role in eliminating weak candidate itemsets. In this paper, a new pruning step is proposed as an alternate to Apriori's pruning step. This alternative is depicted as a filtration step. Five experiments are carried out to claim that proposed pruning method also works as efficient as Apriori's pruning method.

Index Terms – Data mining, ARM (Association Rule Mining), Apriori algorithm, pruning.

1.0 INTRODUCTION

Data mining [8] is a method of extracting non-trivial, inherent, unfamiliar and practical information from large repositories. Association rule mining extracts frequent patterns [1], correlations [19], subsequences [12], substructures [11, 26, 27] or associations [1] among sets of items of the databases. An association rule is an implication $X \Rightarrow Y$, where X and Y are sets of items. The meaning of such expression is that transactions of a database which contain X likely to contain Y . For example-95% of the students who buy a lap-top and a book related to computers can also purchase a pen-drive.

The rules thus discovered from the databases can be used to rearrange the related items together or can be used to make new market strategies which further increase the sales. Application domain of association rule mining is not only limited to the context of retail application but can also be used in the decision logics to the medical applications [7, 13].

This paper is organized as follows. Section 2. A describes the problem statement. Section 3 summarizes the related work in this field. In section 4, a modified Apriori algorithm is proposed with experimental results and in the last section, conclusion and future directions are stated followed by section of references.

2.0 PROBLEM STATEMENT

The following is a formal statement of the association rule mining problem to be solved. Let $N = \{i_1, i_2, \dots, i_m\}$ be a set containing m items. A set of items $X \subseteq N$ is called an itemset and an itemset having k numbers of items is known as k -itemset. Let $D = \{T_1, T_2, \dots, T_n\}$ be a set containing n

transactions, where each transaction $T_j, 1 \leq j \leq n$, is a set of items such that $T_j \subseteq N$. There is a unique identifier, TID , related with each transaction. We can say that a transaction T_j contains an itemset X if $X \subseteq T_j$. A k -itemset is said to be frequent only if all its k items are in some minimum number of transactions. An association rule is an implication of the form $X \Rightarrow Y$, where $X \subset N, Y \subset N$ and $X \cap Y = \phi$. X is called antecedent and Y is called consequent; the rule means X implies Y . For a given set of transactions D , the problem of mining association rules is to generate all association rules that have certain user-defined minimum support, called *minsup*, and user defined minimum confidence, called *minconf*. Support of an association rule is defined as the ratio of the number of transactions that contain all the items of the set $X \cup Y$ to the total number of transactions in the database D , i.e., $support = \frac{|\{T_j \in D | X \cup Y \subseteq T_j\}|}{|D|}$. Confidence of an association rule is defined as the ratio of the number of transactions that contain all the items of the set $X \cup Y$ to the total number of transactions that contain all the items of the set X , i.e., $confidence = \frac{|\{T_j \in D | X \cup Y \subseteq T_j\}|}{|\{T_j \in D | X \subseteq T_j\}|}$. The problem of mining association rules is a two phase process. In first phase, all sets of items which occur with a frequency greater than or equal to the given minimum support are identified and in the second phase, all sets of rules that satisfy given minimum confidence are generated. All sets of items which satisfy minimum support are known as frequent itemsets and all sets of rules which satisfy minimum confidence are known as association rules. Here, the major cost of mining association rules is contributed by first phase only. It is for the reason that most of the researchers focused their investigations on identifying frequent itemsets.

To identify frequent itemsets Agarwal and Srikant [2] proposed an algorithm, called **Apriori**. It is a three steps process: joining, pruning and verification as shown in Table 1.1. In the first step of this algorithm, the k -frequent candidate itemsets are generated by using joining operation which is defined on two frequent itemsets as if $\{x_1, x_2, \dots, x_{k-2}, x_{k-1}\}$ and $\{x_1, x_2, \dots, x_{k-2}, y_{k-1}\}$ are two $k-1$ frequent itemsets and $x_{k-1} < y_{k-1}$ then joining operation will yield the following k -frequent candidate itemset $\{x_1, x_2, \dots, x_{k-2}, x_{k-1}, y_{k-1}\}$. In the second step, these k -frequent candidate itemsets are pruned to generate potential k -frequent itemsets whose all subsets containing $k-1$ items are frequent. In the third step, potential k -frequent itemsets are verified by scanning all transactions of database D for a given minimum support. These steps are repeated until large k -frequent itemsets are generated. Here, large k -frequent itemsets mean that value of k should be as large as possible. Apriori algorithm uses bottom-up approach to generate k -frequent itemsets, so, initially, it requires 1-frequent itemsets

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which can be generated by scanning all transactions of database D against all items of set N for a given minimum support. Prerequisite for the *Apriori* algorithm are: A set of transactions (D), minimum support (*minsup*) and 1-frequent itemsets (F_1).

3.0 RELATED WORK

The very first paper which directly addresses the problem of association rule mining was given by Agarwal *et al* [1]. Their research motivates the direction of enriching the database with more functionality to process those queries which can increase the sales of any retail market. In this paper an algorithm known as *AIS* (Agrawal, Imielinski, Swami) was proposed to answer those queries. In *AIS* algorithm potential candidate itemsets are generated and verified simultaneously during database scan. Drawback of this algorithm is that all the association rules are generated with only one item in their consequent, *i.e.*, if a rule $X \Rightarrow Y$ is generated then $|Y| = 1$.

Agarwal and Srikant [2] proposed a popular algorithm, called *Apriori*, which came out as revolution in this field. In this algorithm generation and verification steps are separated in two steps one after the other. Afterwards, research has been carried out to improve or extend the *Apriori* algorithm. The pruning method used in this algorithm is also used by Mannila *et al* [14].

An algorithm known as *DHP* used direct hashing and pruning technique which improved the *Apriori* significantly [18]. Alternately, Mueller [16] introduced prefix tree instead of hash tree.

A sampling approach was used by Toivonen [23]. The idea is to pick a random sample to determine the negative boundary that separate the large frequent itemsets from the small frequent itemsets and validate the results with the rest of database. Algorithm thus produces exact association rules in one full pass over the database. But if sample misinterprets the negative border then the whole process needs to be repeated.

Savasere *et al* [20] partitioned the database and generated all association rules by scanning the database two times only. Mueller [16] also used partition technique to generate the frequent itemsets.

A new method of overlapping generation and verification step is evolved by Brin *et al* [5]. In this method, Association rules are known as implication rules. These rules are based upon conviction instead of confidence. Here, conviction neither talks about the co-relation nor talks about the co-existence. Conviction gives equal importance to both antecedent and consequent of the rule. Moreover, it is unambiguous and measures actual implication. Because of these two features, implication rules are more interesting than association rules. Ahmed *et al* [4] elaborated and extended the direction of Brin *et al* [5].

Srikant and Agarwal [21] have carried out their research on interval data to generate quantitative association rules by measuring the value of each individual attributes greater than some expected value. Quantitative association rule can be like- 95% of the students who buy a lap-top and a book related to computers can also buy at least two pen-drives. But

methodology of Srikant and Agarwal gets fail when applied to interval data where separation between data values has some meaning [15].

Table 1: Apriori Algorithm

```

Apriori ( $D, \text{minsup}, F_1$ )
//  $D$  is a set of Transactions,  $\text{minsup}$  is the given
//minimum support,  $F_1$  is the collection of 1-frequent
itemset.
1.  $k = 2$ ;
//Step 1: (Joining):  $C_k$  is the collection of  $k$ -frequent
candidate itemsets.
2. while ( $F_{k-1} \neq \phi$ )
3. do  $C_k = \phi$ ;
4. for (each pair of itemset of type
 $\{x_1, x_2, \dots, x_{k-2}, x_{k-1}\} \in F_{k-1}$  and  $\{x_1, x_2, \dots, x_{k-2}, y_{k-1}$ 
5. do if ( $x_{k-1} < y_{k-1}$ )
// $Z$  is the new itemset of size  $k$ .
6. then  $Z = \{x_1, x_2, \dots, x_{k-2}, x_{k-1}, y_{k-1}\}$ ;
7.  $C_k = C_k \cup Z$ ;
//Step 2: (Pruning) -  $P_k$  is the collection of  $k$ -frequent
potential itemsets.
8.  $P_k = \phi$ ;
9. for (each candidate itemset  $Z \in C_k$ )
10. do if (each subset of  $Z$  containing
 $k - 1$  items  $\in F_{k-1}$ )
11. then  $P_k = P_k \cup Z$ ;
//Step 3: (Verification) -  $F_k$  is the collection of  $k$ -
//frequent itemset.
12.  $F_k = \phi$ ;
13. for (each potential itemset  $Z \in P_k$ )
//support() functions returns ratio of the number of
transactions that contain all the items of the set  $Z$  to the
total number of transactions in the database  $D$ .
14. do if ( $\text{support}(Z) \geq \text{minsup}$ )
15. then  $F_k = F_k \cup Z$ ;
//Value of  $k$  is increased to find large frequent itemsets.
16.  $k = k + 1$ ;
17. Print  $\bigcup_{i=1}^{k-2} F_i$ ;
    
```

Agarwal and Srikant [3] also focused on mining the sequential association rules which is a kind of navigation or noticing a generalized behavior followed. Here, rules can be like- 95% of the students who are buying a laptop; followed by buying a book related to computers; and followed by buying a pen drive it is observed that they can purchase an external mouse also.

Continuous association rule are those kinds of rules which are generated online. Hidber [10] investigated continuous association rules and provided flexibility to change given minimum support during first scan of database.

Due to update in database it may be possible that the large frequent itemsets may become small frequent itemsets and vice-versa. Therefore, association rules are kept maintained instead of generating a new set of rules [6].

Interesting information means knowing something unknown, covering a large portion of database, and potentially useful. Association rules generated at high levels are not interesting and association rules generated at low levels are not useful. Therefore, in order to get interesting and useful associations, multilevel association rules are generated by [9, 17, 22].

Concept of recursive median is used by [24, 25] which is a probabilistic approach to discover frequent itemsets. It does not consider all candidate itemsets with equal probability to be frequent itemsets.

Next section 4.1 and 4.2 demonstrates an example to explain the work carried out in this paper. Section 4.3 proposes the modified algorithm and section 4.4 shows the experimental results.

4.0 MODIFICATION OF APRIORI ALGORITHM

The modification applied to *Apriori* algorithm is exposed by taking following example.

4.1 Apriori algorithm with example:

Let $N = \{1,2,3, \dots, 10\}$ be a set of ten different types of items a customer can purchase. Let $D = \{T_1, T_2, T_3, \dots, T_{20}\}$ be a set of twenty independent transactions. Each transaction T_j have a transaction identifier, *TID*, and list of items purchased shown in Table 2 and let us fix user-defined minimum support, *i.e.*, $minsup = 5$. Frequency of each individual item purchased in database D is shown in Table 1.3.

It is easy to generate following 1-frequent itemsets $F_1 = (\{1\}, \{3\}, \{4\}, \{5\}, \{6\}, \{7\}, \{8\}, \{9\}, \{10\})$ by comparing the frequency of each item of Table 1.3 with the given minimum support. These itemsets have frequency greater than or equal to given minimum support.

Thereafter, *Apriori* algorithm’s first step is executed and following 2-frequent candidate itemsets are generated.

$$C_2 = \left(\begin{matrix} \{1,3\}, \{1,4\}, \{1,5\}, \{1,6\}, \{1,7\}, \{1,8\}, \{1,9\}, \{1,10\}, \{3,4\}, \{3,5\}, \\ \{3,6\}, \{3,7\}, \{3,8\}, \{3,9\}, \{3,10\}, \{4,5\}, \{4,6\}, \{4,7\}, \{4,8\}, \{4,9\}, \\ \{4,10\}, \{5,6\}, \{5,7\}, \{5,8\}, \{5,9\}, \{5,10\}, \{6,7\}, \{6,8\}, \{6,9\}, \\ \{6,10\}, \{7,8\}, \{7,9\}, \{7,10\}, \{8,9\}, \{8,10\}, \{9,10\} \end{matrix} \right)$$

In the second step, pruning is applied on the outcome of first step and following potential 2-frequent itemsets are generated.

$$P_2 = \left(\begin{matrix} \{1,3\}, \{1,4\}, \{1,5\}, \{1,6\}, \{1,7\}, \{1,8\}, \{1,9\}, \{1,10\}, \{3,4\}, \{3,5\}, \\ \{3,6\}, \{3,7\}, \{3,8\}, \{3,9\}, \{3,10\}, \{4,5\}, \{4,6\}, \{4,7\}, \{4,8\}, \{4,9\}, \\ \{4,10\}, \{5,6\}, \{5,7\}, \{5,8\}, \{5,9\}, \{5,10\}, \{6,7\}, \{6,8\}, \{6,9\}, \\ \{6,10\}, \{7,8\}, \{7,9\}, \{7,10\}, \{8,9\}, \{8,10\}, \{9,10\} \end{matrix} \right)$$

Table 2: Set of Transactions

Transaction	TID	Items Purchased	Transaction	TID	Items Purchased
T_1	101	{1,4,6,7, 8,9}	T_{11}	223	{3,7}
T_2	102	{1,3,4,5,6, 7,8,9}	T_{12}	507	{1,4,7, 8,9}
T_3	103	{3,4,6, 8,9}	T_{13}	345	{1,2,3,4,5, 9,10}
T_4	201	{1,4,6}	T_{14}	309	{1,4,6,7}
T_5	213	{1,5,7,8, 9,10}	T_{15}	316	{1,3,4,6, 8,9,10}
T_6	123	{3,4,6, 8,9}	T_{16}	224	{4,8,10}
T_7	205	{2,4,6,9}	T_{17}	508	{1,5,8,9}
T_8	234	{2,3,4,8}	T_{18}	346	{1,4,6,9,10}
T_9	301	{3,7,8}	T_{19}	356	{1,4,5,6,9}
T_{10}	306	{1,2,3,4, 6,7,9}	T_{20}	366	{1,4,6,9}

Table 3: Individual Items Frequencies

Item number	Frequency	Item number	Frequency
{1}	13	{6}	12
{2}	4	{7}	8
{3}	9	{8}	11
{4}	16	{9}	14
{5}	5	{10}	5

In third step, the frequencies of above itemsets present in the database D , shown in Table 4, are compared with given minimum support and following 2-frequent itemsets are generated.

$$F_2 = \left(\begin{matrix} \{1,4\}, \{1,5\}, \{1,6\}, \{1,7\}, \{1,8\}, \{1,9\}, \\ \{3,4\}, \{3,6\}, \{3,8\}, \{3,9\}, \{4,6\}, \{4,7\}, \{4,8\} \end{matrix} \right)$$

These itemsets are used to generate 3-frequent candidate itemsets in next iteration. All the above three steps are executed iteratively until the large k -frequent itemsets are generated. It is worth mentioning here that the following itemsets ($\{1,3\}, \{3,7\}, \{6,7\}$) are not 2-frequent because frequency of these itemsets is less than the fixed minimum support as shown in Table 1.4.

Table 4: 2-Frequent Itemsets Frequencies

Potential 2-Frequent Itemsets	Frequency	Potential 2-Frequent Itemsets	Frequency
{1,3}	4	{4,8}	8
{1,4}	11	{4,9}	12
{1,5}	5	{4,10}	4
{1,6}	9	{5,6}	2
{1,7}	6	{5,7}	2
{1,8}	6	{5,8}	3
{1,9}	11	{5,9}	5
{1,10}	4	{5,10}	2
{3,4}	7	{6,7}	4
{3,5}	2	{6,8}	5
{3,6}	5	{6,9}	9
{3,7}	4	{6,10}	2
{3,8}	f6	{7,8}	5
{3,9}	6	{7,9}	5
{3,10}	2	{7,10}	1
{4,5}	2	{8,9}	8
{4,6}	12	{8,10}	3
{4,7}	5	{9,10}	4

In the second iteration, following 3-frequent candidate itemsets and following 3-frequent potential itemsets are generated by first and second step respectively.

$$C_3 = \left(\begin{array}{l} \{1, 4, 5\}, \{1,4,6\}, \{1,4,7\}, \{1,4,8\}, \{1,4,9\}, \{1, 5, 6\}, \\ \{1, 5, 7\}, \{1, 5, 8\}, \{1,5,9\}, \{1, 6, 7\}, \{1,6,8\}, \{1,6,9\}, \\ \{1,7,8\}, \{1,7,9\}, \{1,8,9\}, \{3,4,6\}, \{3,4,8\} \\ \{3,4,9\}, \{3,6,8\}, \{3,6,9\}, \{3,8,9\}, \{4, 6, 7\}, \{4,6,8\}, \\ \{4,6,9\}, \{4,7,8\}, \{4,7,9\}, \{4,8,9\}, \{ 6,8,9\}, \{7,8,9\} \end{array} \right)$$

$$P_3 = \left(\begin{array}{l} \{1,4,6\}, \{1,4,7\}, \{1,4,8\}, \{1,4,9\}, \{1,5,9\}, \{1,6,8\}, \\ \{1,6,9\}, \{1,7,8\}, \{1,7,9\}, \{1,8,9\}, \{3,4,6\}, \{3,4,8\}, \\ \{3,4,9\}, \{3,6,8\}, \{3,6,9\}, \{3,8,9\}, \{4,6,8\}, \{4,6,9\}, \\ \{4,7,8\}, \{4,7,9\}, \{4,8,9\}, \{ 6,8,9\}, \{7,8,9\} \end{array} \right)$$

At this point, it is to be noted here that 3-frequent candidate itemsets {1,4,5}, {1,5,6}, {1,5,7}, {1,5,8}, {1,6,7} and {4,6,7} are bold faced. The reason for making itemsets bold faced will be discussed in part 3.2 of this section.

Frequency of the 3-frequent potential itemsets, shown in Table 1.5, is compared with given minimum support and following 3-frequent itemsets are generated.

$$F_3 = \left(\begin{array}{l} \{1,4,6\}, \{1,4,7\}, \{1,4,9\}, \{1,6,9\}, \{1,7,9\}, \\ \{1,8,9\}, \{3,4,6\}, \{3,4,8\}, \{3,4,9\}, \{3,6,9\}, \\ \{4,6,8\}, \{4,6,9\}, \{4,8,9\}, \{6,8,9\} \end{array} \right)$$

mentioning here that following itemsets $(\{1,4,8\}, \{1,6,8\}, \{1,7,8\}, \{3,6,8\}, \{3,8,9\}, \{4,7,8\}, \{4,7,9\}, \{7,8,9\})$ are not 3-frequent because frequency of these itemsets is less than minimum support. Similarly, in third iteration, following 4-frequent candidate

$$itemsets C_4 = \left(\begin{array}{l} \{1, 4, 6, 7\}, \{1,4,6,9\}, \\ \{1, 4, 7, 9\}, \{3, 4, 6, 8\}, \\ \{3,4,6,9\}, \{3, 4, 8, 9\}, \{4,6,8,9\} \end{array} \right);$$

followed by 4-frequent potential itemsets $P_4 = \left(\begin{array}{l} \{1,4,6,9\}, \\ \{3,4,6,9\}, \{4,6,8,9\} \end{array} \right);$ and then

followed by 4-frequent itemsets $F_4 = \left(\begin{array}{l} \{1,4,6,9\}, \\ \{3,4,6,9\}, \{4,6,8,9\} \end{array} \right)$ are

generated by first, second and third step respectively. At this point again, the significance of making the following 4-frequent candidate itemsets $(\{1, 4, 6, 7\}, \{1, 4, 7, 9\}, \{3, 4, 6, 8\}, \{3, 4, 8, 9\})$ bold faced

will be discussed in part 3.2 of this section. Frequency of 4-frequent potential itemsets is shown in Table 1.6. There will be no more 5-frequent candidate itemsets generated by *Apriori* algorithm for this example because none of two itemsets from

following 4-frequent itemsets $(\{1,4,6,9\}, \{3,4,6,9\}, \{4,6,8,9\})$ are possible

to join using joining operation in next iteration and therefore, *Apriori* algorithm terminates.

4.2 Alternate to *apriori's* pruning step

In section 3.1, it is observed that large *k*-frequent itemsets can be generated by modifying the second step of *apriori* algorithm. For this, not only *k*-frequent but *k*-infrequent itemsets are also generated in the third step of *Apriori* algorithm. Then, the output of the first step is filtered by taking help of all infrequent itemsets generated so far. It is obvious that this modification is applicable from second iteration onwards.

Continuing the discussion from part 3.1 of this section, in the first step of second iteration, bold faced 3-frequent candidate itemsets {1,6,7} and {4,6,7} and in the first step of third iteration, bold faced 4-frequent candidate itemset {1,4,6,7} are useless to generate because itemset {6,7} is not 2-frequent.

Similarly, {1,4,5}, {1,5,6}, {1,5,7}, {1,5,8} are useless to generate because {4,5}, {5,6}, {5,7}, {5,8} are not 2-frequent. By eliminating

{1,4,5}, {1,5,6}, {1,5,7}, {1,5,8}, {1,6,7} and {4,6,7} itemsets from 3-frequent candidate itemsets following 3-frequent potential itemsets are generated.

$$P_3 = \left(\begin{array}{l} \{1,4,6\}, \{1,4,7\}, \{1,4,8\}, \{1,4,9\}, \{1,6,8\}, \{1,6,9\}, \\ \{1,7,8\}, \{1,7,9\}, \{1,8,9\}, \{3,4,6\}, \{3,4,8\}, \{3,4,9\}, \\ \{3,6,8\}, \{3,6,9\}, \{3,8,9\}, \{4,6,8\}, \{4,6,9\}, \{4,7,8\}, \\ \{4,7,9\}, \{4,8,9\}, \{6,8,9\}, \{7,8,9\} \end{array} \right)$$

Similarly, bold faced itemsets ($\{1,4,7,9\}, \{3,4,6,8\}, \{3,4,8,9\}$) from the 4-frequent candidate itemsets are useless to generate because 3-frequent itemsets ($\{3,6,8\}, \{3,8,9\}, \{4,7,9\}$) are not 3-frequent. This process will result the following set as a 4-frequent potential itemsets $P_4 = (\{1,4,6,9\}, \{3,4,6,9\}, \{4,6,8,9\})$. This method of pruning advocates an alternative to pruning step of *apriori* algorithm. In this paper, this process of eliminating some or all itemsets from k -frequent candidate itemsets, using infrequent itemsets generated, is expressed as a “filtration” for first step of *Apriori* algorithm.

Table 5: 3-Frequent Itemsets Frequencies

Potential 3-Frequent Itemsets	Frequency	Potential 3-Frequent Itemsets	Frequency
{1,4,6}	9	{3,4,9}	6
{1,4,7}	5	{3,6,8}	4
{1,4,8}	4	{3,6,9}	5
{1,4,9}	8	{3,8,9}	4
{1,5,9}	4	{4,6,8}	5
{1,6,8}	3	{4,6,9}	10
{1,6,9}	7	{4,7,8}	3
{1,7,8}	4	{4,7,9}	4
{1,7,9}	5	{4,8,9}	6
{1,8,9}	6	{6,8,9}	5
{3,4,6}	5	{7,8,9}	4
{3,4,8}	5		

Table 6: 4-Frequent Itemsets Frequencies

Potential 4-Frequent Itemsets	Frequency
{1,4,6,9}	5
{3,4,6,9}	5
{4,6,8,9}	5

4.3 Modified apriori algorithm

A modified *Apriori* algorithm is proposed in Table 7. Filtration step is an alternate to the pruning step used in *Apriori* algorithm. Prerequisite for modified *Apriori* algorithm are same as with the *Apriori* algorithm.

This new pruning method is based upon following lemma.

Lemma: if any itemset Z is infrequent then none of its superset can be frequent.

Proof: Let Y be an itemset containing all the items of set Z and number of items in set Y is more than number of items in set Z , i.e., $Z \subset Y$. As if Z is infrequent, it can be stated that:-

$$Support(Z) < minsup \tag{1}$$

It is obvious that support of itemset Y can't be greater than support of any of its subset in a given database because cardinality of set Y is more than cardinality of set Z , i.e., $|Z| < |Y|$. It can be said that:-

$$Support(Y) \leq Support(Z) \tag{2}$$

Using property of associativity from equation “(1)” and “(2)” it can be stated that:-

$$Support(Y) < minsup \tag{3}$$

In other words set Y can't be frequent if it is superset of any set Z which is infrequent.

Table 7: Modified Apriori Algorithm

Apriori_Filter ($D, minsup, F_1$)
 // Dis a set of Transactions, $minsup$ is the given //minimum support, F_1 is the collection of 1-//frequent itemset.

1. $k = 2$;
- //Step 1: (Joining) - C_k is the collection of k -//frequent candidate itemsets.
2. **while** ($F_{k-1} \neq \phi$)
3. **do** $C_k = \phi$;
4. **for** (each pair of itemset of type $\{x_1, x_2, \dots, x_{k-2}, x_{k-1}\} \in F_{k-1}$ and $\{x_1, x_2, \dots, x_{k-2}, y_{k-1}\}$)
5. **do if** ($x_{k-1} < y_{k-1}$)
 //Z is the new itemset of size k .
6. **then** $Z = \{x_1, x_2, \dots, x_{k-2}, x_{k-1}, y_{k-1}\}$;
7. $C_k = C_k \cup Z$;
- //Step 2: (Filtration) - P_k is the collection of k -frequent potential itemsets and IF_k is the collection of k -infrequent itemset
8. $P_k = C_k$;
9. $IF_k = \phi$;
10. **for** (each infrequent itemset $Z \in \cup_{i=2}^{k-1} IF_i$)
11. **do if** ($Z \subset \{Y | \exists Y \in P_k\}$)
12. **then** $P_k = P_k - Y$;
13. $IF_k = IF_k \cup Y$;
- //Step 3: (Verification) - F_k is the collection of k -frequent itemset. $F_k = \phi$;
14. **for** (each potential itemset $Z \in P_k$)
15. **do if** ($support(Z) \geq minsup$)
16. **then** $F_k = F_k \cup Z$;
17. **else** $IF_k = IF_k \cup Z$;
- //Value of k is increased to find large frequent itemsets.
18. $k = k + 1$;
19. **Print** $\cup_{i=1}^{k-2} F_i$;

5.0 Experimental Results

Five experiments are performed on synthetic datasets generated as described by [2]. Each experiment is executed three times for both *Apriori* and proposed algorithm. Average time taken (in seconds) by both algorithm in each experiment is shown below in respect to minimum support value. Following parameters are set for each experiment.

1. Number of total transactions in database are 100000, *i.e.*, $|D| = 100K$, numbers of items are 100, *i.e.*, $|N| = 100$, average size of transactions is 5, *i.e.*, $|T| = 5$, average size of maximal potentially large itemsets is 2, *i.e.*, $|I| = 2$, value of *correlation level* is set to 0.5, number of maximal potentially large itemsets are 200, *i.e.*, $|L| = 200$, and value of minimum support is changed from 4% to 10% with a step increment of 1%. Results of this experiment are plotted in Figure 1.
2. Number of total transactions in database are 100000, *i.e.*, $|D| = 100K$, numbers of items are 100, *i.e.*, $|N| = 100$, average size of transactions is 5, *i.e.*, $|T| = 10$, average size of maximal potentially large itemsets is 2, *i.e.*, $|I| = 2$, value of *correlation level* is set to 0.5, number of maximal potentially large itemsets are 200, *i.e.*, $|L| = 200$, and value of minimum support is changed from 10% to 20% with a step increment of 1%. Results of this experiment are plotted in Figure 2.
3. Number of total transactions in database are 100000, *i.e.*, $|D| = 100K$, numbers of items are 100, *i.e.*, $|N| = 100$, average size of transactions is 5, *i.e.*, $|T| = 10$, average size of maximal potentially large itemsets is 4, *i.e.*, $|I| = 4$, value of *correlation level* is set to 0.5, number of maximal potentially large itemsets are 200, *i.e.*, $|L| = 200$, and value of minimum support is changed from 10% to 20% with a step increment of 1%. Results of this experiment are plotted in Figure 3.
4. Number of total transactions in database are 100000, *i.e.*, $|D| = 100K$, numbers of items are 100, *i.e.*, $|N| = 100$, average size of transactions is 5, *i.e.*, $|T| = 20$, average size of maximal potentially large itemsets is 4, *i.e.*, $|I| = 4$, value of *correlation level* is set to 0.5, number of maximal potentially large itemsets are 200, *i.e.*, $|L| = 200$, and value of minimum support is changed from 15% to 30% with a step increment of 3%. Results of this experiment are plotted in Figure 4.
5. Number of total transactions in database are 100000, *i.e.*, $|D| = 100K$, numbers of items are 100, *i.e.*, $|N| = 100$, average size of transactions is 5, *i.e.*, $|T| = 20$, average size of maximal potentially large itemsets is 6, *i.e.*, $|I| = 6$, value of *correlation level* is set to 0.5, number of maximal potentially large itemsets are 200, *i.e.*, $|L| = 200$, and value

of minimum support is taken 6%, 9%, 12%, 15%, 20%, and 25%. Results of this experiment are plotted in Figure 5.

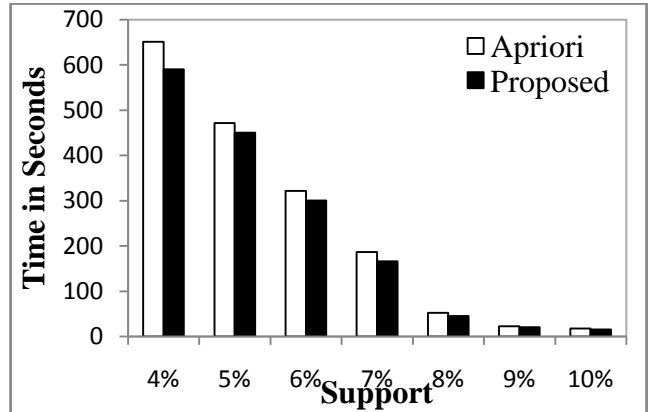


Figure 1: Apriori algorithm vs. Proposed algorithm for $|D| = 100000$, $|N| = 100$, $|T| = 5$, $|I| = 2$.

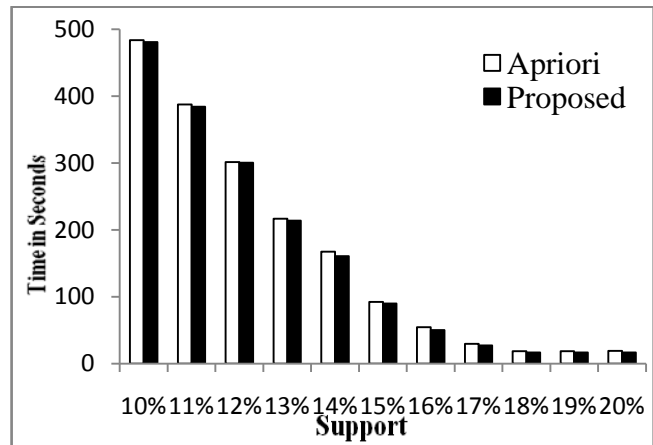


Figure 2: Apriori algorithm vs. Proposed algorithm for $|D| = 100000$, $|N| = 100$, $|T| = 10$, $|I| = 2$.

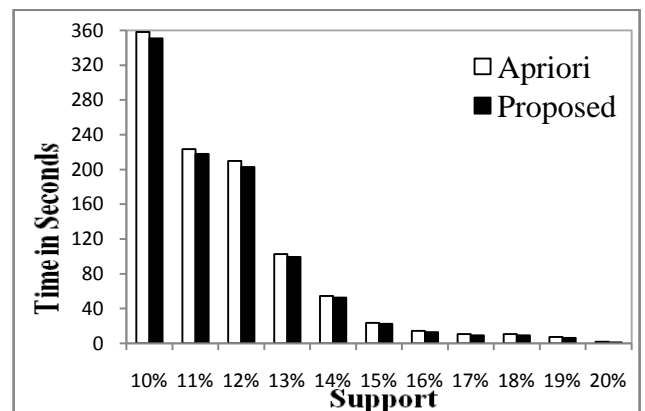


Figure 3 Apriori algorithm vs. Proposed algorithm for $|D| = 100000$, $|N| = 100$, $|T| = 10$, $|I| = 4$

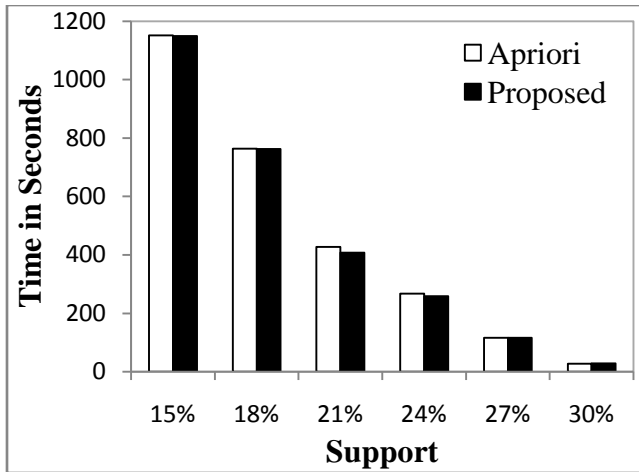


Figure 4: Apriori algorithm vs. Proposed algorithm for

$|D| = 100000, |N| = 100, |T| = 20, |I| = 4$

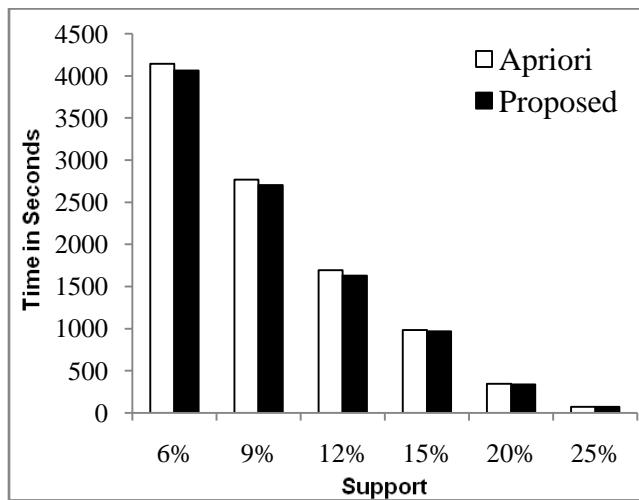


Figure 5 Apriori algorithm vs. Proposed algorithm for

$|D| = 100000, |N| = 100, |T| = 20, |I| = 6$

All experimental results show that proposed algorithm improves Apriori algorithm.

6.0 CONCLUSION AND FUTURE WORK

In this paper, a new pruning method is proposed as an alternate to pruning method of Apriori algorithm. This method is expressed as a filtration for joining operation of Apriori algorithm. By using this new method, same candidate k -frequent itemsets are generated as by the Apriori's pruning method. It is observed that proposed approach works as efficient as the existing method. In future, proposed pruning approach may be helpful in FP-Growth, Eclat algorithm.

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Design of Linear-Phase Digital FIR Filter Using Differential Evolution Optimization with an Improved Ripple Constraint Handling Method

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Abstract - For the optimal design of frequency-selective digital filters, evolutionary optimization algorithms have been applied. In these design methods the goal of the optimization process is to find the optimal filter coefficients which closely approximate the desired frequency response. In this paper, an efficient alternative method for the design of linear phase digital FIR filter with ripple constraint is discussed. This method of optimization uses DE algorithm with modified selection rule for ripple constraint handling. The results obtained using this method are compared with those obtained for another method of ripple constraint handling based on penalty function using DE algorithm. From the simulation results it is observed that ripple constraint handling method based on the modified selection rule of DE shows better performance than that obtained using DE with ripple constraint method based on penalty function when number of runs is applied.

Index Terms — Differential Evolution algorithm, FIR filters, Frequency response, Ripple constraint.

NOMENCLATURE

$H(e^{j\omega})$: The frequency response of a digital filter,
 $h(n)$: The impulse response of a digital filter,
 $A(\omega)$: The magnitude response,
 $\theta(\omega)$: The phase response,
 $a(k)$: The filter coefficients,
 $E(\omega)$: The approximation error function,
 $W(\omega)$: The weighting function,
 $D(\omega)$: The desired frequency response,
 $L_2(\bar{X})$: The discrete form of L_2 norm approximation error,
 \bar{X}_k : The k^{th} solution vector ,
 x_{kj} : The j^{th} component of the solution vector,
 F : The scaling factor,
 CR : The crossover factor.

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1.0 INTRODUCTION

Digital filters are recognized by great flexibility in design and implementation. This makes it is easier to implement complex signal processing schemes utilized in digital communication systems. The digital filters are classified according to the length of the impulse response as Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters [1]. Special features of the FIR filters are their inherent stability and precise linear phase. The phase response of the FIR filter is linear if the coefficients of FIR are symmetric around the centre coefficient. Linear phase FIR filters have many applications such as in telecommunications, for demultiplexing the data that have been frequency-division multiplexed, without distorting the data in this process, and in systems, where it is necessary to have minimum signal distortion and signal dispersion so as to avoid inter symbol interference.

In order to seek better control over different parameters in the design of digital filters, the design methods based on optimization algorithms are developed. Thus, Evolutionary algorithms (EA), such as Genetic algorithm (GA), Particle swarm optimization (PSO), and Differential evolution (DE) and many others have been used for better individual control over the parameters of digital filters. Generally, in these design methods, the unconstrained optimization is used. In this paper, DE algorithm is used for the design of linear phase digital FIR filter with two ripple constraint handling methods. One method is based on penalty function [2] and the other is based on a method proposed by Lampinen [3]. The simulation results obtained for these two methods show that when number of runs is applied, the ripples obtained in different frequency bands using the second method have smaller ripple size and smaller value of error as compared to those obtained for the first method. Thus a better performance is exhibited by the second method.

2.0 LITERATURE SURVEY

For the design of the digital FIR filters two classical methods are used namely, windowing method and frequency sampling method [4]. In general, an approximation error norm is used in these methods for designing an FIR filter. The two most commonly used norms are the least-squares (L_2) norm and Chebyshev (L_∞) norm.

In the design method based on windowing, the decrease in the transition bandwidth causes increase in the magnitude of the side lobes and consequently an increase in the approximation error. Also this method does not offer individual control over the approximation errors in different bands with any constraint criterion. The design method based on frequency sampling,

provides good control over the transition bandwidth; however, the approximation error is zero exactly at the sampling frequencies.

Recently, the design methods based on optimization algorithms are developed. Genetic Algorithm (GA) is one of the most useful, general purpose optimization algorithm [5]. GA has been used to solve a wide range of engineering design and testing optimization problems such as ATM network design [6], optimal testing of nonlinear allocation problems in modular softwares [7], etc. GA has also been applied for the design of digital FIR filters by Xu and Daley [8], Cen, [9] and others. Although GA is a good global searching algorithm, sometimes it gets trapped into the local minima, and is complex in coding. Also GA has slower convergence and takes more execution time.

Particle swarm optimization (PSO) algorithm developed by Kennedy and Eberhart [10] requires less parameters and is simple. PSO has been used for various engineering optimization problems such as, in malicious node detection and path optimization for wireless sensor networks [11]. PSO and its variants have also been applied for the design of digital filters [12]-[15]. It gives faster convergence as compared to GA as shown by Ababneh [12]. The modified PSO is applied by Sharma and Arya [13] for the design of linear phase digital FIR filter to control global exploration and local exploration.

Another optimization algorithm, Differential evolution (DE), developed by Storn and Price [16] has been used in power systems for optimization in planning, operation and distribution etc. [17]. DE has also been used for the design of digital FIR filters by Zhao and Meng [18], Albataineh et al. [19], Singh and Kaur [20], Sharma et al. [2] and others. DE algorithms provide good global optimization if its control parameters are adjusted properly. DE algorithm, with two ripple constraint handling methods, is used in this paper for the design of linear phase digital FIR filter. One method is based on penalty function [2], and another is based on the method proposed by Lampinen [3]. The comparison of the simulation results obtained for these two methods shows that the maximum error magnitude between desired frequency response and the designed frequency response is equal to or below the constraint in the specified frequency bands. However, when number of runs is applied, the ripples obtained in different frequency bands for the first method have almost constant magnitude; while the ripple size and final error value is less in the case of second method and thus a better performance is exhibited by this method.

This paper is organized in six sections as follows: In Section 3, Problem formulation of linear phase digital FIR filters is presented. Section 4 explains the DE algorithm for optimizing filter coefficients and describes the ripple constraint handling methods. In Section 5, design of linear phase FIR filters using DE with ripple constraint methods is given. Then, in Section 6, simulation results are discussed and analyzed. Finally, conclusion and future scope are discussed in Section 7.

3.0 PROBLEM FORMULATION

The frequency response of a linear-phase FIR filter is given by:

$$H(e^{j\omega}) = \sum_{n=0}^N h(n)e^{-jn\omega} \quad (1)$$

Where, $h(n)$ is the real-valued impulse response of filter, $(N+1)$ is the length of filter and ω is the frequency of interest. The linear phase is possible if the impulse response $h(n)$ is either symmetric {i.e. $h(n) = h(N - n)$ }, or, is antisymmetric { $h(n) = -h(N - n)$ } for $0 \leq n \leq N$.

In general, for causal linear-phase FIR filters, the frequency response $H(e^{j\omega})$ can be expressed as:

$$H(e^{j\omega}) = e^{-jn\omega/2} e^{j\beta} A(\omega) \quad (2)$$

Thus, the magnitude response is:

$$|H(e^{j\omega})| = A(\omega) , \quad (3)$$

& the phase response is:

$$\theta(\omega) = \begin{cases} -N \frac{\omega}{2} + \beta, & \text{for } A(\omega) \geq 0, \\ -N \frac{\omega}{2} + \beta - \pi, & \text{for } A(\omega) < 0. \end{cases} \quad (4)$$

When $\beta = 0$, $h(n)$ is symmetrical, and when $\beta = \pi/2$, $h(n)$ is antisymmetrical.

The amplitude response [1], for the case of type-I linear phase FIR filter, by substituting $N = 2M$, is given by:

$$A(\omega) = \sum_{k=0}^M a(k) \cos(\omega k), \quad (5)$$

where, $a(0) = h(M)$ and $a(k) = 2h(M - k)$, for $1 \leq k \leq M$.

For the design of low pass digital FIR filters, the objective of the algorithm used for computation, is to determine the vector \vec{X} of coefficients $a(k)$, so as to minimize the difference between the desired frequency response, $D(\omega)$, and the realized amplitude frequency response, $A(\omega)$. Generally this difference is specified as a weighted error function $E(\omega)$ given by:

$$E(\omega) = W(\omega)[A(\omega) - D(\omega)] \quad (6)$$

Where, $W(\omega)$ is a non-negative weighting function and is accepted for the given pass band attenuation δ_p and stop band attenuation δ_s , as:

$$W(\omega) = \begin{cases} (\delta_s / \delta_p), & \text{in the passband,} \\ 1, & \text{in the stopband.} \end{cases} \quad (7)$$

And $D(\omega)$, the desired magnitude response for the low pass filter given by:

$$D(\omega) = \begin{cases} 1, & \text{in the passband,} \\ 0, & \text{in the stopband.} \end{cases} \quad (8)$$

The least-squares, or, L_2 norm; which considers error energy, is defined in the integral form [2] as:

$$\|e\|_2 = \left(\frac{1}{\pi} \int_0^\pi |W(\omega)[A(\omega) - D(\omega)]|^2 d\omega \right)^{1/2} \quad (9)$$

In practice, the discretized version of integral scalar error used in L_2 norm is approximated by a finite sum given by:

$$L_2(\vec{X}) = \left(\sum_{i=1}^K |W(\omega_i)[A(\omega_i) - D(\omega_i)]|^2 \right)^{1/2} \quad (10)$$

Where, $L_2(\vec{X})$ is L_2 norm approximation error determined for a vector \vec{X} and ω_i is suitably chosen grid of digital angular frequencies for the range $0 \leq \omega \leq \pi$ for $1 \leq i \leq K$.

4.0 DE ALGORITHM

DE algorithm introduced by Storn and Price [16] is a simple population based stochastic search algorithm for objective function minimization. Application of DE for the design of digital filters has been described in [2], [18][19][20]. In basic DE algorithm, the initial NP population vectors are formed randomly from the vectors having bounded parameter values. Each of these vectors has D-parameters and belongs to a D-dimensional vector space. The optimization task is to successively improve these vectors by applying mutation, crossover and selection operators; similar to those used by GA. DE generates new solution vectors in the D-dimensional vector space using mutation. To produce mutated vector the weighted difference between two randomly chosen, distinct population vectors, is added to another distinct vector. Then crossover is performed to produce a trial vector from target vector and mutated vector. By evaluating objective function for target vector and trial vector, either one is then selected on the basis of their fitness.

4.1 The Steps of DE Algorithm

Step 1:

Initialization: An initial population of ‘NP’ solution vectors is generated as follows:

$$P^0 = [\vec{X}_1^0, \vec{X}_2^0, \dots, \vec{X}_{NP}^0] \quad (11)$$

Where, P^0 is the initial population of solution vectors, \vec{X}_i^0 , for $1 \leq i \leq NP$ given by:

$$\vec{X}_i^0 = [x_{i1}^0, x_{i2}^0, \dots, x_{iD}^0] \quad (12)$$

The j^{th} component, or parameter, x_{ij}^0 , for $1 \leq i \leq NP$, $1 \leq j \leq D$, is obtained from uniform distribution as follows:

$$x_{ij}^0 = x_j^L + (x_j^U - x_j^L) * rand_j, \quad (13)$$

Where, x_j^L and x_j^U are lower and upper bounds on parameter x_j and $rand_j$ is a random number in the range [0, 1].

Step 2:

Mutation: A mutant vector in the generation (G + 1) is created for each population vector by mutation:

$$\vec{V}_i^{G+1} = [v_{i1}^{G+1}, v_{i2}^{G+1}, \dots, v_{iD}^{G+1}] \quad (14)$$

In this paper DE/best/1/bin is implemented for the design of FIR digital filter, hence a single difference of vectors is utilized. In DE/best/1/bin, a mutant vector \vec{V}_i^{G+1} is generated for each target vector \vec{X}_i^G by adding a weighted difference

between two randomly selected distinct population vectors, \vec{X}_{r1}^G and \vec{X}_{r2}^G , to the best vector \vec{X}_{best}^G as follows:

$$\vec{V}_i^{G+1} = \vec{X}_{best}^G + F(\vec{X}_{r1}^G - \vec{X}_{r2}^G) \quad (15)$$

Where, \vec{V}_i^{G+1} is a mutant vector, \vec{X}_{best}^G is the best vector of the current population which gives the lowest cost function value; $r1$ and $r2$ are randomly chosen integers such that $r1, r2 \in \{1, 2, \dots, NP\}$, $r1 \neq r2$; and F is a real and constant scaling factor which usually lies in the range [0, 1].

Step 3:

Crossover: To increase the diversity of population, crossover operation is used. This operation causes crossover or exchange of parameters of mutant vector with those of the target vector and generates trial vector \vec{T}_i^{G+1} given by:

$$\vec{T}_i^{G+1} = [t_{i1}^{G+1}, t_{i2}^{G+1}, \dots, t_{iD}^{G+1}] \quad (16)$$

In the binomial crossover scheme, uniform crossover is performed as follows:

$$t_{ij}^{G+1} = \begin{cases} v_{ij}^{G+1}, & \text{if } (rand_j \leq CR \text{ or } j = j_{rand}) \\ x_{ij}^G, & \text{if } (rand_j > CR \text{ and } j \neq j_{rand}) \end{cases} \quad (17)$$

Where, t_{ij}^{G+1} is j^{th} component of trial vector \vec{T}_i^{G+1} , v_{ij}^{G+1} is j^{th} component of mutant vector \vec{V}_i^{G+1} and x_{ij}^G is j^{th} component of target vector \vec{X}_i^G . $rand_j$ is the j^{th} evaluation of the random number in the range [0, 1]. CR is the crossover constant in the range [0, 1] and j_{rand} is randomly chosen index within the range [1, D]. As shown above, the trial vector component is adopted from the mutant vector \vec{V}_i^{G+1} , if the random number $rand_j$ is less than or equal to CR, or j is equal to index j_{rand} . Otherwise, the trial vector component is adopted from target vector \vec{X}_i^G . The index j_{rand} ensures that the trial vector \vec{T}_i^{G+1} contains at least one parameter from mutant vector \vec{V}_i^{G+1} and does not duplicate the target vector.

Step 4:

Selection: In order to decide whether trial vector \vec{T}_i^{G+1} , or, the target vector \vec{X}_i^G , is to be selected as the member of population vectors in next generation G + 1, the objective function is evaluated for target vector and trial vector. If the trial vector gives a smaller value of objective function, then this vector replaces the target vector for the next generation; otherwise, the old target vector is retained as follows:

$$\vec{X}_i^{G+1} = \begin{cases} \vec{T}_i^{G+1}, & \text{if } f(\vec{T}_i^{G+1}) \leq f(\vec{X}_i^G), \\ \vec{X}_i^G, & \text{otherwise.} \end{cases} \quad (18)$$

The process of mutation, crossover and selection is executed for all target vector index i and new population is created till

the optimal solution is achieved. The procedure is terminated if maximum number of generations has been executed.

4.2 Bounce Back Technique for Handling Bounds on Parameters of Mutant Vector:

In the process of generating mutant vector, some of the components of this vector may cross the lower or upper bounds. In such cases bounce back mechanism [17] is adopted to bring such elements of the mutant vector within limit. In this method the element, which has violated the limits, is replaced by a new element whose value lies within the best vector value and the bound being violated. The following relations are used for violated mutant vector elements:

$$v_{ij}^{G+1} = \begin{cases} x_{best,j} + rand \cdot (x_j^L - x_{best,j}), & \text{if } v_{ij}^{G+1} \leq x_j^L \\ x_{best,j} + rand \cdot (x_j^U - x_{best,j}), & \text{if } v_{ij}^{G+1} > x_j^U \end{cases} \quad (19)$$

Where, v_{ij}^{G+1} is j^{th} element of mutant vector, \bar{V}_i^{G+1} , $x_{best,j}$ is j^{th} element of the best vector, \bar{X}_{best}^G and x_j^L, x_j^U are lower and upper bounds on parameter x_j respectively and $rand$ is a random number in the range [0, 1].

4.3 Ripple Constraint Handling methods:

In this paper two methods are used for ripple constraint handling. First we have discussed the method based on penalty function used by Sharma et al. [2]. Another method is based on modified selection rule as proposed by Lampinen [3].

4.3.1 Method # 1: Method Based on Penalty Function:

This method is based on penalty function, which penalizes infeasible frequency response ripple values obtained in the pass band and stop band. Thus, for a vector \bar{X} , the objective function with ripple constraint $J_2(\bar{X})$ is developed as follows:

$$J_2(\bar{X}) = c_L L_2(\bar{X}) + c_p \delta_p(\bar{X}) + c_s \delta_s(\bar{X}), \quad (20)$$

with $c_L + c_p + c_s = 1$.

Where, c_L, c_p and c_s are suitable weight parameters for $L_2(\bar{X})$, $\delta_p(\bar{X})$ and $\delta_s(\bar{X})$ respectively. $\delta_p(\bar{X})$ and $\delta_s(\bar{X})$ are the maximum pass band and stop band ripples given as follows:

$$\delta_p(\bar{X}) = \max_{\omega_i \in \text{Passband}} |1 - A(\omega_i)| \quad (21)$$

$$\delta_s(\bar{X}) = \max_{\omega_i \in \text{Stopband}} [A(\omega_i)] \quad (22)$$

Where, $A(\omega_i)$ is the magnitude of the frequency response of the filter, defined earlier in (3), for the suitable set of frequencies ω_i .

4.3.2 Method # 2: Method Based on Modified Selection Rule of DE:

The penalty function method uses additional control parameters, which are termed as the weight parameters. Setting the weight (or, penalty) parameters for getting their appropriate values by trial and error method, is a laborious task. The penalty function method effectively converts a constrained

problem into an unconstrained one as shown by Lampinen [3]. This is seen from Equation (20) where, objective function $J_2(\bar{X})$ is used instead of $L_2(\bar{X})$.

In this subsection an improved version of constraint handling method used by Lampinen [3] is described. It allows to get rid of setting of the weight parameters for individual constraints. In this method, only the selection operation of the basic Differential Evolution algorithm is modified, for handling the ripple constraints. The selection criteria of Equation (18) to select either trial vector \bar{T}_i^{G+1} or, target vector \bar{X}_i^G for the next generation vector \bar{X}_i^{G+1} is changed as follows:

- If both solution vectors satisfy all ripple constraints, then the one with lower objective function value is selected, OR,
- If target vector satisfies all ripple constraints, while trial vector does not satisfy, and if target vector also has lower objective function value then it is selected, OR,
- If target vector does not satisfy all ripple constraints but provides lower or equal value for all ripple constraints as compared to the trial vector, and also if target vector has lower objective function value then it is selected.
- Else, trial vector is selected.

5.0 DESIGN OF LINEAR PHASE FIR FILTERS USING DE WITH RIPPLE CONSTRAINTS

This section is divided into two subsections. Subsection 5.1 describes the specifications of the digital low pass FIR filter. The design parameters of DE algorithm with ripple constraints for Method # 1 and Method # 2 are discussed in subsection 5.2.

5.1 Specifications of The Digital Low Pass FIR Filter Designed:

Type-I linear phase FIR filter is designed with the filter length taken as $N+1 = 31$, and the grid of digital angular frequencies as $K = 180$. The cut-off frequency of the pass band is $\omega_p = 0.3\pi$ and cut-off frequency of the stop band is $\omega_s = 0.4\pi$. The desired ideal frequency response $D(\omega)$ has unity gain in the pass band and zero gain in the stop band and is given by:

$$D(\omega) = \begin{cases} 1, & 0 \leq \omega \leq 0.3\pi \\ 0, & 0.4\pi \leq \omega \leq \pi \end{cases} \quad (23)$$

For passband attenuation $\delta_p = 0.06$ and stopband attenuation $\delta_s = 0.06$, the weighting function $W(\omega)$ used, is given by:

$$W(\omega) = \begin{cases} (\delta_s / \delta_p) = 1, & \text{in the passband} \\ 1, & \text{in the stopband} \end{cases} \quad (24)$$

5.2 Design Parameters of Differential Evolution Algorithm with Ripple Constraint for Method # 1:

For applying DE with ripple constraint for obtaining the coefficients of the filter, $a(k)$; the size of each solution vector, \bar{X} , is taken as $D = M + 1 = 16$. The scaling factor F

and crossover constant CR used are taken as, $F = 0.5$ and $CR = 0.7$. The population size is taken as $NP = 50$. The numbers of generations used are 200. The weight parameters c_L , c_p and c_s used in the objective function of (20) are arbitrarily set as 0.0006, 0.2894 and 0.71 respectively so as to reject larger values of objective function for larger size of ripples. It is observed that the amplitudes of the ripples are larger in the stop band, so more weight is assigned to c_s as compared to c_p .

5.3 Design Parameters of Differential Evolution Algorithm with Ripple Constraint for Method # 2:

There is no specific parameter used for ripple constraint handling Method # 2. All other parameters of DE algorithm are kept same as mentioned in the subsection 5.2.

6.0 SIMULATION RESULTS AND ANALYSIS

The summary of the parameters obtained for the best of 30 runs, for Type-I FIR low pass filter (LPF) design, using DE with ripple constraint Method # 1 and Method # 2, is shown in the TABLE-1 and TABLE-2 for the time-domain and the frequency domain respectively. In TABLE-3, the statistical parameters obtained for the two cases are compared.

In Fig. 1, the error plots for the best run of the two cases are shown. The frequency responses obtained for the filter design using DE with ripple constraint methods are compared in Fig. 2. It is observed from Fig. 1, that the absolute value of error obtained for Method # 2 is lower than that obtained for Method # 1. This fact is also exhibited in TABLE-3.

By comparing the frequency responses in Fig. 2, it is observed that ripple constraint handling Method # 2 shows a better frequency response as compared to Method # 1. It is also observed that the stop band attenuation is decreased further with the increase in frequencies in the case of Method # 2. Finally, from the TABLE-3 it is observed that the frequency of convergence of Method # 2 is higher than that of Method # 1;

Table 1: Time-Domain Parameters

DE with ripple constraint Method # 1	DE with ripple Constraint Method # 2
Impulse response h(n)	Impulse response h(n)
h(0) = - 0.0033 = h(30)	h(0) = - 0.0058 = h(30)
h(1) = 0.0081 = h(29)	h(1) = 0.0025 = h(29)
h(2) = 0.0170 = h(28)	h(2) = 0.0104 = h(28)
h(3) = 0.0090 = h(27)	h(3) = 0.0071 = h(27)
h(4) = - 0.0080 = h(26)	h(4) = - 0.0051 = h(26)
h(5) = - 0.0226 = h(25)	h(5) = - 0.0201 = h(25)
h(6) = - 0.0104 = h(24)	h(6) = - 0.0136 = h(24)
h(7) = 0.0229 = h(23)	h(7) = 0.0154 = h(23)
h(8) = 0.0356 = h(22)	h(8) = 0.0367 = h(22)
h(9) = 0.0120 = h(21)	h(9) = 0.0195 = h(21)
h(10) = - 0.0412 = h(20)	h(10) = - 0.0385 = h(20)
h(11) = - 0.0708 = h(19)	h(11) = - 0.0717 = h(19)
h(12) = - 0.0167 = h(18)	h(12) = - 0.0195 = h(18)
h(13) = 0.1316 = h(17)	h(13) = 0.1250 = h(17)
h(14) = 0.2804 = h(16)	h(14) = 0.2839 = h(16)
h(15) = 0.3493	h(15) = 0.3535

however, the value of standard deviation obtained for Method # 2 is larger.

Table 2: Frequency-Domain Parameters

Parameter	DE with ripple constraint Method # 1		DE with ripple constraint Method# 2	
	Pass Band	Stop Band	Pass Band	Stop Band
Lower Band Edge	0.0000	0.4000 π	0.0000	0.400 π
Upper Band Edge	0.3500 π	1.0000 π	0.3500 π	1.000 π
Desired Value: D(ω)	1.0000	0.0000	1.0000	0.0000
Maximum ripple	0.0243	0.0231	0.0229	0.0226
Maximum ripple (dB)	0.2087	- 32.70	0.1972	- 32.88
Minimum ripple	0.0010	0.0057	0.0010	0.0022
Minimum ripple (dB)	0.0094	- 44.78	0.0091	- 52.81

Table 3: Statistical Parameters of DE With Ripple Constraint Method # 1 And Method # 2 for the Low Pass Filter

(Number of runs = 30; Number of generations = 200; Population Size = 50.)

Sr. No.	Parameters	DE with ripple constraint Method # 1	DE with ripple constraint Method # 2
1	Best fitness value of error of all runs	0.2711	0.1552
2	Average value of minimum error of all runs	0.4599	0.3174
3	Worst minimum value of all runs	0.9015	0.7021
4	Standard deviation of minimum error from average	0.1389	0.1440
5	Frequency of convergence*	0.5000	0.6000

*(Frequency of convergence = number of better fitness values than mean out of all runs / total no. of runs)

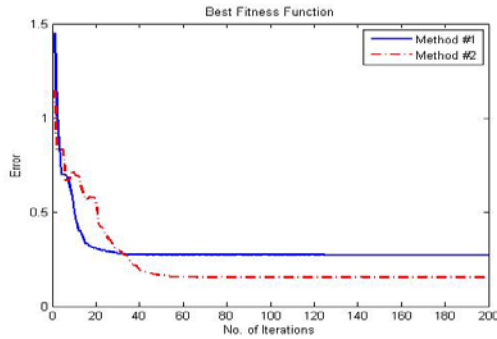


Figure 1: Error plots of Type-I FIR LPF obtained using DE with ripple constraint Method # 1 and Method # 2.

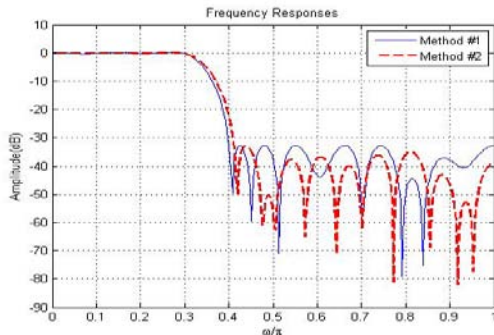


Figure 2: Comparison of Magnitude Frequency responses of Type-I FIR LPF for DE with ripple constraint Method # 1 and Method # 2.

7.0 CONCLUSION AND FUTURE SCOPE

In this paper an efficient alternative method for the design of linear phase digital FIR filter with ripple constraint is discussed. This method of optimization of the filter coefficients uses DE algorithm with modified selection rule for ripple constraint handling. The results obtained using this method are compared with those obtained for another method of ripple constraint handling based on penalty function. From the simulation results it can be concluded that ripple constraint handling method based on the modified selection rule of DE shows better performance than that obtained using DE with ripple constraint method based on penalty function. Thus this method is seen as an efficient alternative method for ripple constraint handling with DE algorithm for FIR filter design. In future the population size of the DE algorithm can be varied and statistically better results are expected.

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A Novel Model for Security and Data Access for Jointly Accessing the Cloud Service

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Abstract - Cloud computing is a set of resources and services offered by Internet. It provides all kinds of services for end user. One of the most important services provided by cloud computing is an Email (Data Storage and File Sharing). Employees or any Committee of Institution are very interested in sharing documents with group members. There is possibility of creating one group to share information with all. So, in everybody's registered email id, they will get notification for it. Here, everybody have their own mail id. In this research paper, a model is discussed which allow one email id and two users sharing same Email id. This mechanism is like Joint access of single bank account between two members.

Index Terms – Cloud Computing, Cloud services, User Access Control, Joint Access of Cloud data

1.0 INTRODUCTION

Nowadays different state governments and central government have taken initiative to successfully implement E-Governance in various areas of Service applying Information and communication Technology to provide better transparency, Accuracy and Security of its Services to the citizens [9]. The current commercial Systems are aimed mainly at governments and corporations with high security requirements [10]. Internet continues to grow and bulk of information is transferred between individuals. Evolution of smart phone and tablets make more usage of cloud services. All these technological developments provide new business model which is known as cloud computing. Main idea behind a cloud is to provide on demand service with high reliability, scalability and availability in distributed environment. Cloud computing entrusts remote services with user's data, software and computation. Thus it is just like using some applications or facilities by not directly installing in devices as we normally do. This system is remote version of remote access [8].

National Institute of Standards and Technology (NIST) defines Cloud computing as:

“Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage,

Applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

This cloud model promotes availability and is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured Service); three service models (Cloud Software as a Service (SaaS), Cloud Platform as a Service (PaaS), Cloud Infrastructure as a Service (IaaS)). There are four deployment models (Private cloud, Community cloud, Public cloud, Hybrid cloud). Key enabling technologies include: fast wide-area networks, powerful and inexpensive server computers and high-performance virtualization for commodity hardware.”[1]

Cloud service is any resource that is provided over the Internet [2]. According to NIST, a cloud model is composed of three service models – IaaS, PaaS and SaaS.

1.1 Infrastructure as a Service (IaaS)

This is considered as a first layer of Cloud computing. Using this service model, you manage your operating systems, data, applications, middleware and runtime. IaaS allows you to easily scale based on your requirements and you only pay for the resources which you used. This means that extra data processing space is available to you whenever you need it, and when you don't need it then don't pay for it.

1.2 Platform as a Service (PaaS)

This layer provides developer the flexibility to make application on the provider's provided platform. It's fully virtualized platform that includes one or more operating systems, servers and also specific applications. Main features offered by PaaS are flexibility, scalability and database. E.g. Google app engine, Amazon web services s3 etc...

1.3 Software as a Service (SaaS)

This layer delivers single software to multiple clients on demand via web browser over Internet. So, Software as a Service consists of a software running on the provider's cloud infrastructure. E.g. Google docs, salesforce.com etc...

2.0 LITERATURE SURVEY

People use cloud because it provides on-demand services with high reliability, scalability and availability in distributed environment. Here, in this research paper, we start with survey of major cloud providers and Authentication Techniques adopted by various providers. After extensive literature survey related to cloud security, we finally proposed a model related to “Joint Access of Cloud Data” which is explained in this paper.

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2.1 Examples of Cloud Service Providers

There are many features of cloud computing. Cloud storage providers like Amazon S3, Microsoft SkyDrive, and DropBox permit consumers to access data online. Second feature is, it provides computation resources for users such as amazon EC2. Third, Google apps or versioning repositories for source code are examples of online collaboration tools.

Cloud service providers should ensure the security of their customer's data and should be responsible if any security risk affects their customers' service infrastructure. [5] Cloud providers must ensure that the information Security Systems they provide are responsive to customer requirements and the data, both primary and secondary, must be preserved as authentic and reliable [11].

- Several vendors with cloud offerings stand to benefit from this trend. Many of these vendors – Amazon, IBM, Microsoft etc. have established cloud products and have been active in this space for number of years.

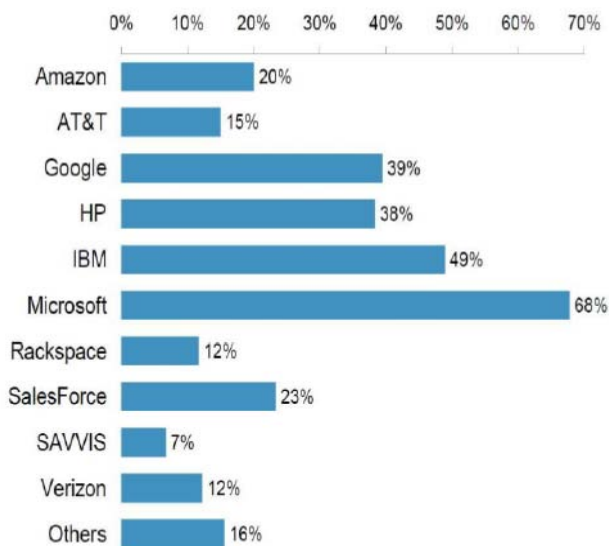


Figure 1: Major Cloud Vendor Used in 2012^[6]

From above Figure 1, we can observe that Microsoft is likely to gain most from a broader adoption of the cloud. Of all respondents, 68% of all respondents who expect to move workloads or provision new ones to the cloud environment mention Microsoft as their preferred vendor of choice [6]. Report Published in 2014 says that in Microsoft's Storage – OneDrive, If Privacy is major Concern then it should be noted that Microsoft reserve the right to scan your files to look for what it would deem Objectionable Content. This could be copyrighted Material or things of an explicit nature. Apple has similar policy, making the two potentially more intrusive than their competitors [12].

3.0 TECHNIQUES FOR USER ACCESS CONTROL

3.1 Username and Password

Unique username is provided to user for accessing services. For security purpose, password is a powerful mechanism if you

choose your password unhackable. Unhackable password is combination of Alpha-numeric characters, special symbols and difficult to imagine by intruder too. It is also known as one factor authentication.

3.2 Two Factor Authentication

Username and passwords are not enough to secure your online data. Two factor authentications must have feature for any successful and popular service to protect it against password phishing, hacking and account hijacking. [3] There are several solutions i.e. One Time Password (OTP), Authenticator app, SMS and email codes, Security questions, Device recognition etc. which are not costly and secure enough too.

3.3 Biometrics Verification

Biometric Verification enables identification based on “who you are”. Every person has distinguishing and measurable physical traits. Personal recognition based on unique physical attributes forms a powerful tool for identity management. Other ways of verifying authorization include “what you have” (a key, a swipe card) and “what you know” (a password, your mother's maiden name). Biometrics is the only mode of authentication that uses “who you are” for verification. [4]

4.0 PROPOSED TECHNIQUE AS “JOINT ACCESS OF CLOUD DATA”

“Ad hoc networking” is popular, which allows device to establish communication, anytime, anywhere without the aid of a central infrastructure [7]. Today, many people carry numerous portable devices, such as laptops, mobile phones, PDAs and MP3 players, for use in their professional and private lives. For the most part, these devices are used separately i.e. their applications do not interact.

Now imagine, however if they could interact directly. Participants at a meeting could share documents or presentations; all communication could automatically be routed through the wireless corporate campus network [7]. So, like sharing documents and all these things if happen via single mail id with separate password mechanism then how much it will be helpful to circulate information between groups of students and participants or user. So, Proposed model follow somewhat same concept i.e With Single Shared Mail ID user can access shared data by their personal password mechanism. Generally single user has single id and single password to access cloud service. But in proposed model, user id will be single and passwords will be infinite.

Following Simple Steps shows how our proposed model will work to access jointly accessing cloud based data:

- Step 1: Input User ID and Password.
- Step2: System will compare (by password) about which user want to access cloud data.
- Step 3: System will forward Barcode image File to registered email id of Particular user.
- Step 4: User will provide correct barcode image file
- Step5: System will check that verification of correct barcode

file upload or not?

Step 6: If step 5 is correct then User can access cloud based data otherwise he will perform again from step 1.

Above 5 steps are explained in Figure 2 which shows flow to retrieve data from cloud. Here, multifactor authentication is applied on cloud.

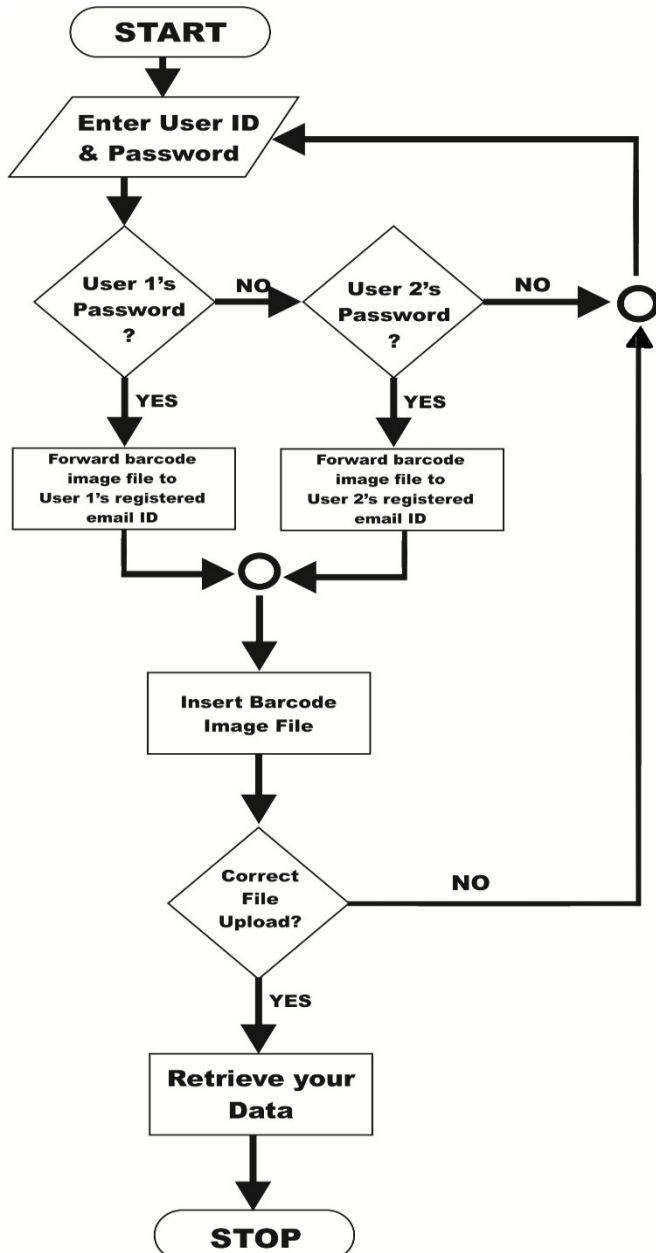


Figure 2:Flowchart of “Joint Access of Cloud Data”

From Figure 2 we can see that, to access any cloud service or data, user needs to enter their Id and Password. In this model, User Id will be shared between multiple users and each user will have their own password. So, when user will enter their user Id and password, web service will check that entered

password is of which user. E.g. If Id phd101@exampleuni.ac.in is shared between guide and Ph.D. scholar.

We assume that Guide’ password is “guide101” and Ph.D. scholar’s Password is “student101”. So web service will check that which password is entered by user. If User entered “guide101” then barcode image file will be sent to registered email id of guide. If User entered “student101” then barcode image file will be sent to registered email id of Ph.D. scholar. This registered email id is personal Id of each user. If password is wrong, then web service will assume that user is not valid. So again user will need to enter valid id and password for accessing cloud data.

After accessing barcode image file, user will import that barcode image file (.jpeg) and if that code is valid for that user then that user will access their data. If uploaded file is not valid then user will not be able to access their data.

Sometimes it may happen that “Example University” want to share their Exam schedule between guide and student then they will just mail on jointly access mail id which is phd101@exampleuni.ac.in.

Whenever guide or student needs to access this account they will enter joint id and their own password. If they forget their password then they can request their admin to send reset password link into their registered email id.

4.1 Advantages and Disadvantages of Proposed Model

Advantages

- It is not costly compare to other high security methods.
- This model reduces number of email ids. (I.e. sharing of email id reduces numbers of email ids).
- This model is easy to implement.
- It provides high security then single factor authentication.
- Barcode cannot be altered or predicted by human being. So, if text based security is provided to user then code can be altered by human being intentionally or unintentionally.
- This model is reliable.
- Any organization or person can share data with multiple users having same id and different passwords.

Disadvantages

- Sometimes user may feel bore to upload and download barcode image file.
- Many times users don’t like to have same email id.
- Network overhead will be increased compare to Present System of 2 Step Verification.

5.0 CONCLUSION AND FUTURE WORK

In this paper, three main cloud service models are described. Data security is big hurdle in cloud. It is cloud provider’s duty to keep user’s data safely. This model is helpful to those organizations where single cloud based data need to be shared between multiple users. But, sharing should be securely. These users can be of same field, same region or from same caste or community. Here, multifactor authentication is used to add

second layer of security while sharing data with people.

This model is one of the small steps from our side to enhance cloud security and accessing jointly access of cloud based data. Presently we had proposed this model, but in near future we have plan to test this proposed model on live cloud.

6.0 ACKNOWLEDGEMENT

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Predictive Estimates of Employees' Intelligence at Workplace with Special Reference to Emotional and Spiritual Intelligence

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Abstract - *The piece of writing investigates the relationship between employees' emotional and Spiritual intelligence. A conversation of spirituality and emotions within the workplace can be an unthinkable topic. However, emotional intelligence and spiritual intelligence are, at present, more widely acknowledged. Drawing a research connected with these construct we suggest that emotional intelligence within the employees in organisations may provide employees with a medium to better understand and mix spiritual experiences within their work. Study further explain that spiritual intelligence in employees also simultaneously improve the expression of emotional intelligence at work because result shows that emotional and spiritual intelligence are significantly and positively correlated to each other. Also by doing regression analysis, taking emotional intelligence as dependent variable or spiritual intelligence as independent variable and vice-a-versa model revealed that spiritual intelligence predict approximately 80 percent of emotional intelligence of employees and emotional intelligence predict approximately 51 percent of spiritual intelligence whereas another 49 percent due to another factors which are not explained in the study.*

Index Terms – *Intelligence, Emotional Intelligence, Spiritual Intelligence, Employee, Workplace.*

1.0 INTRODUCTION

In any of the organization, for educators, experts, corporate instructors, recruiters, managers there are some reasons for their extra performance apart from average performance. It is not the scientific skills, it is not intelligence either rather it is something else that cannot be defined in words i.e. personnel skills. In literary terminology intelligence can be understood as one's capacity for learning, reasoning and understanding. Here in the similar forms of mental activity; aptitude in grasping truths, relationships, facts, meanings may also be included. After talking a long time about personnel skills in organizations our approach to examine what makes people shine at workplace indicates that we can replace these personal skills with objective and measurable terms i.e. emotional and spiritual intelligence. There are few of emotional intelligence and spiritual competences that have been related with success

in job. Earlier researchers have discovered that emotionally healthy individuals are better learners, better at resolved conflicts, a reduced amount of aggressive and added understanding, feel better about themselves, have better desire control, are less involve in destructive behavior also have few problems related to behavior. For employees, emotional intelligence offers an essential foundation for developing the skills of effective independent learning and personal development. Spirituality survives in the hearts and minds of individual everywhere, within religious traditions and independently of traditions. Spirituality defines as the field of final concern, and then everyone is spiritual because everyone has ultimate concerns which can be understand in different ways. The investigations into spiritual intelligence suggested that it is one of several types of intelligence and that it can be developed relatively independently. Spiritual intelligence also helps to knowing others. It can be refined through searching, questioning, and practice.

Emotional Intelligence (EI) has come to mean many things to many different people. For some people, it is about being a nice people whereas other people see it as a dilemma and they find it hard to believe that emotions can be intelligent. Emotional intelligence is indication as a predictor of success in a number of life domains, including work Goleman¹ who conceptualized emotional intelligence as the capacity for recognizing our own feelings and those of others, for motivating ourselves and for managing emotions well in ourselves and our relationship. Individuals first notice the term "emotional intelligence" around 1995 with the publication of Daniel Goleman's best-selling book Emotional Intelligence who laid out a powerful case that such factors as self-awareness, self-discipline, and empathy determine personal and professional success. Based on BarOn's [2] work, "emotional intelligence is an array of non-cognitive capabilities, competencies and skills that influence one's ability to succeed in cop up with environmental demands and pressures". The working definition of emotional intelligence as given by Mayer, Caruso & Salovey [3] is 'an ability to recognize the meanings of emotions and their relationships, and to reason and problem-solve on the basis of them'. An alternative model has been suggested to encompass a range of 'non-cognitive capabilities, competencies and skills which influence one's ability to succeed in coping with environmental demands and pressure' by Bar-On [2] which includes intrapersonal qualities (e.g. emotional self-awareness), interpersonal (e.g. empathy), adaptability (e.g. problem-solving), stress management (e.g. tolerance to stress) and general mood. Primarily Mayer and Salovey [4] the inventors of the theory of emotional intelligence, propounded an ability model of emotional

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intelligence which defines it as the capability to reason with, and concerning emotions. For them, emotional intelligence combines feelings with thinking, and thinking with feeling. Goleman⁵ described the five main components of emotional intelligence as self-awareness, self-regulation, empathy, social skills and motivation that further assented that “a learned capability based on emotional intelligence those results in outstanding performance at work. Our emotional intelligence determines our potential for learning the practical skills based on the five elements: self-awareness, motivation, self-regulation, empathy, and adeptness in relationships. Mayer and Salovey[4] coined the theory of emotional intelligence which defines emotional intelligence as the capability to reason with, and concerning emotions. For them, emotional intelligence combines feelings with thinking, and thinking with feeling. Accordingly emotional intelligence is the ability to perceive emotions, to access and generate emotions so as to assist thought, to understand emotions and emotional knowledge, and to reflectively regulate emotions so as to promote emotional and intellectual growth.

The mix model by Goleman [6] of emotional intelligence is most widely used and accepted by people. It occupies a variety of competencies which are divided in two different skills sets. Figure-2 summarized Goleman's model.

Self awareness	Self management
Emotional self awareness, Accurate self assessment, Self confidence	Self control, Trustworthiness, Conscientiousness, Adaptability, Achievement orientation, Initiative
Social awareness	Social skill
Empathy, Organizational awareness, Service orientation	Developing others, Communication, Change catalyst, Influence, Leadership, Building bonds, Teamwork

Figure 2: Goleman's Emotional Intelligence competencies
Source: Goleman (2010)

Spiritual intelligence means recognizing the work life principle and the seasons of life and may be termed as the expression of innate spiritual qualities through ones thoughts, actions and attitude which expands ones capacity to understand others at the deepest level. Spiritual understanding allows distinguishing both the 'true cause' of behavior without judgment, and serve the 'true needs' of others until they themselves learn to meet their own needs. This capacity is developed by first learning to free you from attachment and neediness and being able to meet our own inner needs. The word spirituality has its roots in spirit which means “nature of mind or outlook”, “a mental disposition characterized by firmness or forcefulness” Covey⁷. Zohar and Marshal⁸ define spiritual intelligence as the

intelligence which helps us solve the problems of life significance and value the concept of our action and life. The theory of positive disintegration having relevance to spiritual intelligence illustrated it as the one's capability to discard the normal ways of thinking and behaving for want of compassion, integrity and altruism, however the theory on self-actualization emphasized the values such as justice, truth & beauty, wholeness, and uniqueness. On the similar lines the humanist psychology emphasized the central point of the individual's instinctive drive to be a better person through values of openness, caring, and the desire for entirety of life, body, mind and spirit. The theory of flow i.e. when a person's entire being is stretched in full functioning of body and mind all doings of the individual become worth doing for its own sake (Dabrowski's[9];Maslow[10];Rogers[11];and Csikszentmihályi [12]). The researches carried out in recent years have fostered increasing awareness to the study of spiritual intelligence and its application in various fields specially in working places. King [13] is defined spiritual intelligence such as:” Spiritual intelligence is as a set of intellectual capacity that contributes to the integration and knowledge and adaptive application of spiritual and supernatural aspects of personal existence and lead to critical existential thinking, increased meaning, identify of superior universe and dominated of spiritual. In this study four dimensions as explained in Figure-3 have been used to measure spiritual intelligence.

Critical Existential Thinking (CET)	Refers to the ability to critically think about the reality of existence, being, universe, time, death, and other beyond normal and existential issues.
Personal Meaning Production (PMP)	It is the ability to create personal purpose and the goal existed in all mental and physical experiments, including the ability to create and to dominate over the goal of life
Transcendental Awareness (TA)	TA is the ability to understand transcendental aspects in ourselves, others and the physical world, when you are alert and awake.
Conscious State Expansion (CSE)	Refers the ability to enter into the levels and states of spirituality and beyond consciousness and also coming out of it when you intend.

Figure 3: Dimensions of Spiritual Intelligence
Source: King (2008)

2.0 RELATED STUDIES

The relationships of biographical information with emotional intelligence in two opposite professions of social work and software was examined by Singh¹⁴ which revealed that there is

no significant difference in emotional intelligence of social work and software professionals. The study by Naghari & Radzum [15] examined that boys are less emotional intelligent in comparison to girls and also emphasis that high emotional intelligence in boys enhance their achievement. The research by Akintayo [16] found that managerial effectiveness was appreciably predicted by emotional intelligence. Emotional intelligence has been found linked with job performance and also individuals' high emotional intelligence reported a more positive experience. However the relationship of employees' perceptions of supervisor's emotional intelligence with a number of important organizational outcomes pointed out those organizations in the UAE which might be benefited by developing emotional intelligence skills in their leaders (Gupta [17]; Whiteoak and Rana [18]). The study by Vakola, et al. [19] explored that the "big five" dimensions of personality in association with emotional intelligence can smooth the progress of organizational change at an individual level. The study by Singh, Punia and Kumar [20] conducted on supervisory personnel proposed the cultivation of an emotional quotient and the desired organizational climate to enhance the employees' mental health vis-à-vis the organizational effectiveness. The findings of the study highlighted that some of the dimensions of organizational climate (performance standards, reward system, decision-making process etc.) and emotional competency (adequate depth of feeling, encouragement of positive emotions etc.) have meaningful relationships with the anxiety level of the personnel. Khatri and Duggal [21] investigated the role of transformational leadership and explored that the factors like its effectiveness, innovativeness & quality improvement and the transactional leadership have direct lineage with each other through the relationship was not very strong. The result further indicated that for maximum satisfaction and performance from employees, the leader must exhibit charisma and intellectually strong motivation. Anari [22] investigated the inter-relationship of emotional intelligence, job satisfaction, and organizational commitment, among high-school English teachers. The role of gender and age in emotional intelligence, the study went in support of gender differences, with females reporting higher emotional intelligence same as a result by Punia [23] who glimpsed that women have more emotional intelligence due to their high score on the dimensions of emotional intelligence, on the other hand in relation to their age Punia [23] reveals a parabolic trend with emotional intelligence whereas Anari²² results revealed no differences among the participants according to their age. Emotional intelligence is also related to other important work outcomes namely family-work conflict, goal conflict, frustration and readiness to create and innovate. Significant differences with regard to the perception of emotional intelligence, conflict, readiness to create and innovate have been established across the background of participants discovered employee's with higher levels of emotional intelligence reported to lower levels of conflict and higher levels of readiness to create and innovate (Hess & Bacigalupo [24]; Suliman & Al-Shaikh [25]). Sahafi, Danaee &

Sarлак [26]; Modassir & Singh [27]; Chin, Anantharaman, & Tong [28]; Yunus[29]; Salarzehi, et al. [30]; and Yoghoubi et al. [31] (as cited in Yadav and Punia [32]) highlighted that the five aspects of emotional intelligence had significant positive impact on employees' organizational citizenship behaviour. Emotional intelligence was significantly correlated with conscientiousness, civic virtue and altruism and also mentioned that emotional intelligence of leader enhance followers' organizational citizenship behaviour. Results also showed that level of emotional intelligence varies from industries to industries because of their unique characteristics of individuals. Gender plays a significant role in emotional intelligence and organizational citizenship behaviour of supervisors and their subordinates and three dimensions of emotional intelligence i.e. self control, self motivation and empathy have major effect on organizational citizenship behaviour.

Gardner [33] acknowledged that there was some neurological evidence for "spirituality" in patients with temporal lobe epilepsy as far as spiritual intelligence is concerned and they tend to become contemplative and develop and increasingly tending toward the study of philosophy and religion and the persistent evaluation of deep questions. However Persinger³⁴ and Ramachandran et al. [35] established a relationship between heightened temporal lobe activity and the spirituality wherein the ideas on spirituality were apparent in different belief systems of ancient civilizations, religions, and the indigenous cultures. This entire phenomenon led to exhibit the connectedness or the belief that everything is part of one cosmic whole which is also acknowledged by contemporary society of the inherent wisdom and spirituality of indigenous people within the Australian Aboriginal communities. The connection of the society to the land and values that place collective needs above those of the individual was apparent and for many indigenous cultures, adolescence is a significant time in the spiritual life cycle and rites of channel guide people in the journey from childhood to adulthood (Kerr & Mcalister [36]). Doostar et al. [37]; Sara Piroozfar [38]; Chen & Yang [39]; and Rastgar, et al. [40] (as cited in Yadav and Punia [32]) highlighted spirituality as a predictor of organizational citizenship behaviour and showed that there are significant differences between different levels of workplace spirituality and organizational citizenship behaviour. Values, attitudes, and behaviors of leaders have positive effects on spirituality of the employees and relationship among workplace spirituality, organizational citizenship behaviour and job performance of employees was positive and workplace spirituality had a significant positive influence. The studies as reviewed above specify that emotional and spiritual intelligence is not only an important predictor of employees' success but also organizational success. The relationship and prediction of employees' emotional and spiritual intelligence is also a significant factor for job performances. Hence keeping this and the added significance of emotional and spiritual intelligence in view, the current research has been carried.

3.0 OBJECTIVES AND METHODOLOGY

The present study aims to predict the employees' emotional and spiritual intelligence and also find out the relationship between these two intelligences. The incidental objectives which contributed to the prime objective have been given as under:

1. To study the relationship between employees' emotional and spiritual intelligence vis-à-vis their dimensions.
2. To explore the predictive estimates of emotional and spiritual intelligence of employees' while taking them dependent and independent variables on reversal basis.

This research is based on sample size of 149 employees which encompass 90 male and 59 female respondents from different organizations. The present study is based on primary data collected through well-structured research instruments that measures the related variables of emotional and spiritual intelligence. The scale designed by Goleman¹ has been used to examine the emotional intelligence of employees which consist of 32 statements and represent its four different dimensions. The inventory on spiritual intelligence developed by King¹³ has been used which consist of 24 statements representing four different dimensions. The collected data was analyzed using relevant statistical techniques like mean score, standard deviations (SD) and Pearson's correlation coefficients (r) and regression analysis as per the requirements of the study.

4.0 RESULTS AND DISCUSSION

Objective-1: To study the relationship between employees' emotional and spiritual intelligence vis-à-vis their dimensions.

To study the relationship between employees' emotional and spiritual intelligence, correlation analysis has done and the results have been shown as per the Table-1. As shown in Table-1, out of four dimensions of spiritual intelligence only one dimension i.e. Critical Existential Thinking (CET) was not found correlated with self-awareness dimension of emotional intelligence. However all the dimensions of spiritual intelligence except the one mentioned above have been found positively correlated with the all dimension of emotional intelligence. It signifies that both these intelligences are significantly and positively correlated to each other.

Objective-2: To explore the predictive estimates of emotional and spiritual intelligence of employees' while taking them dependent and independent variables on reversal basis.

To estimate the effect of one's spiritual intelligence on emotional intelligence and vice-a-versa regression analysis has been done while taking the two intelligences dependent and independent variables alternatively and the results of the same have been shown as per Tables-2&3. The Table-2 depicts the results of regression analysis wherein emotional intelligence has been taken as independent variable and the spiritual intelligence as the dependent variable.

It can be witnessed from the Table-2 that the value of R square is 0.516, which denotes that four dimensions of emotional intelligence can predict 51.6 % of the spiritual intelligence. There might be many factors that can explain spiritual intelligence of the employees but our model, which includes

only emotional intelligence, can explain 51.6 % of it. That means other 48.4 % part of spiritual intelligence can be explained/predicted by some other factors but approximately half of spiritual intelligence predicted by only emotional intelligence. The value of f- ratio is 38.35 and significant value is 0.000* which is significant at 5 % level of significance that means our regression model result is significantly better predictor of spiritual intelligence.

The Table-3 depicts the results of regression analysis with spiritual intelligence as independent variable and the emotional intelligence as the dependent variable.

It can be seen from the Table-3 wherein emotional intelligence is taken as a dependent variable and spiritual intelligence as independent variable, results of regression analysis revealed that spiritual intelligence dimensions predict 80% (R square = 0.0800) of the emotional intelligence. There might be many factors that can explain emotional intelligence of the employees but as per the present study only spiritual intelligence, can explain up to 80.0 % of it. It denotes that means 80.00 % part of emotional intelligence can be explained/predicted by one's spiritual intelligence only and rest of the 20 percent emotional intelligence is predicted by other factors. The value of f- ratio is 144.32 and significant value is again 0.000* which is also significant at 5 % level of significance. In short, the results pointed that 80 % of emotional intelligence of employees is explained by spiritual intelligence. While giving a summative note it can be viewed that if an individual is spiritually intelligent his chances of being emotionally intelligent are 80 percent. However one's being emotionally intelligent his spiritual intelligence can be only approximately 50 percent (51.6%). Therefore, spiritual intelligence carries more weight as compared to emotional intelligence.

When we compare the findings of the present study with previous studies of the nature some similar and interesting findings have emerged. The result of present study showed that emotional and spiritual intelligence were highly correlated which replicate the findings of pervious researches of Kaur et al. [41], Koohbanani et al. [42], King et al. [43], and Harmer [44] who also found the positive and significant relationship between emotional and spiritual intelligence. The employees having the knowledge of their divine, inner sense, critical thinking about the reality, time and death, creating goal in mental and physical experiments, ability to enter and exist in consciousness i.e. awareness of something and responding to one's surroundings and construct a life purpose is possible only when he knows about himself or herself, about his emotions or other's emotions and feelings. All emotions are important on the job, not just fear or worry. The answer is that emotions express information which you need to be effective in your work. Another major finding of present study is about predictive estimates of emotional and spiritual intelligence of employees' which is in consonance with the finding by David [45] who also found that emotional intelligence is not only the individual predictor of workplace success also spirituality that means knowing the things other than emotional awareness is also important.

5.0 CONCLUSION

Intelligence can be understood as one's capacity for learning, reasoning and understanding. Here in the similar forms of mental activity; aptitude in grasping truths, relationships, facts, meanings may also be included. Researchers have discovered that emotionally healthy individuals are better learners, better at resolved conflicts, a reduced amount of aggressive and added understanding, feel better about themselves, have better desire control, are less involve in destructive behavior also have few problems related to behavior. For employees, emotional intelligence offers an essential foundation for developing the skills of effective independent learning and personal development whereas spirituality survives in the hearts and minds of individual everywhere, within religious traditions and independently of traditions. Spirituality in fact delineates as the field of final concern, and then everyone is spiritual because everyone has ultimate concerns which can be understand in different ways. In the present study emotional and spiritual intelligence were significantly positively correlated and also found that emotional intelligence predict only approximately half of spirituality of employees' while spiritual intelligence predict most of things other emotional intelligence of an employees.

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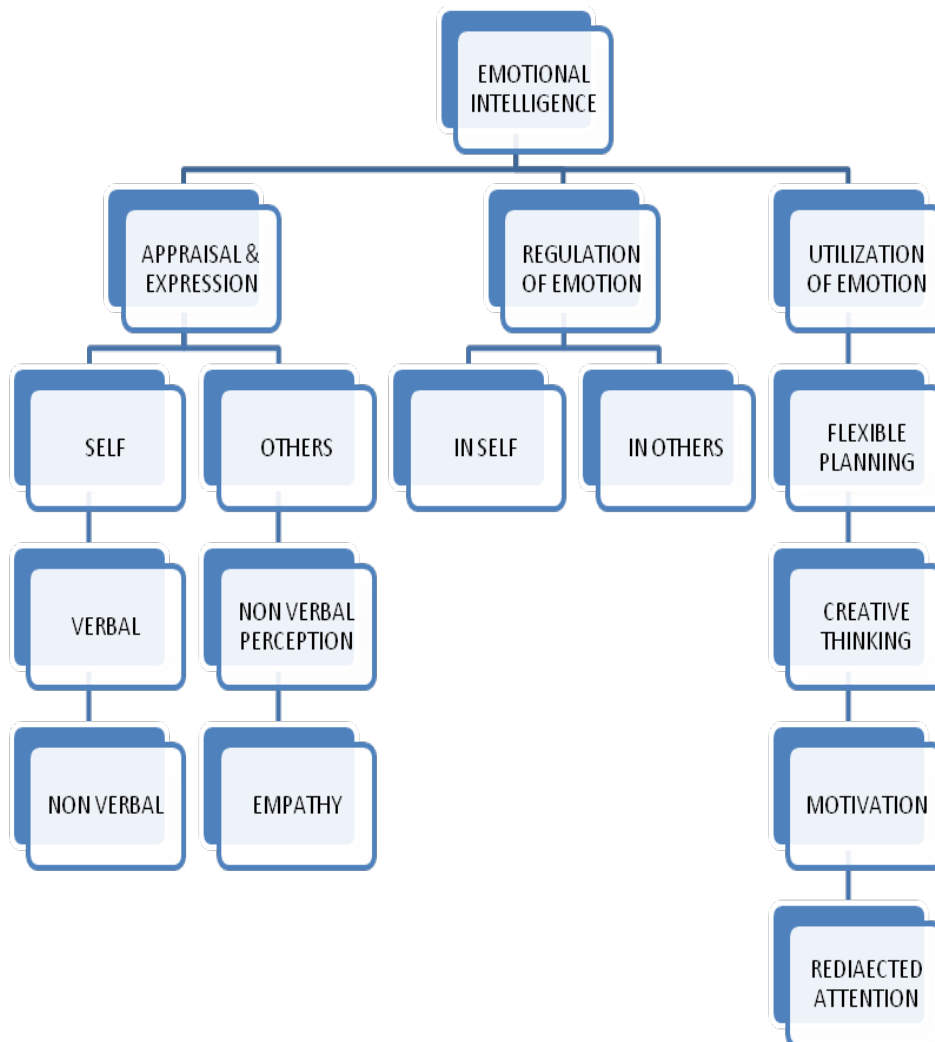


Figure 1: The Concept of Emotional Intelligence Source: Salovey & Mayer (1990)

Table-1: Correlation between Emotional and Spiritual Intelligence Dimensions

SI	EI	<i>Self Awareness</i>		<i>Social Awareness</i>		<i>Self Management</i>		<i>Social Skills</i>	
		PC	Sig.	PC	Sig.	PC	Sig.	PC	Sig.
	<i>CET</i>	0.150	0.068	0.220	0.007*	0.178	0.029*	0.266	0.001*
	<i>PMP</i>	0.497	0.000*	0.425	0.000*	0.458	0.000*	0.478	0.000*
	<i>TA</i>	0.884	0.000*	0.692	0.000*	0.791	0.000*	0.592	0.000*
	<i>CSE</i>	0.683	0.000*	0.598	0.000*	0.632	0.000*	0.570	0.000*

*= Significant at 5 percent level of significance.

Note: EI= Emotional Intelligence, SI= Spiritual Intelligence, CET= Critical Existential Thinking, PMP= Personal Meaning Production, TA= Transcendental Awareness, CSE= Conscious State Expansion, PC= Pearson Correlation

Table 2: Regression analysis while Emotional Intelligence is Independent Variable and Spiritual Intelligence is the Dependent Variable

<i>Variables</i>	<i>Un-standardized Coefficient beta</i>	<i>Standard error</i>	<i>T value</i>	<i>P value</i>	<i>R square</i>	<i>Adj. R square</i>	<i>f- ratio</i>	<i>P value</i>
Self Awareness	0.292	0.100	2.916	0.004*				
Social Awareness	0.111	0.079	1.418	0.158				
Self Management	0.237	0.093	2.562	0.011*	0.516	0.502	38.35	0.000*
Social Skills	0.191	0.085	2.249	0.026*				

*= Significant at 5 percent level of significance.

Table 3: Regression analysis while Spiritual Intelligence is Independent Variable and Emotional Intelligence is the Dependent Variable

<i>variables</i>	<i>Un-standardized Coefficient beta</i>	<i>Standard error</i>	<i>T value</i>	<i>P value</i>	<i>R square</i>	<i>Adj. R square</i>	<i>f- ratio</i>	<i>P value</i>
CET	0.004	0.024	0.163	0.870				
PMP	0.057	0.028	2.056	0.042*				
TA	0.550	0.040	13.710	0.000*	0.800	0.795	144.32	0.000*
CSE	0.232	0.045	5.122	0.000*				

*= Significant at 5 percent level of significance.

Cloud Computing in SMEs: Case of Saudi Arabia

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Abstract - Cloud computing technology is now in an advance stage having crossed many hurdles that came in its way to broad acceptability by the business world as well individuals. Cloud computing not only provides storage but also provides a range of services on a rental basis, which enables firms to limit their infrastructure to a minimum and so makes it affordable by many. Cloud computing provides many entrepreneurs as well as businesses, especially the small and medium- sized enterprises (SMEs), with low cost alternatives to for starting and managing their businesses. In particular SMEs of many developing countries, who cannot always afford to mobilise huge capitals to start new businesses are immensely benefiting from this technology. Saudi Arabia is a developing country with a good infrastructure for small to medium sized industries. Many of the Saudi SMEs are using a range of technologies and platforms including cloud computing to sustain and manage their businesses. In this article we look at the extent of cloud computing applications in SMEs in the Kingdom of Saudi Arabia. To measure the extent of the use of cloud computing, we present an analysis of a comprehensive survey conducted on a large number of small organisations in the West Coast of Saudi Arabia during the course of this research.

Index Terms – Cloud Computing, Entrepreneurs, SMEs, IT Infrastructure, Developing Countries, Saudi Arabia

1.0 INTRODUCTION

Cloud computing has now emerged as a leading technology of the 21st century and has been embraced by industries around the globe. Its progress and advancement could be compared to the advances of E-Commerce at the turn of the last century. Many entrepreneurs and businesses, in particular the small to medium sized businesses (SMEs) find it very helpful in setting up new business as well as sustaining old businesses. In this article, authors will analyse the extent of cloud computing presence in Saudi SMEs. This study will be carried out with the help of an industry survey conducted by the authors. An example of a government who brought in cloud computing initiatives to enrich and strengthen SMEs is the UK government, which has initiated a cloud framework called "G-Cloud framework" [1]. The difference between G-Cloud and other frameworks is that SMEs can pay for services as they use them, rather than being tied to inflexible, long-term contracts. This model of G-Clouds is very attractive to SMEs.

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1.1 Growth of SMEs in Saudi Arabia

The Kingdom of Saudi Arabia (KSA) is one of the richest countries in the world. Yet, it falls into the category of developing countries. The main reason for it not making into the list of the developed countries is the slow advancement in the industrial sector, in particular the SMEs. The export of petroleum has contributed significantly to the economic growth, which has earned the Kingdom a membership of G20, an alliance of countries whose economies are highly influential in the world. The G20 countries have a lion's share or more than three-fourth of the world trade [2]. Therefore, it would seem to be unfair to find some statistics suggesting Saudi Arabia to be one of the developing countries. However, some other sources like the International Statistical Institute [3], excludes Saudi from the list of Developing Countries. Likewise, a former US diplomat [4] is convinced that Saudi Arabia is a semi-developed country.

1.2 Historical and religious Significance of Saudi Arabia

Makkah (Mecca) in Saudi Arabia is well known for housing the Kaaba, which marks the direction of prayers for Muslims all over the world. Makkah is more than four thousand years old. The city is the centre of the annual pilgrimages known as the Hajj and Omrah, which are attended by millions of people every year. Some information and details of the Hajj and Omrah can be found in [5]. These pilgrimages further inject about 16 billion dollars to the economy[6]. Currently Saudi Arabia is undergoing a number of major projects involving various arms of the Saudi industry and in particular the SMEs. These projects include a rail link between major cities and Makkah, huge expansion of the holy mosques in Makkah and Madinah and various other educational, health and cultural projects which are amounting to hundreds of billions of dollars in expenditures by the Saudi Arabian government, see [7] and [8]. Mohammad Yamin [9] and Abdullah Basahel [10] provided some more information about Saudi Arabia, who has earned the reputation of being the leading economy not only in the Middle East but the whole Arab World.

As has been the case with many developing countries, the growth of SMEs in Saudi Arabia was slow at the beginning. However, as the oil revenue increased and economy boomed, industrial growth picked up pace. As a result, in addition to having a considerable presence of multi-national companies, the KSA has achieved remarkable growth in local businesses and home grown industries. Some of the details of SMEs in Saudi Arabia can be obtained from [11]. The aim of our study in this paper is carry out a study on the presence and impact of Cloud Computing in SMEs in Saudi Arabia. In particular, we look at the case of Sanitary Ware, which represents a small industry. To analyse the impact of Cloud computing in SMEs,

we have surveyed eighty businesses, whose analysis will be presented in this article.

1.3 Role of SMEs in World Economy

According to a major study conducted by Sweden's Globalisation Council [12], "One main conclusion is that changes by globalization will affect the SMEs and entrepreneurs in different type of economies both on a national and regional perspective. The world is globalized so is the world for entrepreneurs and innovations. All type of companies will be affected by the changes that one nowadays could observe, not only SMEs or innovative entrepreneurship but of course also the behaviour of multinationals and large firms, and the relations between large and small firms". In another major study conducted by UNU World Institute for Development Economics Research [13], from a theoretical perspective, SMEs have several advantages over both SOEs and large privatized SOEs (PSOEs). In SMEs the incentives for both managers and workers tend to be clearer and stronger than in larger organizations. Governance problems are less significant since in many cases the managers and owners are the same people. The small size of many of the SME firms allows owners easily to monitor the performance of managers while the cost of monitoring labour is also lower. Table 1 shows SME employment as a percentage of total employment and manufacturing employment in various countries. For details, see [13].

Table 1: SMEs share in employment

Country	Year	Country	Year
EU	69	Japan	33
France	69	Croatia	30
Germany	64	Romania	27
Belgium	72	Hungary	24
Italy	80	Poland	23
Georgia	58	Slovenia	19
US	53	Russian Fed	10
Estonia	43	Belarus	6
Czech Rep	37	Kyrgyz Rep	3

SMEs in Saudi Arabia represent almost 93 percent of total enterprises and account for about 24.7 percent of total employment, which is fairly low as compared to many of the developed countries listed in Table 1, see [13]. Moreover, Saudi Arabia's businesses contribute about 33% of the national GDP whereas the figures for some developed countries are as follows: US (50%), France (56%), Spain (57%) and Japan (64%), for details see [14]. As can be seen, the GDP share of SMEs of Saudi Arabia is much lower as compared to the countries of G20. A detailed analysis of SMEs and their socio-economic contribution can be found in [15]. However, investment in small and medium enterprises in Saudi Arabia is expected to grow to more than USD 70 billion by the end of 2015, with the government and banks providing much-needed funding, according to industry data compiled by Zawya [16].

Having realised the importance of SMEs, the Saudi Arabian government has endorsed some attractive ways to finance the SMEs, details of these ways can be found [17] and [18]. These measures are expected to lower the unemployment rate of the Kingdom, and provide highly needed support to the development of the local economy. Once this happens, the Kingdom of Saudi Arabia may find itself a step closer to be classified as a developed country.

2.0 CLOUD COMPUTING

Cloud computing is a disruptive innovation and technology of the 21st century. It has affected the industrial world in the same manner as outsourcing, E-Business and E-Learning did in the 20th century. Cloud computing has created opportunities to new and existing businesses, especially the entrepreneurs to setup and realise their dream businesses without much of the infrastructure and capital of their own, as the technology provides much of these on a rental basis.

2.1 Models and Characteristics

To be able to comprehend cloud computing, a well-organized definition is essential. As described in [19], The National Institute of Standards and Technology (NIST) has defined cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. The NST definition as

Cloud Computing - Definitions ...

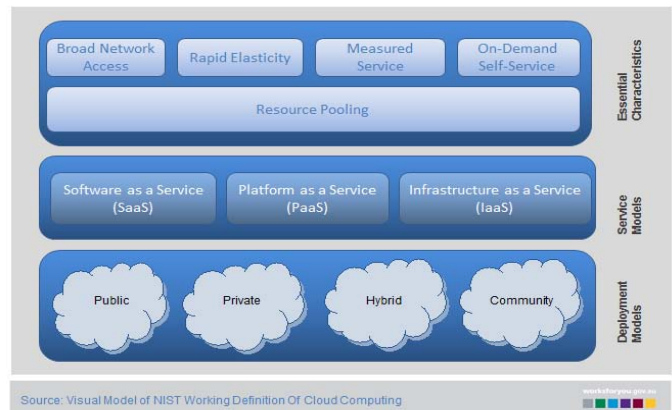


Figure 1: Cloud Computing Definition

seen in Fig 2 includes four characteristics namely, Broad Network Access, Rapid elasticity, Measured Service and On-Demand Self-Service. The service models for cloud computing can be Software as a Service (SaaS), Platform as a service (PaaS), and Information as a service (IaaS), and can be deployed as Public, Private, Hybrid or Community. Many other people have defined and described cloud computing. For example, in [20], cloud computing is referred to as both the delivery of applications as services over Internet, and the hardware and systems software in the data centres that provide services (SaaS).

There have been concerns about the security of data in the custody of the cloud providers. Initially, there were serious concerns and many organisations, especially the government owned businesses and corporations were very reluctant to make use of the cloud computing platforms. Considerations of data security and privacy would assume a very high priority when trans-border data sharing was involved. As discussed in Security and Resilience in Governmental Clouds (2009), this has significant implications for the use of cloud databases to manage private and sensitive data. Thus, one of the main considerations for many corporate and government organizations, especially in the industrial world where security and privacy is paramount, is whether to make the sensitive (e.g. defence, national security) personal data available to cloud providers. However applications used in periodic processing and those involving activities like database development and testing, data mining, database backups and off-site disaster recovery are regarded as safe and can be managed and stored through clouds. These considerations have been quite critical for many government corporations including those of the Saudi government sector, where cloud computing is slowly and gradually taking its share in the government and privately owned businesses. For example, the webmail system of the King Abdulaziz University is hosted on cloud. From these and other numerous descriptions, cloud computing has emerged as an easy to acquire and use infrastructure, software, systems, memory and maintenance in a variety of ways to all kinds of organisations and individuals. This has allowed new starters of businesses to benefit from these facilities.

2.2 Impact of Cloud Computing on Economy

With the prospects of eliminating a need for a large capital investment, the economy of many countries, especially the developing countries, is significantly improving the financial abilities of the organisations and businesses. This trend is likely to continue and is expected to affect the economies of a large number of countries, getting deeper into the poor nations of Africa and Asia. Cloud computing is redefining methods and models, reducing the burden of having huge capital to start a new or sustain and expand an established business. Many entrepreneurs, who would otherwise find it impossible to start their dream business due to lack of resources and capital for investing in IT infrastructure and systems technology, would now be in a position to fulfil their aspirations and expectations. The most attractive feature of cloud computing is its affordability, an aspect that SMEs are expected to benefit from. It is expected that many bonuses in poor and developing countries would be able to enhance and strengthen their business activity for many new IT organizations.. In the last two decades, many leading organizations of the western world have resorted to outsourcing, especially offshore outsourcing. This model of business has so far benefited countries both in the developing and the developed world. However, with the advent of Cloud Computing, outsourcing is likely to undergo structural changes and is likely to involve cloud computing in

its model. On the other hand, many organisations, with the help of local IT support, may resort to cloud computing in place of outsourcing; hence the outsourcing activity might decline. Initially the cloud providers, and hence the large corporations of the developed countries and their economies may benefit in the way of providing systems, infrastructure and other resources need by the cloud providers. However, once the saturation point occurs, the developing countries might make significant gains due to picking up the lost business of outsourcing. It is expected that the use of cloud computing will increase in Saudi Arabia, which currently has only some businesses making use of it. In this paper we shall analyse the result of a survey conducted in 2014 of several businesses in Saudi Arabia to measure the usage and impact of cloud computing. An economic impact of cloud computing, known as Cloud Economy, was presented by Mohammad Yamin in [21].

2.3 Cloud Computing and Small Businesses

With the help of cloud computing, many SMEs can start their businesses with little capital. Cloud computing can be used by existing firms as well, where they can reorganize their way of doing business. With the implementation of cloud computing services, many services can be achieved such as rent data storage, software and systems, maintenance and services for a fee. Moreover, it's well known that offshore and onshore outsourcing enables organization to do their business with less capital and infrastructure. As for when both cloud computing and outsourcing join together to save capital for organizations, it is expected that many existing businesses which outsource some of their work process, would reorganize their ways of doing business to benefit from cloud computing services, and that would maximize their efficiency. For details, see [22]. According to a survey, conducted by Janet Kourik [23], by 2020, over 70% of users will use internet-based (cloud) software to perform work." Moreover, the usage of cloud computing would grow at an astonishing rate. According to the survey, about 69% of the Americans use cloud computing services such as online backup, webmail, and other services. People in developed countries are not the only users of cloud computing services. Moreover, there are about one thousand and five hundred Indian companies who use cloud computing. In [23], it was remarked that senior decision-makers in SMEs often are not aware of cloud computing. In view of [24] and [25], further benefits to SMEs are in the form of: friendliness, lower cost of organisational ownership, better return on

Gartner Emerging Technology Hype Cycle – Cloud Computing – 2008 - 2014

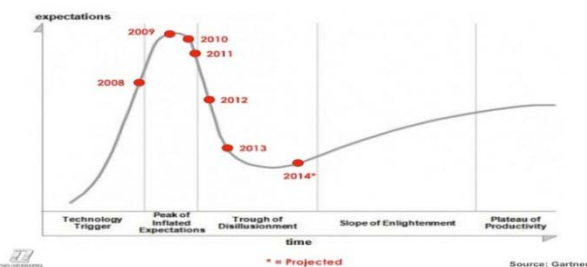


Figure 2: Gartner Hyper Cycle Emerging Technologies

investment, greater flexibility with range of plans, packages, and add-ons to address diverse business requirements

2.4 Proliferation of Cloud Computing

In the recent decades, with the introduction of the Internet, web 2.0, technologies, and E-Business have changed the way business is conducted in the 21st century. The political, economic, social, and other factors have also changed the ways in which the businesses are run. The technological factor, for instance, has made it easy for all kind of firms to achieve more efficiency in almost all fields. Cloud computing is now a hot topic in the field of technology. Cloud computing has been developing at an astonishing rate [26]. Through Gartner's Hype Cycle methodology which provides a graphical view of the maturity, adoption and business application of specific technologies, this section aims to expose the high improvement that cloud computing has achieved. Gartner releases an annual update to the Hype Cycle showing how close technologies are to high growth adoption [25]. Below are graphs presenting cloud computing on the Hype Cycle from 2008 – 2014 [27]. Cloud computing's projected positioning on the Hyper Cycle for 2014 is also included. Firstly, let us look at Fig 3, which suggests that this year in 2015 cloud computing should be enjoying a period of enlightenment, after going through a technology trigger in 2008, peak of inflated expectation during 2009-11, and tough disillusionment during 2012-13. Let us now analyse the extent of cloud computing in 2010 as shown in Fig 4. In 2010, cloud computing was only an emerging technology in the Hyper Cloud of Information Technology of 2010, and Gartner did consider making a separate cycle for this technology. However, starting from 2011 onwards, Gartner has produced separate hyper cycles for cloud computing. In 2011, as is seen in Fig 5 Hyper Cloud for year 2012 shows the peak of activity as a hyper activity and figure 6 of that of year 2014 shows continuation of the hyper activity of inflated expectation, steadily rising the slope of enlightenment. These hyper cycles are very much in line of the projections given by Gartner.

3.0 SURVEY: CLOUD COMPUTING AND SMEs

In this section, we shall describe our survey, which was conducted in 2014 to measure the extent of cloud computing in

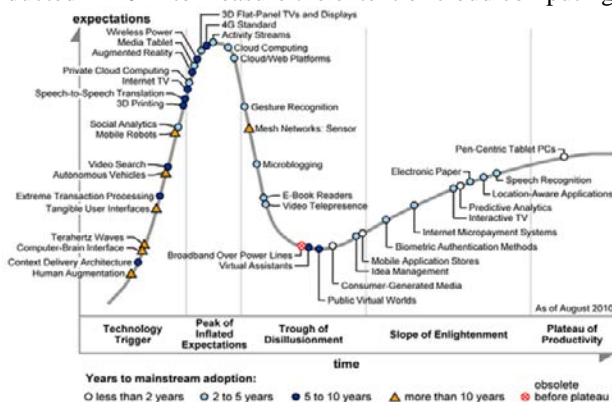


Figure 3: Gartner 2010 Hype Cycle Emerging Technologies

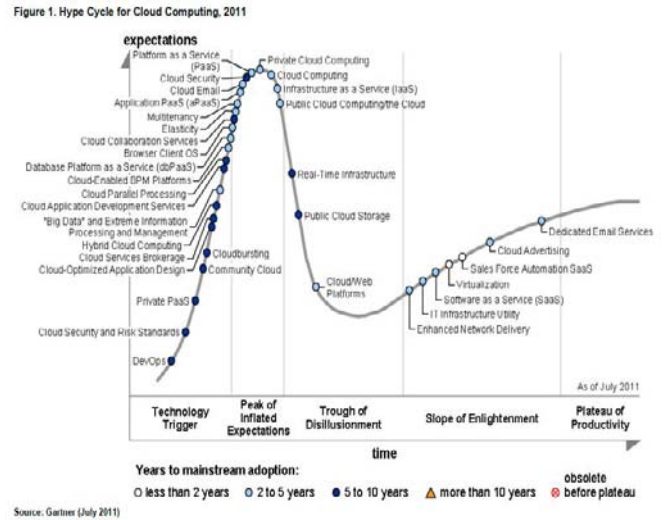


Figure 4: Gartner 2011 Hyper Cycle for Cloud Computing

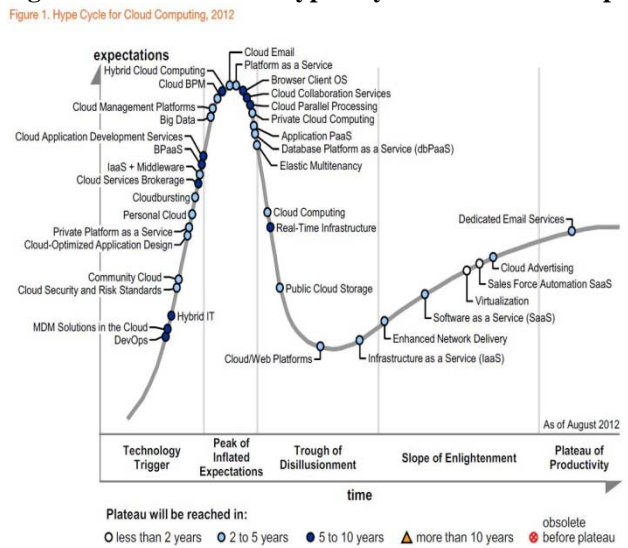


Figure 5: Gartner 2014 Hyper Cycle Cloud Computing

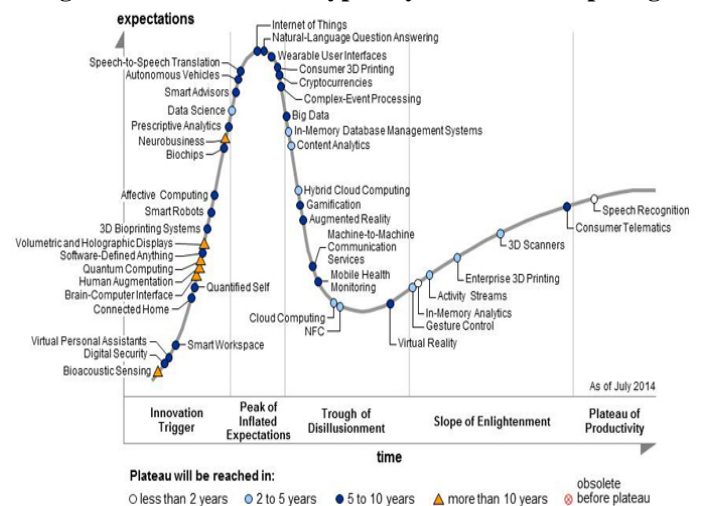


Figure 6: Gartner 2014 Hyper Cycle Cloud Computing

Saudi Arabian SMEs. The main objective of the survey was to guide the direction of this and future research related with SMEs and cloud computing. The success of business unquestionably depends on information systems.

SMEs and cloud computing. It is a forgone conclusion that most of the modern enterprises today depend on information systems for their effective, efficient and smooth functioning. Business intelligence is driving businesses to be increasingly dependent on IT solutions. However, information systems require an IT environment and facilities for their operation and the cost of the IT infrastructure for operating such systems has traditionally been very costly. With the availability and advancement of cloud computing paradigm, many companies now can lease cloud computing services as an alternative to upfront payment for setting up the needed infrastructure. As discussed earlier, cloud computing provides IT infrastructure, systems, software, tools, services and services on a rental basis for a specified time or by a meter system of usage. For many entrepreneurs, cloud computing is an economical way to start their businesses.

Saudi Arabia has many small enterprises that are still looking for ways to reduce their cost of setting up a business and running it efficiently - cloud computing is cost-effective and easy to acquire. To measure the extent of cloud computing usage in Saudi Arabian small enterprises, a survey was conducted of eighty companies in Jeddah. Due to the small size of Saudi population and a relatively small number of companies in the Kingdom, it was concluded that a sample of eighty companies was sufficiently robust to enable generalisations to be made about SMEs in the emergent economy.

3.1 Choice of Method

This research paper aims to develop a research model which would determine the extent of the use of cloud computing amongst Saudi SMEs. One of the major challenges in conducting our survey was to determine and select suitable SMEs to obtain the relevant data from. Another challenge was to educate officials of some of the SMEs who had never heard of Cloud Computing. Under the circumstances, the research methodology and questionnaire, used for the survey, were kept very simple. For relevant literature, publications and studies were reviewed in order to get in-depth information on the use of cloud computing in Saudi Arabian SMEs. The survey was selected as a suitable tool for gathering the relevant data because it was capable to collect first-hand information from actual companies within the demographic region under consideration. Only the selected SMEs in Jeddah were surveyed through a simple questionnaire. We acknowledge that there are some limitations to quantitative research methods. However, the strengths of such methods, related to the research aim, render a quantitative survey and the potential scope of such a survey preferable over a qualitative alternative. While interviews could perhaps produce more detailed responses, they are not suited for determining widespread usage because of their smaller size.

3.2 Sample of the Survey

A suitable sample size was estimated using industry standards, firms were selected with the help their publications and public records related to the selected demographic for the research, and were contacted either by email or in person. Once an organisation agreed to take part in the survey, the questionnaire was emailed or handed personally to the nominated representatives of the SMEs; they were asked to return the survey within a two-week period. Unfortunately, many organisations declined to receive the questionnaire despite agreeing to participate, and three organisations did not return the questionnaire. One organisation was late with its responses and was therefore not included in the research data. Although more than one hundred organisations were contacted as described above, only eighty of them provided the data.

3.3 Ethical Considerations

The aim of this survey was only to measure the extent of usage of cloud computing SME enterprises in Saudi Arabia. Therefore, seeking highly personal and sensitive information was not required. Only general questions were asked like name of the officer, the name of the company, contact details, name of the Cloud Computing provider used by the company and the location of the company. Moreover, they were assured that this information would be used purely for the use of the researcher and would not be made public. In keeping up with established norms, information provided by the participants was treated confidentially and used for the sole purpose of this research. Ethical considerations related to the research study were primarily based on anonymity. The data collected, as published here, does not identify the organisations or individuals who provided the data. The respondents knew that their answers would not be linked to their identity. As a result the respondents did not show any anxiety or fear on account of their participation. For example, if an organisation admitted to not knowing anything about cloud computing, linking their organisation to such a response would have rendered their brand or business being labelled 'old-fashioned' or 'out-of-date'. That would have affected their reputation, sales, investment, and partners. So, confidentiality was a key element in ensuring that the study followed an ethical code of conduct.

4.0 SURVEY CONTENT AND RESULTS

The survey questionnaire contained thirteen questioners, with a purpose of asking simple questions. Participants were asked to provide their responses on a scale of seven indicators as follows: 1 = completely disagree, 2 = disagree, 3 = somewhat disagree, 4 = neutral, 5 = somewhat agree, 6 = agree, 7 = absolutely agree. Our choice of the scale of seven choices was to allow the respondents with greater flexibility. The questioner is presented in Table 8, and the results of the survey are presented in Table 9.

Table 2: Survey Questionnaire

1	My company doesn't use any Cloud Computing services.
2	My company is planning to use hire Cloud Computing services in the next 12 months.
3	My company is using some Cloud Computing services.
4	My company is missing-on/taking an advantages of Cloud Computing services.
5	Cloud Computing is an economical way of employing IT facilities.
6	Cloud Computing is a better way of dealing with technical issues of enterprises
7	Cloud Computing is helpful for establishing a new business.
8	Cloud Computing is way to get rid of old IT systems.
9	Cloud Computing eliminates the need for having technical expertise.
10	There are privacy issues with use of Cloud Computing services.
11	There are data security issues associated with the use of Cloud Computing.
12	Use of Cloud Computing doesn't require significant training for the enterprise personnel.
13	Cloud Computing improves performance of workers on job

After carefully analysing the survey responses from our eighty completed responses from various SMEs, we decided to base our research simply on the averages of responses for each question. These averages are provided in Table 9.

4.1 Implications of the Survey Responses

From the results of the survey, analysts can see that it is evident that majority of small enterprises in Jeddah in the province of Makkah of Saudi Arabia do not use cloud computing services. It also shows that the small enterprises indicated that the SMEs have fair awareness of Clouds and their benefits. In fact managers of many of these enterprises have admitted to the fact that if they were using cloud computing, they would gain many advantages. However, small private sector companies were sceptical or uncertain whether there were any advantages of having this technology. In other words, the analysis shows that small enterprises are not against hiring products or services from the cloud computing providers. It was also indicated that the small enterprises had very little or no concerns about privacy and data security issues associated with the use of cloud computing. Therefore, there

Table 3: Survey Results

Questions	Average	Questions	Average
Question 1	7	Question 8	5
Question 2	4	Question 9	5
Question 3	2	Question 10	4.4
Question 4	4	Question 11	4.3
Question 5	4	Question 12	4.3
Question 6	4	Question 13	4.3
Question 7	4		

is no reason for the slow growth of the usage of cloud computing in small enterprises sector in Jeddah, Saudi Arabia. Performance of these SMEs could be much better. Also, more cost reduction would be feasible on hiring cloud computing services. A further research is warranted to examine the cases of different parts in the kingdom and other developing countries of the Middle East and the region..

4.2 Limitations

This was a quantitative survey of only eight SMEs, in only one region namely Jeddah, Saudi Arabia. Jeddah is the main port city of Saudi Arabia and has a well-developed industry presence. While it provides important and generalizable data and highlights deficiencies that need to be studied more rigorously, it is far from exhaustive. However, the results of the research study seem to be congruent with the published data related to the subject. Further research would be needed to identify the barriers proliferation of cloud computing services in the Kingdom of Saudi Arabia and perhaps the entire Middle East.

5.0 CONCLUSIONS

As we find from the analysis of our survey, all of the SMEs who participated in the survey do not use cloud computing. However, the majority of them said that their firm would benefit from having cloud computing and were in the process of acquiring the technology for the future. Most of the respondents were of the view that cloud computing improves the performance of the workers. Many responses confirmed that cloud computing helps in getting rid of old and ailing systems. Hence, Saudi Arabia needs to strengthen its cloud computing industry so that SMEs can benefit from this technology. This would be a step closer to the Kingdom's aspiration to find itself in the list of developed countries. It is fair to say that the Saudi Arabian government has been trying to make the latest technology available to the business community of the country. The role of cloud computing, especially in the SMEs should not be ignored otherwise the industry will find it difficult to keep up with pace of the developed countries. Saudi Arabia, having a good technological base, is a candidate for excelling in cloud

computing technologies. Cloud computing is out there and it will reach the private SMEs. Therefore, in the future, we might expect a higher growth rate in the private as well as the public sector. The Saudi government on its part needs to continuously support and bring in fresh incentives to enrich and increase the industry, especially the SMEs.

6.0 ACKNOWLEDGEMENT

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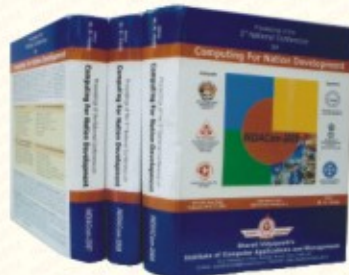
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