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System (NRDMS) & its Developments at CSIR-NISTADS, New Delhi - A Few **Examples**

Gagandeep Singh Narula, Subhan Khan and Yogesh



Bharati Vidyapeeth's Institute of Computer Applications and Management A-4, Paschim Vihar, Rohtak Road, New Delhi-63

Email : bijit@bvicam.ac.in, Website : http://www.bvicam.ac.in

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It is a matter of both honor and pleasure for us to put forth the fifteenth issue of BIJIT; the BVICAM's International Journal of Information Technology. It presents a compilation of eleven 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 eleven papers, that were finally published, were chosen out of eighty six 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 7.76 for 2014, 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 <u>bijit@bvicam.ac.in</u> and help us in further enhancing the quality of forthcoming issues.

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Gagandeep Singh Narula, Subhan Khan and Yogesh

Adaptive Context-Aware Access Control Model for Ubiquitous Learning Environment

Jagadamba G^1 and B Sathish Babu²

Submitted in April, 2014; Accepted in July, 2015

Abstract – In a ubiquitous environment the users access to any services at anytime, anywhere through any device is the new dictum. Thus, ubiquity and mobility of devices made the access control, adaptive in nature by using the contextual information. However, dynamically changing context does not leverage on access control for the resources requested. We propose an access control mechanism that adapted through means of gathering the dynamically changing contextual information that has an impact on access decisions. As a result, a fine- grained access control decisions is assessed through well-tuned analysis about a user behavior and need before granting or denying. Results and performance analysis is presented for the proposed contextaware access control mechanism.

Index Terms – Access Control, Authentication, Context-Aware, Security, Ubiquitous Environment.

NOMENCLATURE

ASCII- American Standard Code for Information Interchange, RBAC-Role Based Access Control, CAAC- Context-Aware Access Control, CS-Checksum, IP-Internet Protocol.

1.0 INTRODUCTION

Context is defined as, the information that is utilized to characterize the situation of an entity. Intuitively, it is reasonable to accept location, identity, activity and time [1, 2] as essential attributes of the context. In a ubiquitous environment, the context-awareness term was introduced by Schilit in 1994[3]. The Context-aware devices [4, 8] intellectually capture the circumstances under which they operate, based on rules, situations, requirements and react accordingly to their environment. Thus, ubiquitous computing personalizes services to the end users based on context.

Manipulative access to resources is usually done by listing access control rules or policies. Adaptability in access control consistently requires evolving change and requirements in a ubiquitous environment. However, the security related challenges, like authentication, authorization, access control, integrity, confidentiality, and availability needs to meet in any context-aware system. In our proposed system, we concentrate on authentication and authorization by considering the required data for access control. Authentication verifies the identity of an entity, i.e., what you know, what you are or what you have.

^{1,2} Dept. of Comp. Science and Eng., ^{1,2} Siddaganga Institute of Technology, Tumakuru, Karnataka, India.

Passwords, passphrases, secret codes, certificate based [5]and personal identification numbers (PINs) found as what you know; keys to lock and unlock for what you have and biometric authentication methods like iris, image, fingerprints, and keystroke [6], presents what you are. Once the identity of the user gets declared in the authentication stage, the users were assigned a set of authorizations considered to be the rights, privileges, or permissions associated to do with the resources. The system administrator assigns the authorization by considering the system security policies. The policies define the right varying from the boundaries of not allowing anything (permit nothing) to allowing everything (permit everything) or to allowing in between [7]. In our proposed system, the user types are found accordingly to the change in context. The change in context and behavior is analyzed while fulfilling the need if the request comes from the genuine user.

1.1 Ubiquitous learning

Learning about the right thing at the right place and time in the right way is needed in ubiquitous computing environment [9]. Context-aware Ubiquitous environments adapt the user's real situation to provide adequate information for learning. Ubiquitous learning [10] creates a situation or surroundings to acquire the context information all around the user, where he/she may not be conscious of the learning developments. Developments in ubiquitous learning environment adds the advantages of adaptive learning with the benefits of ubiquitous to provide users, freedom to access to their individual needs with allowable flexibility.

1.2 Proposed Adaptive Context-aware Access Control

Learning based on user requirement, becomes necessary for access control based on the role the user is playing in a ubiquitous learning environment. Where a user can play a single or multiple roles at a time, but computing system in this needs a generous level of understanding of the situation they are and the complex relations between the various essentials. Thus, the ability becomes perception and malleable to the situation accordingly termed as "adaptability". Adaptive context-aware access control knowledge includes: monitoring users activity, understanding user's requirements and preferences, and using these newly gained information to facilitate access control.

The proposed Context-Aware Access Control (CAAC) adapts itself to the varying environment by developing a proactive centralized monitoring system that acts as a context server through acquiring and managing the context information for analyzing user requirements. The analyzed output will bring in the corresponding decisions.

¹ jagadambasu@gmail.com, ² bsbsit@gmail.com.

This paper is organized as follows: Section 2, discuss related works in the area of context-aware models, section 3 describes the proposed CAAC system, section 4 discusses the performance analysis, section 5 presents the results and section 6 concludes with future work.

2.0 RELATED WORKS

Access control models were categorized to [11]: mandatory access control models, discretionary access control model, and role-based access control model. A role-based access control models allow users, computers, and applications to follow static policy for accessing computers, files, applications, servers, communication ports and devices.

The Role-based Access Control (RBAC) [12] started with multi-user and multi-application on-line systems pioneered in the 1970s. The RBAC grants the access permissions based on the roles and various job functions the user is playing in an organization. All RBAC models restrict the access control through static policies. But, the model [13] allows for the definition of context-aware security policies for requested tasks and makes it easy to define, and understand complex security systems. An effective access control model that is aware of context modifications and change authorizations when location, date, time of access, and resources settings changed in Context-Aware Access Control Model (CAACM) [14]. Cerberus [15] included context-aware identification, authentication and access control and reasoning about context, but the process was complicated to implement. Generic context-based software architecture (Gaia) [16] was aware of physical spaces based on geographic region with limited and well-defined borders, containing physical objects, assorted networked devices, and users performing a varied of activities. This model uses the context of first-order logic and Boolean algebra, which allowed them to describe straight forwarded rules. The Kerberos authentication [17] proposed the process to enable activation or deactivation of roles assigned to a user depending on his/her context. If we consider a user, in an un-secure place like a canteen, the access to sensitive data is not allowed, but when the user is in a research lab, private chambers or hostel building rooms is permitted to access the confidential data. The system [17] is context aware in nature to block the accessing if the user is in unsecured context or allow access if the user is in a secure context.

Context-aware access control based on ontology [18] was aware of developing the policies based on the user, device, and place for software services that are static in nature. In [19] the context-aware access control policy T consists of two parts: the context attributes set $TS = \{\text{teacher/student, teaching time/spare}\)$ time, Pad/mobile phone/personal comp.} and the operation attributes set $TO = \{\text{Read/Write/Read-write}\}\)$, namely $T = \{TS$ AND TO $\}$. The context attributes set TS consists of four subattributes, which denotes user uses the device at a particular time in a place, namely $TS = \{\text{Who AND When AND Where}\)$. For example, for the resource R, following policy is established to control access: Tro = {{Teacher OR Student} AND {School Teaching OR Spare Time} AND {At School OR Outside School} AND Only}.{Personal Comp. OR Pad OR Mobile Phone} AND Read Trw = {Teacher AND Spare Time AND At School AND Personal Comp. AND Read Write}.

The policy Tro represents the context condition under which the resource R is allowed to read-only mode. The policy Trw defines the context condition under which the resource R is operated in the read/write mode. This is almost acceptable with the [14]. Another system [21] adopts access control based on a need-to-know principle, where the requests for access are allowed when relevance to the requester's project is identified. For example, if we consider a data analyst's present the project development of a mechanical project, it would be illegitimate for the analyst to have access to documents on other aspects, e.g., feminist activities. Above examples contributed to move towards adapting to the situation and need. Adopting the user contexts [14, 19] to his need motivated to implement an adaptive access control according to the changing context.

3.0 PROPOSED SYSTEM

This section describes the architecture and a working model of the proposed system.

3.1 Architecture

Centralized approach or decentralized (distributed) method can follow while building context-aware access control system. However, selection of access control method is based on ubiquitous environmental requirements and associated risks. We adopt a centralized approach for access control model for the users in small ubiquitous environments like a college campus, centralized offices, restaurants, and malls. The architecture of the proposed CAAC model is given in Fig.1.

The architecture comprises of three units: Device Unit, Validation Unit, and Allocator Unit. The Device Unit is the user's device or user registered in the central system maintained on the academic campus. Validation Unit is responsible for authentication and authorization of a user. Allocator Unit manages required credentials of context and context processing for accessing the higher priority resources for the individual user.

The proposed system uses the following types of profiles [15]: **Personal Profile**: It contains data about the user like name, User_Id, password, designation or Usertype, department, mail-Id and address uploaded while registering for the system. These details are used to define the user type while authentication and authorization. For example, usertype may be a student, researcher, guest, teaching faculty or administrative officers. A database in the Allocator unit stores the personal profile in the structure way as per the application requirement.

Explicit Profile: This contains clear user data collected from past interactions. When authorization change is required, this profile is used for customization and synchronized for future analysis. For example a User_Id/username, password, accessed web resources, log details, mobility to the user and device, time

and date of the log and last level defined. The logger of Allocator unit stores the exact profile data.



Figure1: Architecture of CAAC model

Implicit Profile: It is the set of all data objects within a system processed by user profile and explicit user profile data of users for new validations sent on to Validation unit.

3.2 Working Model of the proposed CAAC

This section describes the working of the proposed CAAC model. The working of CAAC is enforced through identification of the subject before granting or denying access to the object. For example, user U authenticates himself to a CAAC system for identification. After the user identification, requests are verified to access resource R. The computing system verifies the privilege before the permission P is granted for the user U for accessing resource R. If the privilege of accessing the resource R for user U is not included in the access policy set, permission is granted or denied only after processing of contextual information C about a user. The Algorithm.1 depicts the operation of CAAC.

3.2.1 Device Unit

As mentioned earlier, this unit defines the user device and user who access the resource. The authentication of the user is delivered from the device the user is using on the campus that has been already registered in the central system.

3.2.2 Validation Unit

Validation Unit is responsible for authenticating and authorizing the user by obtaining necessary data from the Allocator Unit. The Validation Unit consists of Authenticator and *Formatter* for the identification of an individual.

Algorithm 1

- 1. INPUT: Access to web resources
- 2. **OUTPUT: Access or deny**
- 3. Start: Request for resource access 4.
- if: username and password are verified
- 5. allow authorized resources
- else reject as unauthenticated user 6.
- while: access request is for higher privilege resource 7.
- do: training for access control by collecting contextual 8. information about the user
- 9 Set a window size T for observation
- 10. if: logger has supporting data about a user
- 11. Threshold levels are verified
- 12. Implicit data from a database is set and sent to validation unit
- 13. if received data conform to extend an authorization
- 14. allow the user to access
- 15. else: deny by rejecting the request
- 16. end if
- 17. end if
- 18. end while
- 19. end if
- 20. END

Authenticator: Authenticator verifies the user identity whenever a request arrives from Device unit. The user-Id and password is sent to the database in Allocator unit for confirming the identity. In our proposal, user U is associated with the user type defined permanently at the time of registration. The user is authorized to access the resources coming under his privilege.

The User_Id identify the usertype and associated privilege p. The usertype for a user U belonging to five categories with privilege level p from 1 to 5 given in Table.1 are expected from eqn.(1). For example, if User_Id is a registration number of a student starting from 1 to 1000, then the User_Id associates the privilege p1 to define the Usertype-1 or if the User_Id is an Employee_Id starting from 1000 to 2000, it associates the privilege p2 as Usertype 2.

 U_{id} =User type* P_i (1)

Formatter: Formatter is used to convert the heterogeneous context information into predefined ASCII values. These representations are defined as checksums and the conversions are done for the processing of data values for training. Checksums are scaled between 0-25 in the *Priority Assigner* and *Observer*, discussed in detail in section 3.2.3.

3.2.3 Allocator Unit

The whole process of collecting the contextual information for training and modifying of the usertype requires the participation of *the Database, Priority Assigner, Observer and Logger.*

Database: The database is used for storing all the relevant user data and threshold values for authentication and authorization. If the resources are found increasing, a resource optimization using XML can be opted [20]. A query for authentication and authorization are presented in <Username, hash_Password> and <Username, Resources> format. The password is hashed and stored to avoid the malicious hand attack on the database.

Priority Assigner: It assigns the priority for different contextual information. This contextual information is retrieved from the user device from the repositories either in a pull or push mode. In a pull mode, the context-aware system explicitly requests for context information from GPS systems periodically, or GPS system can drive the contextual information whenever a new location is discovered. The extracted context data are transferred to the *logger* for further processing of the profile data mentioned in Sec. 3.1. Earlier to this contextual information is assigned a static priority level ranging from 1 to five as shown in Table 2. Where 1 represents the lesser priority levels may change with time depending on user behavior. For example, if a PG student spends lots of time in a lawn rather than in a research lab or classroom and trying

to access the research related resources. Subsequently, user priority level for lawn changes from 1 to 2 to that user.

Observer: The *observer* gets the time interval and window size for training the user. The window size is used to verify the allowable time for observation before changing the authorization. The defined static Usertype is modified from eqn.(1) according to the requirements of the user by putting him/her to training/observation for a window size of T_o . The Window size is defined [22] for each user for a time interval t_i from eqn.(2). For a number of requests x_n , the proportional time interval t_i is found for *i* values from 1 to 1440 min(24*60) from eqn.(2). Eqn.(3) provides required window size for the user U_i and this remains to be predetermined forever for *N* number of access requests. A total number of five Usertypes and resource type were considered for the experimental purpose.

 $t_i = x_n / min$ (2)

User		Privilege	
Туре	Users	Sites	Download capacity
1	Undergraduate students	Education related sites	2Mbps
2	Postgraduate students	Resources of the first level with technical sites	4Mbps
3	Faculties & Research Students	Resources of the second level with scientific related resources	6Mbps
4	Head of the dept., deans, placement officers	Resources of third level with commercial resources	8Mbps
5	Administrative officer or head of the institute	No restriction	10Mbps

 $T_0 = t_i * (N/5)....(3)$

Logger: This verifies and stores the new access permission for the user. As mentioned in the Observer section, the training is adopted when an unauthorized resource request is made. Logger performs the process of training by gathering the contextual information through the following steps:

- Gather priority for each context attribute from assigner.
- Threshold fixation for accessing each resource through data analysis, which acts as the restriction parameter for the unauthorized access.

Table 1: Statically defined User type and privilege levels

Table 2: priority levels defined for Context information

In the process of registration the CAAC model, the every Usertype is defined with the set of resources in his/her privilege. In the process of training the new resource is allotted by calculating the dynamic threshold T to decide the allowable resources. The threshold for the new resource (0, 1), where 0 represents resource with high priority, and 1 represents a resource with low priority. The allowable upper threshold UT ($\mu + \sigma$) and lower threshold LT ($\mu - \sigma$) are evaluated through the standard deviation and mean from eqn.(4) and eqn.(5) respectively. The y_i is the captured value about the particular resource among N types. These values supports to take the access decision on resources. The context data are validated by the checksum value of eqn.(6) using the eqn.(7). Where the eqn.(7) gets the checksum value for the serving resources (R1, R2, Rn) at the priority level (P1, P2,...... Pn).

$$\mu = \frac{\sum_{i=1}^{n} \mathbb{Y}_i}{\frac{N}{\sigma = \sqrt{\sum_i (\mathbb{Y}_i - \mu)^2}}} \dots (4)$$

 $CS_{CD} = User type \times \sum_{n=1}^{4} C_n \dots (6)$

 $CS_{Ri} = P_i \times R_i \times CS_{CD}$ (7)

$$CS_{T_{n}} = t_i \times Usertype.....(8)$$

The overall checksum is found by the formatter through eqn.(6) and eqn.(8) for the user U. A final checksum CS_f is considered from eqn.(9) for promoting the user to a higher level. Where CS_{Ri} is the checksum value of resource R_i and CS_{To} is the checksum value of the threshold values of the contextual analysis. Thus, a new Usertype is authenticated in the Validation unit with allowable threshold and forwards the access permission without any interruption or interaction with the user, otherwise Validation unit responses with a suitable message.

$$CS_f = CS_{Ri} + CS_{To} \quad \dots \dots \quad (9)$$

Before we proceed further, let us consider a case study below to build the required scenario for our proposed CAAC model.

Let us consider the user is an undergraduate student trying to download software or videos from the project lab on the date Dec. 25th. But according to the access control policy, the student belongs to the Usertype-1 and don't have the privilege of obtaining commercial resources. At this situation, the context-aware system extracts the contextual information related to the user and requesting resource. The system identifies the location of the user as project lab through an IP or MAC. The assignor has a priority level of 4 out of 5 for the project lab, and date has a priority value of 4 out of 5. The combination of these context checksum values provides proper values to upgrade the Usertype to higher levels as per the allowable threshold values in the database. On the same, logger collects the past data regarding the involvement of the user in the research or development activities. After identifying these, training the request for some time interval is required for better analysis. Completion of all these learning produces a change in Usertype for the temporary session. Once the session is completed or if he/she becomes idle, the system is attentive to find that the user is not active. Thus, the new Usertype is discarded and predefined Usertype is allocated.

Keeping the above scenario in mind, we consider C1, C2, C3 and C4 as context data related to the user while requesting for the resource. Where C1 may be the location extracted and C2 may be the date and time of the request, C3 is past access level provided, and C4 is the resource requested. The combination of these contexts verifies the considerable change in the Usertype. From CS_{CD} , we find the level of change required, and every incident of change in Usertype are stored in the logger as recent historical data.

4.0 PERFORMANCE ANALYSIS

Every model, system or mechanisms are analyzed for its performance with respect to various aspects concerning its application. In this section, we discuss a statistical foundation by considering a performance cost as a quality metric for performance analysis of context-aware access control model.

Average Access Delay: The adaptive access control models bring in more the performance cost compare to traditional models [19] as new procedures are considered for access decisions. The investigation of the level of performance value is measured with a quality metric called Average Access delay (AAD). AAD is the difference between the time of access request sent and the time of access control decision made.

AAD in milliseconds for n access request made by a user U on the same resource R is considered. Each access request varies with the context; priority levels (1, 2, 3, 4 and 5) but operates on the same attribute cardinality (i.e. after 3). The overall ADD was assumed to be about 0.2% higher in sensible context levels 4 and 5 in Table.1.

Contextual data	Туре	Level of
		Priority
	Canteen ,Recreation club, stadium and	01
	lawn	02
	Classrooms, Laboratory	03
Location	Faculty Chambers, research lab and	04
Location	Project lab	05
	Heads and Dean Chamber	
	Principal office, Placements office and	
	administration office	
	August and February	01
	September and March	02
Date	October, November, April, and May	03
	December and June	04
	July and January	05
	Educational	01
	Educational and Technical	02
	Educational, Technical and Scientific	03
Resources	Educational, Technical, Scientific and	04
	Commercial	
	Educational, Technical, Scientific,	05
	Commercial and Entertainment	

Sensible Iterations: To ensure the statistical significance of the experimental result in sec.5 we identified the AAD for multiple iterations r. A particular value of r, at which the unpredictability tends to disappear is selected and used subsequent with the access control delay factor. In accordance,

a larger value is considered, and it leads to the less effect of randomness on the AADs. So r from eqn.(10) is satisfied to reach the precision level for the effect.

$$\mathbf{r} \ge \left(\frac{\mathbf{t}_{\infty/2} \rtimes \mathbf{S}}{\epsilon}\right)^2$$
.....(10)

For small values of r, $t_{\alpha\beta}$ is used, as t_{α} is the student's tdistribution. Where S is the standard deviation and ε is the specified error.

As sample size *r* increases, the distribution became just about customary to normal standard distribution and found for a population of unknown mean μ and an unknown standard deviation. A student distribution $t_{\infty/2}$ is computed with (r-1) degree of freedom from eqn.(11) for $n = (3, 4, \dots, 12)$. The n = 12 is predicted to be appropriate which is almost equal to the normal standard deviation.

5.0 RESULTS

The testing of CAAC model includes different parameters of its subject to evaluate the system efficiency by discovering the AAD.

Table 3: Time required for processing i/p & o/p data

TI	Input	Output	Time(ms)	
Umt			RBAC	CAAC
Formatter Unit	UC	FC	15	15
Allocator Unit-Observer	FC	Flag	-	16
Allocator Unit- Priority Assigner	FC	FC	21	21
Allocator Unit- Logger	FC, UC	Void	-	16
UC –Unformatted Context information, FC– Formatted Context information				

The addition of context in access control always attaches additional burden on computation, intern increasing the performance cost. Hence, evaluated the time required to process i/p request to access resources for our proposed model by considering the context attributes for a user with the RBAC model which is based on the roles the user. We found that 32ms of extra delay was introduced due to the consideration of context information shown in Table.3. In the same form, three sample cases for 2000, 5000 and 10000 access requests are considered for observing the deviation in the performance cost measured in msec. The observation was done from Fig.2, that higher performance cost for 2000 access request, an increase of 0.2 % for 5000 access requests and the normal range for 10,000 access requests. The proposal extends only by 0.2% for n number of access requests for different contextual information.



Figure 2: Context attributes v/s number of requests



Figure 3: AAD for the location attributes



Figure 4: AAD for resource attributes



Figure .5 AAD for time attributes



Figure 6: AAD for history of access attributes



Figure 7: AAD for change in the authorization

The flexibility in access and memory to store related data add performance cost. So evaluation of AAD for change in authorization for different Usertypes is demonstrated to decide access control of the requested resource. A more AAD was observed for low level Usertypes compared to higher level Usertypes as the promotion to a higher level needs a clear and perfect analysis. For example Usertype 1& 2 requires more analysis compared to Usertype 3 & 4 because, Usertype 3 & 4 has almost all privileges except commercial and entertainment as mentioned in Table.2, but Usertype 1 & 2 have minimum rights. Fig.7 confirms the above discussion that, Usertype 1 & 2 requires 20% extra processing cost compared to Usertype 3 & 4.

6.0 CONCLUSION AND FUTURE SCOPE

The request to access particular resource is authorized when the content of request information is relevant to the user's current context information. The user's information is extracted through contextual information like resource, location, time and history. All these together, determine a required authorization for a user and makes the access control adaptive in nature.

In our future works, we intend to adopt a trust based adaptive context-aware access control, as trust enhances the action and activity to change the access control for the user in the security system.

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Crime and Criminal Tracking Networks & Systems Using Agile Methodology

Saru Dhir¹ and Swati Sarraf²

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Abstract- Paper represents the implementation on the project: Crime and criminal tracking network and system (CCTNS), using the advance and current methodology such as agile methodology which is important and beneficial for both customer and the organization also. Various factors like on time delivery, customer satisfaction, minimum cost, customer involvement, minimal documentation, more face to face communication, better understanding, high performance, better quality product are necessary factors for a project to be successful and this is where current methodology comes as compared to earlier traditional approaches where planning is fixed, strict rules are to be followed, requirements are initialized before start of the project, more documentation, less customer involvement, whole product to be given to the customer at the end which is not appropriate for the current scenarios.

Index-Terms: CCTNS, CAS, Agile methodology.

1.0 INTRODUCTION

Crime and criminal tracking network and system, project automates functioning at all the police stations so as to provide security and safe living for the common people. Hence the police department is turning towards IT to increase efficiency by enabling better utilization of resources. The goal of the paper is to generate a core application software(CAS) for CCTNS which not only benefits police department, but also creates mechanisms and facilities to provide public services, i.e. for citizens like registration of online complaints, verification of persons, for knowing the status of their registered complaints, for any registration of foreigner. The project provides enhanced tools for crime investigation, crime prevention, etc. Only voice connectivity between the police stations is there, but there is no system where one police station can directly contact with other one. The whole system believes only on paper work. So the goal of the project is to facilitate retrieval, collection, analysis, transfer, storage and sharing of data [1].

This project makes police to detect criminals and crime faster as there will be centralized database, make functioning citizen friendly, assist police in better management of all services and functions, keep track of all the cases, reduce much paper work application, which is because of a power cut problem which means during a large part of the day power is not there so this problem is to be managed. Hence offline forms are provided. The offline forms are provided for citizens. The question comes why there is a requirement of some offline forms of this.

¹Amity University, Greater Noida, Uttar Pradesh, India. ²Wipro Ltd., Greater Noida, Uttar Pradesh, India.

Email: ¹sdhir@amity.edu and ²swati.sarraf11@gmail.com

Synchronization must be there between the project office and the agile management office [2] because any new methodology takes time to get absorbed in the organization. The current methodology is an incremental and iterative approach of software development which welcomes the changing requirements of customers as and when required, where priority is given to the tasks and features to be implemented, shorter milestones are considered. There are no fixed rules and guidelines to be followed in current methodology, but of course some principles are there [17]. Different requirement tools are also used to support a secure web application and increased the process maturity level [11] [19]. Due to the flexible nature of the current methodology, the level of customer satisfaction increases [14].

2.0 LITERATURE SURVEY

Some of the work done in the Common Integrated Police Application (CIPA) [4], in which data is collected and managing the records, applying the statistical analysis and office automation on crime and criminal data. Crime and Criminals Information System (CCIS) was launched in 1990 and it is a National Crime Records Bureau driven program. It has been put into operation in 35 states and union territories.

Wireless Criminal Tracking System using Mobile Computing aims to apply mobile information system in the police department. The system introduces the development of central data to be accessed on mobile phones by police and others which is maintained by administrator at each police station [5] [13]. This system is useful tool to keep track of criminals and their activities. There are problems in identifying criminals due to lack of instant data about them. These problems were solved by making the required data available on mobile. This reduced policemen's labor and precious time. The benefits of this system are fast and effective communication between common people and police, user do not require any technical knowledge to use it, the system can be maintained easily, less implementation cost and software easily available.

The process of agile software development was described with the comparison between traditional and agile approaches [6].

3.0 AGILE METHODOLOGY

Agile methodology is an incremental and iterative approach of software development which works on following principles [6] and agile manifesto [7] :

- Individual and interaction over process and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following a plan.

The characteristics of agile software development processes are time bound, adaptive, modular, iterative, incremental, people oriented, and collaborative [8]. As the customer requirement became change or need to make modifications continuously, in that case it becomes difficult to estimate the project which shows the unpredictability; to overcome from this chaos agile methodology is used [9]. There is more customer involvement in the project. Customers who are involved in the development process are known as active stakeholders and provide their requirements directly to the developers and set the precedence according to the need. It was also suggested the conditions that are needed in traditional and current methodologies and improvements of agile methodology so that this methodology can be implemented in the organization effectively [10].

The methodology does not follow any rules for implementation of the project, but yes, there are some ethics and principles upon which it works. Documentation is less which in comparison to earlier approaches where everything depends on documentation [12]. It delivers the project in short milestones to the customer so that customer can know and track the progress. Face to face communication is there which increases more understanding of the problems, requirements, etc. [3]. The development team prioritizes the task and features with a focus on higher priority task first. A new development life cycle was defined, Swift Tack, under Agile methodology [18]. In this methodology requirement are described by the product owner and all the details regarding what to do is included in the product backlog list. Then some features are given priority to select the product from the product backlog list to scrum backlog list. There are various methods of this methodology which are feature driven development, dynamic software development methods, lean software development, crystal methodologies, scrum and XP [16]. There are different automated testing tools and models are used to support the agile methodology [15].

4.0 IMPLEMENTATION OF PROJECT USING AGILE METHODOLOGY:

In this section now, how the project CCTNS is implemented using current approach is discussed. Firstly Crime and Criminal Tracking System automates all the functioning at police stations. It not only provides crime investigations, reports, FIR etc., but also provide citizen services in which one part is Eforms which are offline forms, can be downloaded as xml to upload data which saves time and prevents internet connection problem due to power constraint problems in rural areas. This increases performance and speed too as compared to another part CAS where these citizen forms are also available but not in offline mode. Due to heavy data in the forms and session time out problem E-forms are made. Firstly the citizen logins on the system with his login id and password, secondly, he clicks on the link download and submit e-form, then the respective form can be saved and then all the data is filled, after this the xml can be generated and saved on local disk. Finally the xml is uploaded in the respective form and then the form is submitted. The flow of e-forms is depicted as in following Fig. 1



Figure1. Flow chart for E-forms

During the project development there are certain factors due to which team adopted agile methodology. In the project development, customer has a continuous interaction with the project development and customer updates the team with new requirements. The customer has continuous involvement during the software development and direct interaction with the whole team. The team is divided into different members such as managers, developers, testers, project lead, scrum masters and stakeholders.

The team has 2 DBA's, 9 developers and 4 testers and each team member have the face to face communication between each other to avoid any type of miscommunications and misconceptions. Developers and testing team worked together and implement and test the parallel code. Testing team reduced the bugs and generated the bug report helps in reducing the discrepancies. All team members were responsible for the whole project and their activities. At the initial stage project was divided into different tasks and prioritize them. User stories were created and each task is divided into different sprints.

Meetings were conducted every week for 15min. In each and every meeting different issues were discussed related to the project team. Different issues such as their current work status, achieved target status and the issues faced by the team members were discussed. All of these issues were discussed in the presence of customers and team leads. Weekly project performance, quality was tracked by customers and new modifications were done according to their need. After the completion of each sprint cycle final product was delivered to the customer and tested on client site. Fig.2. shows the theme of CCTNS using the current methodology; where current methodology is agile methodology.



Figure2. Theme of CCTNS using the current methodology

5.0 CONCLUSION

Research Paper is based on the case study, having the implementation of the project, Crime and Criminal Tracking Network and System. The focus of the project was to provide services to citizens related to criminal complaints, FIR etc. E-forms were generated which can be filled offline by users to save the time. This increases performance and speed too as compared to another part CAS where these citizen forms are also available but not in offline mode. The project was implemented using agile methodology produces a higher quality product, resolve the unpredictable needs of customer, development of the project become more flexible as the business climate growing at an exponential rate of change.

Using the agile approach project development, its final results were transparent to the whole team.

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An Approach for Server Consolidation in a Priority Based Cloud Architecture

Suneel K S¹ and H S Guruprasad²

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Abstract - Cloud computing is a new emerging technology in IT field. Cloud computing has capability to provide whole IT as a service to its users. There are many characteristics of cloud computing that makes it attractive in a variety of problems. Users of the cloud are free from the housekeeping activities related to the infrastructure. This is because in cloud computing, managing the hardware is cloud service provider's concern. When a user application is deployed in the cloud, depending on the QoS specified by the user, cloud service provider deploys servers for smooth running of the user application. The total number of servers deployed for a user application must be optimal, because underutilized servers are not economical for both cloud service provider and cloud user. Underutilized servers consume power when they are idle; hence deploying optimal number of servers is critical in the operation of the cloud. Server consolidation is the method of increasing the utilization levels of servers, such that more applications are accommodated in servers, this avoids unwanted deployment of servers. This paper provides an approach towards server consolidation in a priority based cloud architecture.

Index Terms - Cloud Computing, Server Consolidation, Priority based Cloud Architecture, Server Consolidation Algorithm, Live Task Migration

1.0 INTRODUCTION

Cloud computing is mainly based on utility computing. Utility computing meters the amount of resources, which is provided for the customer, and bills the customer accordingly. Usually utility computing has limited set of resources to provide but cloud computing has huge computing infrastructure that can be provisioned to the customer. Similar to water, electricity and many other utilities, 21st generation is moving towards utility computing [1]. Utility computing is realized through cloud computing. A cloud has one or more datacenters and each datacenter may have one or more hosts on which the tasks submitted by the customers run.

There are many features that make cloud computing very successful in current computing generation. Among these, two features of concern are "pay-as-you-go" and shared environment. "pay-as-you-go" means that the customers of the

¹PG Scholar, Dept. of CSE, BMSCE, Bangalore, kssunil.shastry@gmail.com,

²Professor and Head, Dept. of CSE, BMSCE, Bangalore, drhsguru@gmail.com [Corresponding Author]

cloud may not have to be bothered about the upfront financial investment before using the cloud and charges from the cloud, are based on the amount and time of resources that the customer has used.

If the demand for which the organization or company requires computing resources is periodic or volatile or the company is not able to accommodate the computing infrastructure, then cloud computing acts as the perfect solution. In cloud computing, the computing infrastructure and its related aspects are cloud service provider's concern. Second feature that is of concern is the shared environment. Multiple users share the same underlying cloud infrastructure. This increases the utilization of the resources and thus decreases the cost per utilization of the resources.

Cloud computing has improved the computing infrastructure efficiency by means of four key factors [2].

1. Dynamic provisioning: Typically, IT managers deploy more resources than the actual resources that are needed to run an application. The reason for this is to tackle the fluctuations in demand. But, this results in over-provisioning and underutilization of resources. In cloud computing, cloud service providers deploy dedicated resources to overview and predict the behavior of demand of the deployed application, so that they can automatically scale-up and down the resources depending on the demand of the application. This is called dynamic provisioning and it is visioned on the better utilization of IT resources.

2. Multi-tenancy: Multiple organizations can use the same cloud for their purposes. The cloud differentiates between each organization and provides resources accordingly. This leads to the shared environment which increases the utilization of resources and decreases the overall energy use.

3. Server Utilization: Servers in cloud can process requests at a greater speed than the on-premise servers. The reason for this is that cloud service providers tend to run the servers at a higher utilization levels. Servers at the cloud can handle multiple types of requests using virtualization. For each request, a virtual machine is created in cloud and all virtual machines are made to run on a single underlying platform.

4. Datacenter Utilization: Server utilization ultimately leads to the datacenter utilization. Cloud service providers carefully balance the energy consumption in datacenter and datacenter utilization.

The software at the cloud service provider side, such as cloud coordination software, is responsible for the management of idle time of hosts under a datacenter. The load balancing at the datacenter specifies that no host should be idle until all the user requests at the datacenter are executed. A static load balancing strategy is not sufficient to manage the idle time of the hosts. Hence, in this paper a runtime strategy, which uses collaboration between servers, is used in combination with the static strategy in the management of idle time of servers at the datacenter. Management of idle time of servers in datacenter finally leads to the server consolidation.

2.0 LITERATURE SURVEY

2.1 Priority based cloud architecture:

A cloud in cloud computing is a set of one or more datacenters and each datacenter has one or more hosts that execute the user's tasks. In a priority based cloud, hosts are grouped into different sets and each set is assigned a priority level.

Hosts in a priority level only execute incoming tasks which corresponds to same priority level. Depending on the levels of the priority of user's tasks, the grouping of servers in the datacenter can be tuned accordingly.



Figure 1.1: Priority based cloud architecture

In Fig 1.1, the datacenter can handle three priority levels. The Figure shows the static scheduler that is situated at the datacenter level. The main functionality of this static scheduler is to distribute the tasks onto the group of hosts according to their priority levels.

This architecture uses static approach for load balancing. The basic essence of load balancing is that the load on the hosts must be distributed such that no host should be idle until all the tasks in the datacenter are executed. This means that the hosts in the datacenter must be utilized almost equally to increase the speed of task execution. In this architecture, if the granularity of arrival of tasks at a priority level, say p, is less than the granularity of arrival of tasks at priority level p', then hosts that handle priority p is always idle between the two corresponding arrival of set of tasks and hosts that handle priority level p' is always overloaded.

This introduces the variation in the utilization levels of hosts. This variation affects the overall utilization of the datacenter. In order to overcome this, a combination of static and dynamic approach for load balancing is used in this paper which is adaptive to the events of load balancing. The approach proposed in this paper uses the collaboration between the hosts of a datacenter, so that they can manage their workloads. Since both static and dynamic approaches have been used, the proposed methodology is stable and effective [3].

2.2 Server Consolidation

Datacenters are the central elements in cloud computing. Datacenters are responsible for the storing, managing, networking and controlling of data. A Datacenter is made up of many numbers of servers. 30% of the servers in a datacenter are under-utilized [4]. Due to under-utilized servers the ratio of power consumption to server utilization is very high. This indicates that the amount of power consumed by a underutilized server is same as the amount of power consumed by a moderately utilized server [4]. In cloud computing, cloud service provider must be able to rapidly increase the server numbers in peak demands. Increasing number of servers at peak time adds flexibility in the technology. But, technology like cloud computing which treats electric power also a utility, must optimize the number of servers required for the operation. This calls for the server consolidation techniques that have to be implemented at the cloud [5]. Server consolidation in layman's term can be defined as the process of aggregating multiple tasks running on different servers to a reduced optimum number of servers.

[7 & 10] lists the challenges of the datacenter. Virtualization in datacenter along with server consolidation is sufficient enough to address all the challenges specified in [6]. Some of the advantages of server consolidation is mentioned in [7]. Server consolidation in datacenters leads towards the energy efficiency and resource utilization. But, there is calculated amount of risk in server consolidation. Discussable risk associated with the server consolidation is the performance. When more and more tasks are multiplexed onto a server, achieving performance isolation becomes difficult [8].

2.3 Utilization of hosts in datacenter and overall performance of datacenter:

The above graph shows the percentage of utilization of three hosts in a particular datacenter. It is evident from the figure that the host 3 is utilized at most and host 1 is least utilized. This imbalance in the utilization levels costs the performance of the datacenter because the host 3 can become a performance bottleneck since it is overloaded all the time. The imbalance in the utilization level of hosts indicates that the load is not exactly balanced onto the hosts or the ineffectiveness of the load balancer. In these conditions usual tendency of the cloud coordination software is to deploy more hosts to offset the performance overhead that has occurred. This phenomenon is called automatic scale-up. Although, scaling up does increase the performance, it also increases the energy consumption of the datacenter. Increase in energy consumption raises many concerns in the area of power consumption and environmental impacts.



Figure 1.2: Utilization of Servers in a datacenter

Solution to the above problem is to look at the host utilization. [9] Provides proof that server utilization is the area of improvement to decrease the power consumption in the datacenters. With respect to the above graph, the solution is to balance the utilization levels of hosts under the datacenter either by using improved load balancing techniques or by using special techniques that target the area where load balancer cannot reach. This paper provides one such mechanism that uses the host collaboration to synchronize the workloads between the hosts so that the utilization levels are almost close. The proposed approach also aims at server consolidation.

2.4 Task migration in cloud

A task in cloud represents the user's work that is to be executed in the cloud. In order to understand the task migration in cloud following concepts are required.

2.4.1 Virtualization in cloud:

Cloud mainly relies on server virtualization. Virtualization is used to address the volatile requirements of the computing environments of cloud user. Each server in a cloud is virtualized. Virtualization is the process of abstracting physical hardware and to provide logical or virtual hardware for use of the applications and operating systems. These virtual hardware are called virtual machines (VM). Each virtual machine contains an operating system called as guest-OS that runs on the virtual machine and applications that run on these guest-OS [10].

Some of the benefits of virtualization are [11]

1. Cost reduction: Several virtual machines run on a single underlying hardware reduces the cost of using different hardware for different applications.

2. Decoupling: Traditionally, applications that needed to run on a machine should be present on the same machine. But virtualization decouples this binding and typically allows the applications to reside on the virtual machine.

3. Flexibility: Since a virtual machine represents the environment that an application requires to run, flexibility in using the infrastructure by creating a virtual machine for each of the application.

4. Sustainability: Virtualized environments are soft on resources. They use fewer resources and this leads to the efficient utilization of resources.

A software that runs on the top of physical hardware of the server and manages the virtual machines in the server is called as the virtual machine monitor (VMM). VMM can be

visualized as the operating system of servers. VMM are also called as hypervisors [10].

Since every task in cloud runs on its VM, it is easy to migrate the task from one host to another. It is as simple as moving VM from source host to the destination host.

2.5 Lifetime of a task in cloud:

Lifetime of a task in a cloud includes the following stages [12] 1. Upload: Once a new task is generated by the user, its source code and the data required for the creation of VM is sent to the datacenter of the cloud.



Figure 1.3: Traditional and virtualized server architectures

2. Task assignment: Once the data required for the execution of the task is uploaded to the datacenter, a local dispatcher assigns the task to a server for the execution.

3. Execution: The actual execution of the task is done at this stage by the server.

4. Migration: A task along with its VM may be transferred from one server to another so that the execution is handled by the destination server. This can happen several times in a task's lifetime.

5. Download: At this stage, the user retrieves the results of the execution from the server of the datacenter.

2.6 Challenges for migrating tasks in cloud

The major challenges in migration of a task from one host to another in cloud are defined by two important questions:

2.6.1 When to migrate a task from source host to the destination host in a cloud?

Whenever a task is submitted to the cloud, how to decide when the task has to be migrated from source host to the destination host. There are three models that decide the timing of task migration.

Centralized migration policies: In centralized migration policies, there will be a central component that decides when to migrate a task from source to destination host. This component considers various parameters for the decision such as load balancing, resource acquisition and so on [13]

Server-initiated migration: In centralized migration policies, the complexity of decision is high since it is a cloud-wide approach. Server-initiated migration reduces this complexity. In this approach, server is responsible to take the decision of migration of tasks.

Eg: whenever the load on the server increases, it initiates a migration of tasks to a destination server that is idle.

Task-autonomic migration: This gives task the capability to decide about the migration.



Figure 1.4: Migration of task between servers in a datacenter

2.6.2 How the migration of the tasks from source to destination host happens?

The task migration can be classified into two categories.

Live migration: In this type of migration, the task will be still working during its migration from one host to another.

Non-live migration: In this type of migration, the VM is stopped at the source host and it is transferred to the destination host and then the VM is started. This type of migration leads to the black-out during the migration of the task.

There are many algorithms that can be used to migrate tasks from source host to destination host. Some of them are:

Pre-copy: In this algorithm, the processor on which the task is running is not stopped during its migration to the destination host.

Post-copy: In this algorithm, the modes of the VM and least information that is required for the starting up of the VM at the destination host is sent to the destination host. Then, VM is started at the destination host, after this the source host initiates the page transmission to the destination host. This algorithm eliminates the overhead of resending pages that exist in precopy algorithm. [14, 15].

Three-phase migration (TPM): This algorithm is similar to the pre-copy and has least suspension time for migration of VM with all its mode along with virtual disk [16].

3.0 PROPOSED METHODOLOGY

The following functions are required for defining the algorithm.

Granularity of arrival of tasks at priority levels (G(P)): This function, denoted by G(P) where p is a priority level, determines the granularity of arrival of tasks at priority level p Granularity of arrival of tasks at a priority level 'p' is the amount of time elapsed after the completion of current set of tasks and before the arrival of new set of tasks both at a priority level 'p'.

Priority of tasks and servers: The priority of the tasks and servers are calculated by the following functions.

PLT(t) - determines the priority level of task 't' which are dynamic.

PLS(s) - determines the priority level of server 's' which are preset.

Execution time of set of tasks (E(T)): This function determines the execution time of set of tasks T.

E(T) - execution time of set of tasks T where T={t1,t2,....,tn} Algorithm:

Let $S = \langle S1, S2, \ldots, Sn \rangle$ be the ordered set of servers that can handle tasks with priority levels 1,2,...,n and PLS(S1) \rangle PLS(S2).

- 1. Let T be the set of tasks arrived at the datacenter from the user. For each task ti \in T, calculate PLT(ti) and assign them to the respective servers.
- Servers assigned with the tasks start executing the tasks. Whenever a server Si ∈ S finishes execution of all the tasks assigned to it, Si sends finish message to an immediate server Sj such that PLS(Si) > PLS(Sj).
- 3. Whenever a server Sj gets a finish notification from Si, it performs following steps.
 - 3a. Calculates the granularity of tasks at priority level i by using G(PLS(Si)).
 - 3b. Selects a set of tasks 'M' such that M={m1,m2,....,mk} where mi is a task and 1<=i<=k. And calculates E(M).
 - 3c. If G(PLS(Si))<E(M), then migrate set of tasks M from Sj to Si for it execution at Si and exit. Else

Reduce the number of tasks in M an recalculate the E(M) and go o step 3.c

4.0 RESULT AND DISCUSSIONS

The diagrammatic explanation of the working of the algorithm is shown below.



Figure 1.5: Phase-1 in the working of proposed algorithm

Let's consider a datacenter with 3 servers, which serve different priority levels. Let A, B, C... be the set of tasks arriving at the datacenter.

The simulation of the proposed methodology is done using Cloudsim Simulator. The graph shown in Fig 1.7 clearly explains the utilization of servers in the datacenter. Server utilization curve of the servers without consolidation is almost equivalent to the linear curve. This asserts that the server 3 is over utilized and server 1 is underutilized and the server 2 is in moderate utilization. This imbalance is due to the static scheduler which schedules the incoming tasks to the cloud in a pre-defined way and is not able to balance the utilization levels of the servers. The curve that represents the server utilization levels in a datacenter with consolidation is higher than its counterpart. Efficient balance of the load onto servers normalizes the utilization level of servers which is justified by the corresponding curve.



Figure 1.6: Phase-2 in the working of proposed algorithm



Figure 1.7: Utilization of servers in the datacenter

Fig 1.8 and Fig 1.9, shows the waiting time of tasks at server 2 and server 3. Primary analysis of these graphs specifies the reduction in the waiting time of the tasks after a period of time. Reduction in the waiting time of the tasks at server 2 starts after the tasks at server 1 has finished and server 1 has requested server 2 to send some of its tasks for execution at server 1. The reduced waiting time can be calculated from the graph. In this setup reduction in the waiting time of tasks is due to the effective migration of the tasks that are waiting in one server to

another. The overall approach for server consolidation is justified by the graph that is obtained from the simulation of an instance of the problem.



Figure 1.8: Waiting time of tasks at server 2



Figure 1.9: Waiting time of tasks at server 3

5.0 CONCLUSION

The simulated result of the proposed algorithm for server consolidation works positively and the same is justified by the graphs that are plotted using the simulation results. From the graphs of the simulation, it can also be concluded that the proposed algorithm is efficient increasing the utilization time of the servers by effectively adjusting the waiting time of the tasks at different servers. The proposed algorithm can be further extended to many cloud computing architecture.

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Quick Survey of Benefits from Control Plane and Data Plane Separation in Software-Defined Networking

Pulkit Tanwar¹, Rajender Gohil² and Mudit Tanwar³

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Abstract — Software-Defined Networking (SDN) involves programmable networks. It has recently gained popularity because of simplicity in networks, easy evolvement and providing innovation in network programmability. In this paper, we survey the SDN infrastructure and the OpenFlow standard, examine the need for Control Plane and Data Plane separation, and study various SDN controllers and SDN application in Data Centers.

Index Terms - Control Plane, Data Plane, Software-Defined Networks, Survey, Comparative study, Networking, Virtualization.

1.0 INTRODUCTION

Earlier Traditional networks were referred to as "Internet ossification" because it was highly coupled network [25]. There was very tight coupling between Control Plane and Data Plane. This tight coupling discourages the evolvement of networks. All the decisions of data flowing through the network were made on boards' network element.

Software-Defined Networking, SDN is the newest approach to Computer Networking that separates the data plane i.e. the network devices that forward traffic from the control plane i.e. the software logic. This separation of data plane and control plane allows the network operator to control the network behavior from a single high level control program. This technology is being applied in mobile open networks and mobile transaction systems [26] to efficiently handle mobility in the context of future 5th Generation of mobile networks [27].

The deployment of Software-Defined Networking is used to solve complex Network management problems in real networks. SDN started when distributed network configuration was found to be unpredictable, faulty in operation and buggy. [1] To overcome this, in 2004, Portal Gateway Protocol (PGP) [2] was introduced and the central control point was named as Routing Control Platform (RCP) [1]. In 2005, this architecture was generalized and named as 4D architecture [3]. This 4D architecture spotlight the separation of the routing decision logic and the protocols of the network. In 2008, OpenFlow standard [4] was introduced which standardized the information exchange between data plane and control plane. An industrial driven organization is formed called as Open Network Foundation [5] to promote Software-Defined Networking and OpenFlow standard protocol.

Email Id: ¹pulkit.tan45@gmail.com, ²rajgohil04@gmail.com and ³mudit1102@gmail.com

In this paper, we survey the Software-Defined Networking paradigm and study in detail the infrastructure and architecture of the same. We examine the need for control and data plane separation. We then see the overview of various SDN controllers. At the end, we study SDN application in Data Centers.

2.0 DECOUPLING OF DATA PLANE AND CONTROL PLANE

In Data Communication networks, end user devices are interconnected with network infrastructure. This network infrastructure includes many switching elements such as switches and routers and they are shared between hosts. These routers and Switches are closed devices which have very limited interfaces. So it is very cumbersome for this network to evolve.

Software-Defined Networking infrastructure consists of two parts:

Control Plane

Control Plane is the logic that controls the forwarding behavior in the network. It is also regarded as the brain of the network. Examples:

- Routing Protocols
- Network middlebox configuration
 - i. Firewall configuration
 - ii. Load balancer configuration.

Data Plane

Data Plane forwards the traffic according to control plane logic. Examples:

- IP forwarding
- Layer 2 switching.

The separation of data plane and control plane can be used to evolve and develop them independently. This separation also helps the network to be controlled from a single high level software program which makes debugging easier. Both software and hardware can be evolved independently.

Continual Challenges in separation of control and data plane includes:

- **Scalability:** Control element responsible for a large number of forwarding elements.
- **Reliability:** Controller may fail or compromise.
- **Consistency:** Ensuring consistency across multiple control replicas.

Various opportunities from Control and Data Plane separation include:

- Server load balancing [16]
- Virtual Machine Migration in Data Centers
- Network virtualization

^{1, 2, 3} Department of Computer Engineering,

Delhi Technological University, New Delhi, India

- New routing services in the wide area
- Using multiple wireless access points
- Seamless mobility and migration
- Security in Enterprise Networks
- Denial-of-service attack detection
- Dynamic access control
- Adaptive traffic monitoring
- Energy-efficient networking



Figure 1. Separation of control plane and data plane. Switches only have forwarding elements.

3.0 CONTROL PLANE

3.1 OpenFlow Communication Protocol Specification

OpenFlow protocol [5] defines the message format and separates the data and control plane. OpenFlow controller communicates with "OpenFlow switch" over a secure channel and the protocol effectively instructs the "OpenFlow" switch to update its flow table entries.

3.2 OpenFlow Switch Components

- Flow Table: The flow table performs packet lookup. Flow tables consist of flow entries, which determine where the packet is to be forwarded. Flow entries consist of: (1) match fields, used to match incoming packets; (2) counters, used to count statistics like number of packets received, number of data bytes sent; and (3) a set of actions, to be applied upon a match. The lookup function compares the fields in each packet to a flow table that reside in the switch and looks for a match. The action of a switch depends on the match found. If no match is found, traffic is sent to the controller.
- **Secure Channel:** It is used for the communication of switch and the controller.

3.3 SDN Controller

Some of the important SDN Controllers include:

• NOX [7] : It was one of the widely used open-source, First Generation OpenFlow controller. In NOX, Users implement the control in C++ programming language. It supports OpenFlow v.1.0. In NOX, the programmer first writes a control program that registers for events and then writes event handlers that respond to those events.



Figure 2. OpenFlow Switch Components consisting of flow table and secure channel. Control logic is moved to the controller.

- **POX** [8] : It is NOX implemented in python programming language. POX only supports OpenFlow v.1.0.
- **Ryu** [9] : It is an Open-Source python controller. It supports OpenFlow v. 1.0, 1.2, 1.3, and 1.4. Ryu also has OpenStack [17] integrations.
- **Floodlight [6] :** It is an Open-Source Java controller. It supports OpenFlow v. 1.0. Floodlight is maintained by Big Switch Networks. It was integration with REST API.
- **OpenDaylight** [10] : It is a common industry supported platform. OpenDaylight has OpenStack integrations.
- LoxiGen [14] : It is an existing controller library that generates OpenFlow language-specific bindings. If the input is "Wire-protocol descriptions" of a control protocol, the output would be "protocol specific bindings" in different languages.

Network Virtualization is the abstraction of the physical network that allows the support of multiple logical networks running on a common shared physical substrate. Flowvisor [18] is a proxy controller which can be employed to add network virtualization to OpenFlow networks. It permits diverse controllers to concurrently control the overlapping sets of switches.

Various aspects of the network that can be virtualized include:

- Nodes: Virtual Machines
- Links: Tunnels
- Storage

SDN separates the Control Plane and the Data Plane, whereas Virtual Networks separate logical and physical networks. Network virtualization provides: 1. Rapid innovation, services are delivered at software speeds. 2. New forms of network control, it makes possible to instantiate multiple logical networks on top of a single physical network. 3. Vendor Choice 4. Simplified programming and operation by allowing the network operator to see the network through a logical abstraction

Example: Virtual Machine Environment: Xen [20].

Xen hosts allow multiple guest operating systems that run on the same shared physical hardware. Domain0 runs control software in the XenoLinux environment.

4.0 PROGRAMMABLE DATA PLANE

In a conventional data plane, first the router receives the packet. It then examines the packet header for its destination. It looks for the forwarding table for the next hop output interface. It then modified the header and passes the packet to the appropriate output interface.

Data plane can easily be customized as it consists of streaming algorithms that act on packets.

The data plane can perform the following functions:

- Forwarding
- Shaping and Scheduling
- **Deep Packet Inspection** •
- **Traffic Monitoring** •
- Access control
- Mapping header fields
- Buffering and marking

Two open platforms being used include:

- Click [19] : Software data plane in user space or the kernel, Open, extensible and configurable router framework.
- NetFPGA [11] : Hardware data plane based on FPGAs

5.0 SDN DATA CENTER NETWORKS

One of the applications of Data Centers is mobile cloud computing [22]. Data centers have multiple tenants or independent users which allows the users of the data center to advertise the cost of the shared infrastructure. One of the key enabling technologies behind data centers is Visualization, the ability to run multiple virtual machines on one shared physical machine.

In conventional Data Center topology, the core of the data center is connected to the internet with layer-3 routers. The servers at the edge of the data center were connected to one another with layer-2 switches and the access layer was connected to the core with aggregation switches. This topology has numerous drawbacks like single point of failure, over subscription of links higher up in the topology.

A solution to this topology problem is to use an alternate topology [28] or to design the data center as a multi-rooted fat tree [12], where capacity increases towards roots of the tree. The PortLand [13] design introduces a fabric manager which in combination with positional pseudo MAC address, allows a layer-2 network to scale to tens to thousands of servers inside a data center.

In 2012, Google presented a SDN based network connecting its data centers at the Open Network Summit [15]. B4 [24], one of the largest SDN deployments, is a Wide Area Network connecting Google's Data Centers.

6.0 SDN NETWORK VERIFICATION

Verification of Software-Defined Networks is necessary for the proper functioning of the Networks without any faults. Proper configuration provides the flexibility for realizing operational goals and behavior of the network. For network verification, correctness specification and constraints for global internet routing are being employed. Router Configuration Checker (rcc) is a static configuration tool which is generally used for fault detection.

Data plane verification can be done by performing symbolic execution on packets. Veriflow [23], a layer between a software-defined networking controller and network devices check network-wide invariants in real time using data plane state. It monitors the dynamic changes in the network, constructs a model of the network behavior, and uses custom algorithms to automatically derive whether the network contains errors. Veriflow runs its analysis over a forwarding graph and produces a set of invariant violations and a set of packets that caused the invariant to be violated. Veriflow figures out which sets of packets belong to the same equivalence classes to reduce the number of tests that need to be run.

Kinetic, a domain specific language enables verifiable, event based network control. Network policies are represented as finite state machines, where each finite state machine maps to a pyretic [21] policy. Pyretic enables sequential composition of finite state machines.

7.0 CONCLUSION

In this paper, we surveyed the need to decouple the control and data plane in a network. The control Plane is the logic that controls the forwarding behavior in a network whereas the Data Plane forward traffic according to the control plane logic. We examined various SDN controllers. Further, we studied the OpenFlow communication protocol. The application of Software-Defined Networking in Data Centers is also studied. We also saw the challenges in Control and Data Plane Software-Defined separation. Networking has many applications in Optical Networks, Wireless Access Networks and Enterprise Networks.

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e-Government in Saudi Arabia - An Empirical Study

Mohammad Yamin¹ and Rawan Mattar²

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Abstract - In light of the growing popularity of E-governance, service providers should continuously assess their role, challenges and satisfaction levels of their services to the citizens. For improving the services to the citizens, organisations also need to continuously update their technologies and measure the impact of the new technologies. As the E-governance is dependent on internet and information technology, success and failures can partially be attributed to the enactment of the government policies in the provision and proliferation of these technologies. In this article we discuss the issues, obstacles, impact and evolution of technology concerned with the customers and service providers. We shall also analyse the effectiveness of the role of the Saudi government in provision of E-government services to citizens in Saudi Arabia. Our conclusions are drawn from a survey to measure the impact and effectiveness of E-government on the service levels on west coast of Saudi Arabia. Here we shall present an analysis of this survey and draw some conclusions, which may be relevant for the entire Middle East and other regions with similar prevailing circumstances.

Index-Terms – e-Government, Internet, Technology, Service Providers, Satisfaction Level, Citizens

1.0 INTRODUCTION

The purpose of this study is to identify the extent of improvements in the performance and quality of the E-government service delivery in Saudi Arabia. In this report we also study some other services which are affected by intervention and application of E-government policies in the Kingdom of Saudi Arabia (KSA). Our study also tries to determine implications of the e-Government to other business sectors in the KSA. In this paper we outline obstacles and hurdles in the way of the E-governance. During this study, we have conducted an extensive survey of ninety five business organizations in Jeddah, which is a business centre on the west coast of Saudi Arabia. This survey was conducted to achieve the purposes of the study and answer the key questions of our hypothesis.

¹Department of MIS, Faculty of Economics and Administration, King Abdulaziz University Jeddah, Saudi Arabia myamin@kau.edu.sa

²Department of MIS, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Saudi Arabia, roritaaa_00@hotmail.com

E-government is known by several names. For example it is known as electronic government, e-gov, digital government, online government, or connected government. E-government is provided through digital interactions between a government and citizens (G2C), government and businesses/Commerce (G2B), government and employees (G2E), and also between government and governments /agencies (G2G). For details see, [1]. For a comprehensive study of the framework in which Egovernment operates, see [2]

In this study, we have followed a descriptive method which we believe is suitable to the nature of our research. Our questionnaire is used to collect responses to fulfil our objective. Upon receiving responses to our survey from business organizations, we have carried out a thorough analysis of the results. Our analysis shows the importance of E-government role in improving the performance of organizations. The analysis shows a reduction in the cost of completion of business transactions, as well as the ease and speed of service delivery. Our analysis concludes that the e-Government provides a non-compromising, privacy controlled and cost effective way of conducting business. We have also concluded that companies must not solely rely solely on government. During the course of this research, we have become aware that E-government is transforming the citizen service system in a satisfactory manner despite the fact that there are complexities in the technology and provision of fast internet. The government systems require deep and careful study of all the elements before a full description of their services and applications of all the services can be provided. This can be a future project for someone to take on to.

E-government in the first place emerged as a result of internet. In particular Web 2.0 with a fast speed internet has enabled governments and organisations to provide many online applications, e-Government being one of them. Through Egovernment, municipal, local and central governments of many countries in the world seek to win the confidence of their citizens by providing fast and efficient services to them. Given the availability of very fast internet through fibre optics, Egovernance has attained a resounding success in many countries. In almost all developed countries, E-government dominates the way in which the service provision to the citizens of countries. Of course, E-governance is not only a faster way of service delivery but also removes the red tape which earlier existed to a degree in most of the countries. In the developed regions of the globe, it would be fair to say that the E-governance has become a benchmark of service provision to the citizens. In view of [1], E-government is considered as an integrated philosophy and a radical shift in the realm of public administration at both the theoretical and practical levels. It is also a quantum leap and a peaceful revolution in the concepts,

theories and methods so that it reflects positively on the overall picture of the government administrations i.e. it cancels the traditional perception embodied in the over routine, authoritarianism, nepotism and other forms of negative practices which accumulate in the minds of the people and harm their relations with government bodies.

In last decade a number of national e-Government standards have been developed in North America, the European Union contraries, Australia, and some developing countries. Although developing such standards is a big step towards E-governance, it doesn't suffice to ensure smooth, effective and meaningful services. In this paper we provide results of a quantitative empirical study on the effectiveness and improvement in the field of e-Government service delivery in the Kingdom of Saudi Arabia. Our study finds a relationship in the awareness acceptance levels of the Saudi E-governance. Our report conclusions are drawn from the survey that we have administered on the west coast of Saudi Arabia and in particular the city of Jeddah, which is the second largest city and the largest port city of Saudi Arabia.

In light of the growing interest in the Internet, especially the growth of fibre optics cables in provision of very fast speed internet, and the enhancement of information technology, it was natural to make use of these technologies to serve all areas of life and facilitate better services through e-Government. In light of these developments, it was necessary for many countries of the world which benefit from these technologies, to remove age-old and inefficient management processes. There has been a serious attempt by the government of Saudi Arabia to achieving this objective. For details, see [3].

2.0 LITERATURE REVIEW

Here we shall present some results from earlier studies on e-Government and its proliferation into the Saudi Arabia, which is also known as the Kingdom of Saudi Arabia (KSA).

2.1 Saudi Arabia

Saudi Arabia is the largest exporter of petroleum products and is a member of G20. Land area [4] (Saudi Arabia, of the KSA is approximately 2,150,000 km². Its population according to 2010 census [5] is about twenty seven million, which includes eight and a half million expatriates providing technical and general support to this oil rich country. A large percentage of the KSA is occupied with deserts and mountains, making the delivery of civic and civil service delivery very difficult. Saudi Arabia is a well-known religious country, which makes many people to think that it is a conservative country. In particular, some regard the woman of Saudi Arabia in veil such as in Fig 1 as being deprived of social justice. The reality is quite the opposite and in fact Saudi Arabia is a very vibrant country tuned with the modern education and technology, providing equal opportunities for men and women. The government on the other hand ensures that the women of this country get equal share of opportunities. For details, see [6].



Figure 1: A Saudi Women in veil

Saudi Arabia also houses Kaaba which attracts millions of pilgrims every year. The hajj is a worldwide well known pilgrimage in which people from more than two hundred countries take part. Yamin [7, 8, 9] has extensively studied hajj and other crowded events.

2.2 Saudi Legislation for e-Governance

Since the inception of E-government, the Kingdom of Saudi Arabia (KSA) has taken considerable interest to acquire infrastructure required for implementing the service. Indeed the KSA has since switched off to E-government, and is also facilitating internet services to the organizations and citizens to learn and use its E-government service delivery. The KSA is one of the few countries who have acquired Fibre Optics internet infrastructure and using it since 2011. This has provided a great opportunity and has benefited the national economy.

In order to facilitate smooth e-Government services, Saudi Arabian government has enacted several laws through royal decrees. The important legislations in this regard are as follows:

- (a) Royal Order Decree No. (7/ B/2427), dated 16/1/1424. In this order the Ministry of Finance was authorised to proceed with the establishment of E-government program.
- (b) Royal Decree No. (7/ B /33181), which provided approval to the Ministry of Information Technology to implement E-government policies in Kingdom.

To highlight the importance of the transition to the information society, and to achieve the desired objectives of e-Government, the Ministry of Communications and Information Technology in the year 2005, launched an E-government Program known as Yesser with the participation of the Ministry of Finance, and the Communications and Information Technology. In order to implement the services, a supervisory committee was instituted to monitor the implementation of E-government. For details see [3]. The measures of this committee included the following:

- [5]. The measures of this committee included the following:
- (a) Make adequate arrangements for isolation of pilgrims found to be carrying communicable diseases

- (b) Introduce mandatory health awareness classes in al7. countries with the help of local authorities to be sponsored by tour operators of the event
- (c) Punish tour operators for noncompliance of health procedures

2.3 Reasons for shift towards e-Government

The reasons for the shift towards e-Government can be classified as follows [3].

- 1. Acceleration of technological progress and its associated cognitive revolution
- 2. Trends of globalization and interdependence of human societies
- 3. Democratic shifts and their accompanied changes and popular expectations
- 4. Responding and adaptation to the requirements of the surrounding environment

Saudi Arabia's neighbouring countries are also very active and alert to the needs of providing e-Government services. The United Arab Emirates (UAE) which once was well known for its oil exports today has a diverse and highly developed economy. According to the UAE Economic Report 2015 [10] and [11] released by the UAE Ministry of Economy, the nonoil sector contributed 71.6 per cent to the UAE's GDP, compared to 66.5 per cent in 2008 [3]. In the quest to modernize and be a world first nation, the UAE has invested. generously and aggressively for adopting and implementing Information and Communication Technology (ICT) in itg. government and private sectors. The Global Information Technology Report 2010-2011 indicates that the UAE leads the Middle east and north African (MENA) region in leveraging ICT for increased economic diversification and competitiveness. More studies of the regional e-government in Saudi Arabia and neighboring countries can also be found in [12] and [13].

E-government provides many advantages to a large section of the society, irrespective of the region and country. Many researchers including [12], [13] and [14] have extensively studies the various aspects of E-government in general and pertaining to particular regions and nations. In view of these studies, E-government is providing many advantages and benefits. These benefits flow onto local private organizations including Small to Medium Enterprises (SMEs), which are considered to be backbone of economies of many countries. Some of the benefits are as follows [3]:

- 1. Services more related and responsive to the needs of the masses.
- 2. Comprehensive services and lower costs.
- 3. Reducing reliance on paperwork.
- 4. Improving means of access to information.
- 5. Lower administrative costs with respect to commercial transactions of the government and the private sector.
- 6. Transparency in dealings.

Better development of governments so that they become more closely related and responsive in addition to easier access to them.

2.4 Achievements of e-Government

One of the most remarkable achievements of e-government is remove the direct contact between the client and the service provider. This results in reducing the bias which exists in the society. The problems of direct and face to face contact sometimes results in racial, cultural, religious, and colour discrimination. There are many researchers, including [3], who have studied and commented on the achievements of Egovernment in the Arab World. Here we present a summary of various studies. We know that as the technology refines and develops, awareness and expectations also increase. In the near future we are like to see a significant refinement in the provisions of e-government. Various studies, like that in [13], suggest that we are likely to witness phenomenal expansion of electronic services, especially in the developing countries. However there is still a long way to go.. There still is a considerable gap between the employees and the government service, which calls for proper training in order to provide services efficiently. There appears to be a lack of interactive or inefficient for clients in communications through their networks. But the e-government results in

Increase of electronic documentation and hence a huge reduction in the amount of paper based documents and records

Direct and parallel interaction between the government as a service provider and citizens

Massive data and information flow between the government and citizens

A very welcome transparency and speed of service delivery

Equity and justice in provision of the same service and same costing for everyone, free of favouritism.

Simplicity and easy of access to the services

Ubiquitous services based of telecommunications networks, enabling mobile and distant service delivery in a timely manner.

The Saudi government is also been providing many incentives to the private sector through government linked environment. This enables delivery of services do different cultural environments and societies found in the different regions of the nation. As we know that Saudi Arabia's large areas are classified as deserts and hence the government is making efforts to reach to the distant continuities found in these deserts.

2.5 Local Saudi Arabian Problems and Solutions

As we would expect every region and country has specific advantages and complexities - so does Saudi Arabia. Here we list some of the complexities that Saudi Arabia faces in the way of providing services to the citizens of this nation.

(a) Confidentiality, Privacy and Security, as in case of many developing countries, are issues of concern in the E-governance. These issues are generally resulted from

social and cultural inclinations of countries. For example, privacy and security mechanisms are found to be weaker and sloppy in may many developing countries. However, we should expect improvements in these mechanisms gradually as the technology and service mature

- (b) Funding cuts are seen everywhere in the world and Saudi Arabia is also not spared. Lack of funds, depending on the extent, can potentially derail the whole E-governance program.
- (c) A high unemployment rate can slow down the implementation and progress of E-governance programs. This, like in many developing countries, also prevails in Saudi Arabia. However, the Saudi government has in the recent times initiated several measures and programs to address the high unemployment in the nation. One of the formidable programs is known as Saudization [15], which makes it mandatory on various organizations and sectors to employ certain minimum percentage of Saudi nationals in their works fore. Steps , may slow down the progress of Egovernance
- (d) Lack of training and support may be detrimental for many employees overseeing day to day operations of Egovernment service delivery. It is true that many in the developing countries are investing very little in on Training Programs. As a result, the employees sometimes do not treat their customers in a satisfactory manner. The Saudi government and the organisations linked to the Egovernment need to provide adequate training to their employees.

3.0 THE SURVEY

To measure the level of E-Government services and their effectiveness, we designed an appropriate survey. This survey was completed online by customers who avail these services. Many of the customers include business organisations. In these cases, the survey was completed by responsible staff members of these organisations. However, our survey was limited to the west coast region of Saudi Arabia. But this region includes Jeddah, the second most populous and commercial port city of Jeddah. We used social media to get responses of the survey, which expedited the responses. However, there was a lack of written information regarding the name, title and organization name and location of the organization in some cases.

3.1 Ethical Considerations in our Survey

The aim of this survey was to receive personal and organisational responses from responsible individuals who utilize E-Government program in Saudi Arabia. Therefore, we didn't really require any access to personal information, which always is a sensitive issue. We only asked general questions personal nature such as name, job title, company name and location of the company. Moreover it was categorically stated that this information will only be used for the purpose of the research and their personal information wouldn't be made public.

3.2 Survey Questions

Apart from general questions, there were ten main questions.

These questions were designed to have responses on a Likert scale of seven indicators, 1 to 7. The meanings assigned to the numbers were as follows: 1 = completely disagree, 2 = disagree, 3 = somewhat disagree, 4 = neutral, 5 = somewhat agree, 6 = agree, 7 = absolutely agree. Having a broad scale of seven choices was designed to provide the respondents with a greater flexibility. We present our questionnaire in table 1 and the accumulated average of legal entries is presented in table 2.

No	Question
1	Do you use the official website of the Organization of the Kingdom of Saudi Arabia www.saudi.gov.sa to
	complete government transactions?
	Is the government contributing to the use of electronic
2	transactions towards the completion of the organization
	work efficiency?
3	Does the use of E-government help to make the
5	completion of government transactions more quickly?
	Does the use of E-government help you or your
4	organization make the completion of government
	transactions easier?
5	Do you consider the use of E-government secure?
	Do you or your organization completely depend on
6	completion of your tasks by the E-government
	provision?
	Have the costs of completion of transactions have
7	come down in the organization after the introduction of
	E-government services?
Q	Is the E-government is improving the performance of
0	the organization as a whole?
9	Are you satisfied with the provision of E-government?
10	Do the E-government services require to be improved?

3.3 Survey Analysis and Results

After carefully analysing the survey responses from the 95 companies, a statistical analysis was conducted. The averages of responses to survey questions are provided in Table 2. Based on analysis of the survey results, we have drawn the following conclusion.

Table 2	2: Si	urvey	Results

Question	Average	Question	Average
	Response		Response
Question 1	1.86	Question 7	4.1
Question 2	4.3	Question 8	4
Question 3	4.4	Question 9	4
Question 4	4.4	Question 10	4.3
Question 5	4.1	Question 11	4.7
Question 6	4		

4.0 CONCLUSIONS

We have local knowledge of the people and organisations in Saudi Arabia. This combined with a careful study and observations of the survey results and their analysis, has produced the following conclusions.

- 1. There is high demand for the use of e-government portal, and there is significant awareness of the importance of e-government.
- 2. Use of e-government and hence completing various transactions electronically increases the efficiency of the organizations.
- 3. The use of electronic government is helping to achieve efficiency in completion of government transactions in a timely manner.
- 4. The use of e-government organization is helping the completion of government transactions more easily than otherwise.
- 5. Many organizations believe that the use e-government is secure.
- 6. Many civic and civil services rely on e-government, depending partly, not necessarily fully.
- 7. There is significant reduction in the cost of completion of transactions in the e-government organization as compared to non e-government methods and services.
- 8. E-government is improving the performance of the organization as a whole.
- 9. There is a need to improve, develop and expand on many other aspects, as there is a perceived lack of user satisfaction amongst the users of e-government.
- 10. E-government is has attained a level where the government cannot afford to neglect.

From the above conclusions, we infer that e-government in Saudi Arabia is growing in popularity every day. It is providing a platform of equal and adequate opportunities for men as well women. It is being more useful and applicable for disabled, old and, sick and women of the country. Now there is an expectation of efficiency and ease in accessing government and non-government services which is fulfilled by e-government and its ensuing policies and methods flowing into the private sector. Now governments throughout the world cannot afford to have a blind eye towards providing e-government services. Those who are already providing, such as Saudi Arabia, need to continuously update their technology, systems and environment.

5.0 FUTURE STUDY

We have conducted our study involving only the organisations in the city of Jeddah. Although, Jeddah is the business centre and the largest sea port of Saudi Arabia, but still it cannot represent whole of Saudi Arabia, which has many regions which significantly differ in many ways from each other. Hence the results on e-government satisfaction are far from being complete. Therefore, as a future study, it is de4sirable to conduct a national survey of many organisations and individuals by taking samples from each region, city and locality. We shall return to carry out further study of E- government in Saudi Arabia in particular and the technology itself in general. There are many aspects of E-learning which would get more attention as the time passes. There are many developing countries which are yet to introduce E-government in their jurisdictions.

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E-learning and Women in Saudi Arabia: An Empirical Study

Mohammad Yamin¹ and Shahad Adel Aljehani²

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Abstract –E-learning has revolutionised the way we acquire knowledge, be it education or business. It has enabled provision of knowledge and education in situations where we had never imagined before. Some countries were quick to realise the opportunity and began experimentation of Elearning at its inception while others took their time to catch up with the paradigm shift. E-learning is a by-product of internet, which became usable in the 1990s. Many governments were quick to realise the great benefits of internet and hence did everything possible to make it available to their citizens and businesses. As usual, internet provision in its inception was costly and had a very slow speed, which hampered its propagation into the developing countries until it became viable. Saudi Arabia, the largest oil exporter of the world, didn't waste too much time to enact policies governing with the internet and soon initiated Elearning, which has been developing at a steady rate and is providing education to a large segment of disadvantaged sections of the society. In this article we study the extent of benefits and impact of E-learning in Saudi Arabia. We draw our conclusions based on a survey that we have conducted of selected groups of people on the west coast of Saudi Arabia. The conclusions are drawn after analysing our survey and these conclusions may also be valid for other societies, especially the West Asian and Gulf countries.

Index-Terms – E-learning, Face to Face Learning, Distance Learning, education, Saudi Arabia, Gulf Cooperation Council

1.0 INTRODUCTION

In this article, we study general progress of E-learning and its impact on the education sector and the female population at the West coast of Saudi Arabia which is relevant for entire country in general. In particular, we shall study impact of E-learning on education in Saudi Arabia. Detailed study of our case is complimented with an extensive survey of a number selected group of people who are affected by E-learning or have a view about it. Our finding may have bearing to other countries of the region, especially the ones having similar cultures and problems.

¹Department of MIS, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Saudi Arabia, myamin@kau.edu.sa

²Department of MIS, Faculty of Economics and Administration, King Abdulaziz University Jeddah, Saudi Arabia, shahadaljehani@gmail.com

E-learning began in 1990s and slowly got refined in the rest of the last decade of the twentieth century. Like many other technological evolutions, E-learning was received with a lot of scepticism at its evolutionary stages. As the time passed, Elearning made steady and significant progress, especially in the countries of so called developed world. Many educational institutions in some countries of the world, especially those amongst the list of developing countries, struggled in the begging to comprehend its viability and benefits. Slow progress of E-learning in those institutions had a lot to do with the government policies which regulate the provision of internet which is used for networking of the for the instructions and materials delivery to the learners. In the first few years of the 21st century, internet had cost, reliability and availability issues, and hence many institutions in the world either didn't have access to the internet to begin with or couldn't afford to avail the internet. The second hurdle in the way of E-learning proliferation was stiff résistance by certain educationists and think tanks. Indeed there still is a certain amount of résistance in the way of online education. Despite certain amount of continued criticism from some sections of education society, Elearning has set its feet firmly and has assumed a position of an alternative way of education.

Early years of 21st century not only brought maturity and acceptance to this mode of education but we saw a growth of online education institutions. As a result we now find thousands of online universities around the globe. Even more significantly, some of the online institutions are not only providing courses in social sciences and arts but also other disciplines of education in natural, biological and other sciences. As a result we now have online degrees in almost all of the disciplines which are taught in the face to face mode, sometimes known as the traditional way or mode of education. Like in many countries, educational institutions in Saudi Arabia were slow in embracing and assimilating the concept of E-learning. However, the reasons were not economic. Saudi Arabia is the twelfth largest country [1] and [2] in the world and second largest country in the region with an area of 2,344,858 sq KM. Most of its terrain consists of arid inhospitable desert or barren landforms. There are many communities living in these areas. Despite a lot of educational, infrastructural and social development and incentives provided by the Saudi government, these communities are disadvantaged in accessing or receiving state education programs at the same levels as in the coastal part of the country. As in Saudi women are neither allowed to drive cars and other vehicles, nor to go out alone, they need a mahram, a member of the family, to take them to the educational institutions and other places of daily activities. There are also a significant number of young wives who find it difficult to make to face to face educational

programs. It is these sections of Saudi society who have greater need more and more E-learning programs and institutions.

Our survey has been administered in Jeddah to about 180 participants, mostly the students of E-learning at the King Abdulaziz University. Our survey mainly asked students about E-learning services offered by the university and the society's awareness of the concept of E-learning, the benefits of Elearning for the society, the Saudi government support for this type of education, and the extent of E-learning to enhance the quality of higher learning. The results of the survey responses show that the majority of E-learning students agree that the university is doing well to provide E-learning service for scientific degrees differently but only in certain colleges. Majority of the participants felt that university should widen its reach of E-learning through other faculties as well. As for the extent of community awareness and satisfaction about Elearning, majority has agreed that the university has worked to achieve this., We also found that E-learning is providing great benefits to the Saudi society. Many respondents feel that the Saudi government should do more through its policies to support this type of education, and make it available to all regions of the country.

2.0 E-LEARNING

Distance learning has roots in ancient history. But the advent of internet as an add-on has redefined the distance learning. Thus E-learning has two components namely, distance learning with internet enabled delivery of learning material and program. Distance learning isn't a new concept. In fact distance learning can be traced to early 19th century in different forms to what we have today. The face of distance learning has changed due to the advent of internet, which has termed it as e-learning is the involvement of internet which is used for networking of education providers with those of learners. Remarkable developments in software industry, media equipment and computer industry have tremendously improved the modern day learning known as computer assisted learning. Evolution of internet has revolutionized the way we are taught and the way we learn. Learning with the help of computers by using internet is known as E-learning

A number of researchers have studied and contributed to the Elearning. E-learning which began as an offshoot of internet, took its time to be recognised and accepted as an effective tool of education. In the initial stages, many academics were reluctant to let e-learning take place of the face to face learning partly or fully. However, as the time passed and technology matured an overwhelming majority of academics and educational institutions have come to realise the great benefits using electronic means and internet in learning and teaching. Many institutions have since started courses in E-learning some as early as in the last century and others a little later in the beginning of this century as the methodology and technology went through refinements and expansion.

E-learning started using internet in late last century. Slowly it spread to public and private sectors of education providers. As in many cases of an emerging technology, it became necessary to evolve and agree to a framework of e-learning. The United Nations [3] has provided a framework for the E-learning to guide educational providers and academics to the needs, duties and obligations towards this new found method of teaching and learning. A debate goes on the issue of E-learning and Distance Learning as to whether they are same. For details, see [4].

E-learning has now spread into almost all educational institutions and it is being used either in teaching courses remotely or in a blended mode, which is a combination of distance and face to face learning. All standard educational institutions now provide educational material, including audio/video recordings of lectures through dedicated learning management systems. The E-learning is so popular that dozens of quality journals are publishing hundreds of articles on Elearning every month. For a list of E-learning journals, see [5]. Recent advances in E-learning include the concepts of virtual class rooms, ubiquitous learning [6], Role of sensor technology and RFID in E-Learning, Cloud based e-learning, and the list is growing in the proportions to the refinements in the technology. Some discussions and studies on these topics can be found in a number of articles in the journals listed in [5]. Benefits of E-learning include faster delivery of the instructions and material, greater effectiveness in learning, environment friendliness, rich graphics and reach in remote areas.

3.0 E-LEARNING IN SAUDI ARABIA

In this section we explore the social and educational background of Saudi Arabia.

3.1 The country

Saudi Arabia is an oil rich country of the world. It is the largest exporter of petroleum products and is also a member of the group of twenty known as G-20. This is a grouping of countries with major economies. Saudi Arabia is also the country which houses Kaaba as shown in Fig 1 in Makkah (Mecca), where millions of pilgrims travel to perform pilgrimages known as Hajj and Omrah. Yamin [7, 8, 8, and 10] has conducted extensive studies and have provided detailed description of these pilgrimages and E-learning covering many aspects of the society in Saudi Arabia.

Saudi Arabia is regarded by many as a conservative country. Many people perceive that it doesn't provide adequate facilities to its female population. It is true that Saudi Arabia is a Saudi Arabia is regarded by many as a conservative country. Many people perceive that it doesn't provide adequate facilities to its female population. It is true that Saudi Arabia is a religious country but to say that it treats its female population differently is totally wrong. In fact women in Saudi Arabia have state of art facilities.it is true that many women (and men) get married quite early in the days of their high school or university education. The government of Saudi Arabia has special arrangements for their education and otherwise. In fact some of the facilities provided to females are even better than to their counterpart. E-learning is also a also one of the medium made available to this section of the society. To learn more about these, see [10]. Saudi Arabia has its large areas covered by mountains and deserts. It has traces and tracks of old

civilisations such as those of people of prophet Salah as shown in Fig 2 which are believed to be thousands of years old. This centuries old heritage of this country blends with its cultural, educational and social values.



Figure 1: Kaaba in Makkah

3.2 E-learning in Saudi Arabia

Saudi Arabia has taken very prompt decisions and has played an active role for the acceptance, provision and spread of Elearning. For example, the country had acquired fast internet whatever was available at different times. For the last five years, the country has organisations and citizens have access to Ethernet Fibre Optics for internet, which is the fastest internet in the world today. The government has also passed necessary legislations to make E-learning usable. More details on these aspects can be found in [11], [12] and [13].



Figure 2: Dwellings in Madain Saleh

As we are concerned with the E-learning of women in Saudi Arabia, we provide a brief overview of them here. It is not hidden that the women in Saudi Arabia are not allowed to drive cars and other motorised vehicles, most of them wear veil such as in Fig 2, and many of them get married in their teens. But these cultural and religious peculiarities in no way make them inferior to men. The government of Saudi Arabia takes special care for the educational, social, cultural and economic needs of its female section of the society. The women in Saudi Arabia have state of art facilities in all walks of like. For details, read socio-educational aspects of women (e.g. [10]).

Expansion of internet with Web 2.0 [14] has taken E-learning to new heights. Nowadays, with the evolution of Cloud Computing, the learning has attained even greater heights. With the use of computer technology, internet, Web 2.0 and cloud computing, E-learning is providing state of art material and instructions. The development and spread of the use of private Internet through clouds is enabling the delivery and maintenance of E-learning even easier. In particular, clouds eliminate need for infrastructure and service, which is what, is most beneficial to provide education to distant and remote areas. Saudi Arabia is one of those countries who had legislated use of clouds and cloud computing while many other nations were discussing and debating issues such as security and privacy associated with this technology.



Figure 3: Dwellings in Madain Saleh

A large area of Saudi Arabia is mountainous and desert. But there are many communities living in these areas. So provision of education to these areas is critical. Some localities of people in these areas are either not large enough or are separated with terrain or are situated at significantly apart from each other making it difficult to setup educational institutions exclusively for them. Thus higher education through traditional means is beyond their reach. It is these areas where E-learning is playing very decisive and meaningful role.

4.0 OUR RESEARCH METHODOLOGY

We have conducted our study with help of the literature review and an extensive survey of the female recipients of E-learning programs or any other females who may have had knowledge of these programs and hold an opinion about the service levels. Answers to the survey questions were sought on a raster scale of five, 1 signalling as not agreeing and 5 as agreeing.

4.1 The Survey Questionnaire

Table 1 shows the main questions of our survey. These questions are designed mainly to measure the E-learning quality and levels of satisfaction.

Our survey questionnaire had fifteen questions in addition to a few questions of general nature. It is not only hard to find many women willing to participate in a survey, especially for the reasons of privacy and ethical considerations. We took care of these considerations of the women participating in the survey. We received one hundred and seventy five responses to our survey from carefully selected samples of female respondents. The main thrust of our survey was to measure the experiences with the current state of E-learning in the West Coast of Saudi Arabia through the King Abdulaziz University (KAU) [15] and [16]. The KAU is the second largest university in the country with a healthy world raking and which has more than one hundred and fifty thousand students enrolled in it. Many of the faculties of KAU provide E-learning courses for most of their degree courses. Students of E-learning include people from all ages, especially old age people, married and unmarried, male

and females, especially the young married women with children. As our survey was designed to measure satisfaction levels of E-learning amongst the women, we only concentrated on women.

N#	N# Critorio			
18#	Criteria			
1	I am aware that the King Abdulaziz University (KAU) offers courses and degrees through E-learning			
2	KAU is only providing E-learning for degrees of only few faculties			
3	KAU needs to expand its E-learning base to include courses in other disciplines and faculties			
4	KAU is providing E-learning in a satisfaction manner			
5	E-learning is a result of proliferation of internet and other technological advances			
6	E-learning has redefined the educational process to the benefit of people			
7	E-learning is helping Saudi female society to overcome obstacles in education			
8	E-learning is very helpful for educating people in the remote areas which have no colleges and universities			
9	Saudi government is providing adequate support and infrastructure for the E-learning in the KSA			
10	The government KSA needs to do more to make E-learning to all citizens			
11	E-learning is an effective method of eradicating illiteracy			
12	E-learning is a better than face to face learning			
13	E-learning maintains the quality of educational standard			
14	The KSA government has ensured fastest internet so to enhance E- learning experience			
15	To ensure the efficiency of the quality, the E-learning providers			

4.2 Survey Results

After carefully analysing survey responses and removing outliers, we decided to conduct simple statistical analysis such as averages and means of the responses of the response data. The averages of responses are shown in Table 2

From the Analysis it is clear that the majority of students in Elearning at the King Abdul Aziz University, KSA, agree that the university is working to provide E-learning various scientific degrees of service, but only in some colleges. So many female students desire more E-learning programs covering all disciplines. The extent of community awareness and satisfaction with the majority of E-learning is quite high. But there is unanimity when it comes to choosing between face to face and E-learning – almost all respondents believe that the traditional method of face to face learning and education is better than that of E-learning.

Table 2:	Averages	of res	ponses
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Questions	Average	Questions	Average
Question 1	4.2	Question 9	3.7
Question 2	3.6	Question 10	4.7
Question 3	4.6	Question 11	4.21
Question 4	3.35	Question 12	2.5
Question 5	4.7	Question 13	3.4
Question 6	4.29	Question 14	3.3
Question 7	4.5	Question 15	3.6
Question 8	4.6		

The majority of respondents agreed that E-learning presented is of great benefit Saudi society in terms of overcoming the obstacles, especially what the females have been facing. There is also an agreement that the people in remote areas that do not have easy access to universities are also benefiting from Eleaning. A significant number of respondents believe that the Government of Saudi Arabia supports this type of learning but needs to do more to provide E-learning for all people in all areas. It was agreed by many that the King Abdulaziz University is working to enhance the quality of E-learning provided for students.

It should be known that the king Abdulaziz University has Elearning students from all over the country, not just the west coast of Saudi Arabia. Therefore our survey and study can be treated as a representative of the entire nation of Saudi Arabia, also known as the Kingdom of Saudi Arabia.



Figure 4: Bedouins of Saudi Arabia

5.0 CONCLUSIONS

The future of education lies with E-learning, it's here to stay. Younger generations in most of the developed countries and many developing countries have to work to support themselves and hence their studies. These people often find it difficult to make themselves to the classrooms. So, E-learning is a convenient way of learning for them. There has always been and will continue to be many disadvantaged sections of the society everywhere who will would find E-leaning as a desirable way of getting educated.

E-learning in Saudi Arabia is playing a significantly additional role of educating certain special classes of people. Young and married women, with children in some cases, who cannot travel without a mahram (guardian), are benefiting with E-learning tremendously. As discussed earlier, Saudi Arabia has some communities, known as Bedouins as shown in Fig 4 and described in [17], are educationally backward communities in the country. These communities are spread into many areas making it difficult to set up higher educational institutions within their reach. With great efforts from the government of Saudi Arabia and some social organisations, these people are benefitting from E-learning. It is fascinating to study these communities, their social, cultural, linguistic and economical aspects. These people may be compared with like those of red Indians of America and Aborigines of Australia with a difference that these communities are not being ruled by people who took over the country in one way or the other. Indeed this is a much bigger study to conduct and we falls outside the scope of our article. We endeavour to return to this interesting study sometime in the future.

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Misuse Detection System Using Intelligent Agents for Online Transactions

Anuradha Sharma¹, Shama Parveen² and Puneet Misra³

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Abstract-As E-Business is growing steadily with the increase in internet usage, it has increased the major security risk factors and as for novel attacks it becomes quite difficult to detect them. An Intrusion Detection System (IDS) is a device or software application that monitors network traffic and is able to analyse ongoing malicious activities and reports them to the administrator. Basically an IDS can be a Misuse Detection System or an Anomaly Detection System. There are several techniques for Misuse Detection System making use of Artificial Intelligence, Data mining etc. exploited by intelligent agents. This paper presents the model for Misuse Detection System exploiting data mining techniques with the help of intelligent agents which can be used by servers involved in E-Business. The agent makes use of pattern matching technique for the attack signatures already stored in the knowledge base and analyses audit log files. If it finds the one matching with those stored in knowledge base then the reporting agent immediately intimates the administrator about the malicious activity.

Index-Terms- Intrusion Detection System, Misuse detection, Multi-Agent system, intelligent agents, RETE pattern matching.

1.0 INTRODUCTION

Intrusion detection grew from the notion that computer misuse can be detected by analysing audit data in a computer system or network [1].Intrusion detection basically refers to the monitoring of network or system and the activities going on in them thus providing an important aid to the administrators about the various activities related to security. As networks are growing larger day by day, there must be some mechanism to detect intrusions. Organisations which are spreading their network across the world through internet that is E-Commerce need it the most. Nowadays, the intruders conceal their activities so as to extract maximum information and not only they are confined to information extraction but masquerading and misusing the extracted information for launching novel attacks on the target host for their benefit. Through intrusion detection it becomes possible to identify and recognise all such attacks and report them to the administrator.

An Intrusion Detection System (IDS)[15][16] is a combination of both hardware and software that makes it possible to detect malicious activities. It is able to monitor network traffic, analyse audit log files and match well known attack signatures already stored in knowledge base, etc. That is it gathers information from various known sources and is able to decide whether intrusion has taken place. The functional components of an IDS are- information source, analysis and response [2]. The most widely used IDS are Host Based IDS and Network Based IDS. Host Based IDS are able to detect intrusions on hosts and perform complete analysis on the host machines while the Network Based IDS are busy in sensing and monitoring network traffic that is intruders who attack on network traffic. The focus of this paper is on Host Based IDS.

Data Mining refers to a pattern finding technique in large data sets. Patterns related to normal behaviour and patterns related to malicious events can be computed using data mining [2]. The usage of various data mining techniques such as classification, clustering, association rule mining, outlier detection etc are being used for detection of intrusions. These techniques are also being used with other neural network techniques for more efficient anomaly detection. These techniques are applied on the incoming packets from the network to the server by intelligent agents. Moreover some of the intrusions can be detected by analysing log files and system call sequences. Any deviation from the normal behaviour is a key to detect vulnerabilities. Whenever the user logins for the first time a user profile is generated according to the information provided by the user and this user profile also helps in gaining information about suspicious activities.

The model presented in [3] is a distributed IDS and a similar model can be used for securing servers involved in E-Business. Active attacks are comparatively easier to detect than passive attacks as they involve certain kind of alterations whereas passive attacks are most of the time difficult to detect. Although the model is a combination of misuse and anomaly detection system we have proposed here misuse detection system. Misuse detection systems are good at detection of malicious activities if the patterns are known otherwise they are not able to detect novel attacks whereas anomaly detection systems can detect novel attacks. But anomaly detection systems generate more false alarms as compared to misuse detection agent. Earlier concepts of intrusion detection were based on central systems for monitoring but they had many disadvantages [8]. Although distributed IDS have drawbacks too some of them being [9]- the signature or the knowledge base update has to be done timely, most of the time it happens that the IDS and other security systems do not interoperate and thus it becomes quite inevitable to use any one of them for

^{1,2} Department of Computer Science, Amity University

³ Department of Computer Science, Lucknow University of Lucknow

¹sharmaanuradhak@gmail.com

²naazparveen47@yahoo.in

³puneetmisra@gmail.com

security, IDS architecture needs improvement with time as new technologies come they have to be modified for adaptability. Moreover only these factors are not enough, an IDS has to be flexible, fault tolerant, adaptable and configurable [10]. When working on an agent oriented view, it soon becomes apparent that a single agent is not sufficient. Most problems require a single agent[14].

The next section gives an overview of various agents and multi-agent systems.

2.0 AGENTS AND MULTI-AGENT SYSTEMS

A software agent is a persistent, goal oriented piece of software that autonomously and continuously work in its environment to perform some specified function for the end user or another program. Agents are capable of doing the desired task without continuous direct supervision. The concept of software agents arise from Multi-Agent Systems which are again the concept somewhere used in Distributed Artificial Intelligence (DAI). Based on their mobility they can be classified as-

i. Static agents- They do not possess mobility hence they perform their jobs at the place where they are present.

ii. Mobile agents- They perform their goal at different hosts.

Agents can be classified on the basis of Nwana's primary attribute dimension as- smart agents, collaborative agents, collaborative learning agents and interface agents [12]. On the other hand agents are classified according to their task as mentioned by George F Luger in his book [13]–

- Rote Agents- They simply capture pieces of information and communicate them to others.
- Coordination Agents- These agents support interactions between tasks and other agents so as to prevent collision.
- Search Agents- These agents are used for analysing information and return the chosen ones.
- Learning Agents- They form concepts or generalize after analysing the information so far collected.
- Decision Agents- They are responsible for initiation of actions and come to conclusions from the information they receive.

Intelligent agent is an autonomous agent which senses its environment and accordingly acts upon it that is it is a software agent with intelligence. It can learn and based upon the knowledge it is capable of taking decisions.

Multi-Agent System consists of a network of autonomous software agents that interact with each other to solve the problem which cannot be solved by individual capability. Agents have the ability to act as mediators in solving problems. And such a concept of Artificial Intelligence is being used to tackle security related issues of a network. A Multi-Agent System always works in a dynamic environment on a set of objects with the help of autonomous agents. It can be viewed as a loosely coupled network of autonomous agents where each agent has its own goal to accomplish.

Some of the characteristics of Multi-Agent Systems are [11]-

i. As multiple agents are used, no agent gets complete information.

ii. There is no global control mechanism for any Multi-Agent System as they have less human intervention.

iii. Data is distributed that is there is no single source of data.

iv. Actions are not controlled as they are brought into action by autonomous software agents.

v. They are dynamic systems; they are not confined to work on a limited set of data but are designed to tackle new problems and new data.

vi. Each agent in a Multi-Agent System has a predefined goal and from the data they receive they work exactly on the relevant data of their use.

3.0. THE MISUSE DETECTION SYSTEM

The architecture of Misuse Detection System consists of a collection of agents which work cooperatively to collect and analyze the network data coming to the server. The various agents used in the proposed model are- sniffer agent, filter agent, CIA agent and a reporter agent. The process in brief is:

1. The Sniffer Agent gathers the incoming packet from the connected network for any online transaction.

2. The filter agent helps in filtering the packets being gathered by the Sniffer Agent and sorts them according to their packet format.

3. The filtered packets are then passed to CIA Agent (Confidentiality, Integrity and Availability Agent). This agent analyzes the packets and matches them with the predefined attack signatures stored in the Knowledge Base and is responsible for calculating the digests and comparing them with the already stored ones and accordingly passes the information to the Reporter Agent.

4. The Reporter Agent then analyzes the information passed by the CIA agent and if it is an attack it reports to the administrator.

The knowledge base consists of the rules and signatures of already known attacks as well as some vulnerable ipaddresses, message digests so that the calculated message digest can be compared with the valid one. The figure. 1 shows the proposed model of the Misuse Detection System.



Figure 1. Misuse Detection System Various components have been described below-

3.1 Sniffer Agent

Basically sniffer is a device that captures all the traffic passing through a network. It helps in detection of intrusions by analysing network traffic as it gathers all the packets passing through it. Sniffer agents read packets from the machine and cache them in memory[3]. Thus they are being used for capturing packets and the output of this agent is being sent as an input to the Filter Agent.

3.2 Filter Agent

The Filter Agent is responsible for filtering out specific data as in a network there are various data sources so while considering intrusion as a matter of concern [3]. It differentiates the various fields of the received packets and sorts them according to their category concerning about the intrusions.

3.3. CIA IntegrationAgent

The CIA Integration Agent is the intelligent agent playing the most crucial role for detection of malicious activities going on in the server. It focuses completely on the three parameters namely *Confidentiality, Integrity* and *Availability*. The name being used as the agent proposed here is responsible for checking the requisite constraints for these three issues. The agent being proposed in this paper has multiple functions to perform so that malicious activities can be detected effectively. The CIA Integration Agent after receiving packets from the Filter Agent checks whether they are from an authentic source and for this it checks the signatures of the packets and compares with the known attack signatures already stored in the Reporter Agent and removes those malicious packets.

As the attack signatures are already stored in the knowledge base it requires a rule set and a pattern matching technique so as to detect intrusions. For this RETE algorithm is proposed [5]. The Knowledge Base consists of attack patterns for known attacks as provided by experts of this field. The reasons for using RETE algorithm being its time saving capability and that it does not leads to exhaustive matching of thousands of conditions [4]. As we are focusing on online transactions we assume that the messages are encrypted and before initiating the transaction for the first time public keys are exchanged and these public keys are stored in the knowledge base thus the next time transaction occurs decryption is performed by using the combination of the saved public key. We assume that for the first time if a user is requesting for a service, the details of the user are saved and keys are exchanged and for maintaining integrity of the user credentials a strong hash function is being used. Now the hash values are computed and stored in the knowledge base and the same hash function is used for the entire transaction and thus the CIA Integration agent computes the hash value and matches with the one already stored for each incoming packet from the same source. Apart from this the CIA Integration agent being proposed here is also responsible for analysing user profile because user profile gives an idea of the sort of behaviour expected from the user involved in the transaction, it is like monitoring the user's activities.

Moreover as the intrusion detection is host based it also keeps track of the sequences of the system calls being executed. Any behaviour deviating from the normal is considered to be anomalous. The various log files are analysed by one of the modules of CIA Integration agent known to be Log File Analyzer. The contents of the log files are compared to the patterns present in the knowledge base[6]. The system log files are categorised as- system, application and security logs corresponding to their events [7]. Analysis of host machine's log files provides extra security to the host as time to time the security log files can be analysed. And since the rules are stored in the Knowledge Base it also makes use of rule mining to accomplish its goal.

4.0 LOG FILE ANALYSIS

As log files are the archives of various events taking place in a system and in windows are generally stored in EVTX format [7]. And every event has some attributes associated with it. The log files after*Denial of service attack* as provided by Centre for Cyber Forensics & Information Security and moreover we analysed that there were no considerable changes in log files of Windows XP when it was exploited with the help of BackTrack5.

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Figure 2. Log Files after Dos attack

After performing DHCP snooping through Man In The Middle (MITM) attack the system log file showed some errors and warnings which has to be analysed by the CIA Integration agent and simultaneously the CIA Integration agent has to make an observation on each user's profile so as to detect any malicious event which can be harmful to the server involved in online transactions.

5.0 CONCLUSION

In this paper a novel Misuse Detection System is proposed for the security of servers involved for online transactions. The basic goal of this system is to intimate the administrator about the various malicious activities occurring in the host machine so that appropriate actions are taken immediately. The Misuse Detection System being proposed here is basically a multiagent system making use of intelligent agents having the capability to exploit data mining techniques to detect intrusions. The CIA agent not only checks availability but also checks for confidentiality and integrity by making use of public and private keys and calculating message digests. The system being proposed in this paper also makes use of log files analysis and system call analysis since changes in log files and deviations from the normal system call usage depict vulnerabilities.



Figure 3. Log Files After DHCP Snooping

The system can be extended by adding new task agents and can be used for E-Business where the involved servers store user credentials. The future work includes the additional capabilities to detect novel attacks with less false positive rate without compromising the resources available and thus creating a proactive shield for future attacks.

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Password Protected Locking System Using Arduino

Sriharsha B S¹, Zabiullah², Vishnu S B³ and Sanju V⁴

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Abstract - In this current situation, the degree of security is feeble. So there is a lot of robbery, theft going on in and around the world. So, people fear to keep any of their valuables in their homes. Henceforth, many people prefer to keep it in banks. However, in this insecure world even banks are not too safe enough to satisfy people needs. A common man feels his valuables are secured if there is efficiency in security. Hence this project can give effective security in minimal cost.

Index-Terms: Arduino, Servo motor, LCD 16x2, 4x4 Membrane Keypad, Buzzer.

1.0 INTRODUCTION

In this project we are providing enough security to satisfy the user's needs. The user will be prompted to enter a password to unlock the door. On successful password entry, the door unlocks for a specified amount of time enabling him/her to store or restore his/her valuables. On the other hand, if the user enters an invalid password then corresponding equivalent message will be displayed.

This project "Arduino based password protected locking system" can be used to provide enough security in various places like bank lockers, security doors, BIOS locking in computer etc.

This project uses an arduino kit that consists of ATMega 328 which is one of the most popular microcontrollers that consists of 14 digital pins and 6 analog general purpose pins, EEPROM of capacity 1KB and a ram of 2KB.

2.0 COMPONENTS USED IN DESIGNING

We will be providing the detailed description of every component used in designing this password protected locking system:

2.1 Arduino UNO

This microcontroller is based on the ATmega 328. There are total of 20 pins (0-19) out of which 6 are analog inputs which can also be used as general purpose pins, a ceramic resonator of frequency 16MHz, an USB connection, a power jack and a reset button. It contains everything needed to support a microcontroller. [1].

^{1,2,3}Department of Computer Science & Engineering, Nitte Meenakshi Institute of Technology, Bangalore-560064, India ⁴Department of Computer Science & Engineering, Muthoot Institute of Technology & Science, Varikoli, Ernakulam, India



Figure 1. Arduino UNO with its parts

Summary on Arduino	
Microcontroller	ATMega 328
Clock Speed	16MHz
Analog Input pins	6
Digital input output pins	14 (6 pins provide PWM voltage)
Input voltage	6-20V
Operating Voltage	5V

2.2 LCD

Liquid Crystal Display, which we are using in our project is JHD 1602A. This display consists of 16 columns and 2 rows. The library that is used is cliquidcrystal.h>.

PIN SUMMARY OF LCD 1602A

Pin 1: VSS.

Pin 2: To VDD 5V input.

Pin 3: VL to adjust LCD contrast with the help of 10K potentiometer. Low VL indicates light contrast and high VL indicates dark contrast.

Pin 4: RS for register select. Data registers used for high RS. Similarly, instruction register for low RS.

Pin 5: R/W signal stands for read/write. When R/W bit is high, it indicates a read operation. If R/W bit is low, it indicates write operation.

Pin 6: Clock Enable- Edge triggering.

Pin 7 to 14: Represents from Bit 0 to Bit 7.

Pin 15: back light Anode.

Pin 16: back light cathode.



Figure 2. LCD JHD16x2A

2.3 Membrane Keypad

In our project we used 4X4 matrix membrane keypad. This 16 button keypad provides user interface component for Arduino project. this is programmed using the library <keypad.h>. It has the following features:

- 1. Easy interface to Arduino.
- 2. Ultra-thin design.
- 3. Cheap and economical



Figure 3.4x4 Matrix membrane keypad

SUMMARY about Keypad pins:

- 1. Maximum operation rating: $24V_{DC}$, 30 mA.
- 2. Insulation Resistance : 100M ohm
- 3. Interface: 8 pins can be accessed in the form of 4X4 matrix.

2.4 Servo Motor: The servo used in the project is SG90 Micro Servo weighing about 9g. This is programmed using the library <servo.h>. It has the following operating conditions:



Figure 4. SG90 Micro Servo

Modulation Torque Speed Weight Motor type Gear type Rotation/Support Pulse Width Analog 25.0 oz-in (1.8kg/cm) 0.12 s/60 deg 0.32 oz (9.8g) 3 pole Plastic Bushing 500-2400 micro-sec

2.4 Buzzer

In our project the buzzer is used for beep sound either indicating the countdown time or wrong password. It is as shown below:



Figure 5. Piezo Buzzer

2.5 Potentiometer

In our project we have used a trim potentiometer of 10Kohm resistance in order to adjust the contrast of the Liquid crystal display. It is as shown below:





Figure 6. 10KΩ trimpot

3.0 IMPLEMENTATION- CONNECTION WIRING SPOT DIAGRAM AND CIRCUIT DIAGRAM

The following table shows the connection wiring spot diagram of our circuit.

The entire circuit diagram can be tabulated as shown below. This tabulation is called connection wiring spot diagram. The entire circuit connection is being available in this table Labeling of the pins as per the above tabulation:

D'N': D- Digital pins in arduino. N is the pin number A'N': A-Analog pins in arduino. N is the pin number LCD'N': Liquid Crystal Display pins. N is the pin number DB0-DB7: Data byte pins from 0-7 R/W- Read/Write VD0 and LED+- Positive connection of the LCD VD1 and LED- - Negative connection of the LCD. ROW'N'- Rows of the hex keypad. N is the pin number COL'N'- Columns of the hex keypad. N is the pin number Motor- Servo motor Connection MICRO- Arduino UNO Connection FR- From Connection FR- From Connection E- Enable RS: Reset

The following figure shows the schematic diagram for the project. The components used in design and connections of the project are as follows:

- ARDUINO UNO
- LIQUID CRYSTAL DISPLAY(LCD JHD1602A)
- 4X4 MEMBRANE KEYPAD
- SERVO MOTOR
- 10K POTENTIOMETER

Note: all the description of the above components is provided in section2.1-2.6.

The connections in the above circuit diagram is derived and explained in the connection wiring spot diagram

4.0 WORKING OF THE CIRCUIT

The above flowchart gives a brief idea as to how the project" Password Protected Locking System Using Arduino" works. Initially the password is predefined. When the device is switched on, it resets the servo angle to lock the door. Now the user is prompted to enter the password. The user enters the password through a keypad which is read by the arduino. Now the entered password is checked with the predefined password. If the password matches, then the servo motor deflects and the door unlocks for 30s else the buzzer beeps indicating the invalidity of the password.



Figure 8. Flow chart of the working circuit

The step by step working is given as below. When the arduino is switched on, the LCD displays the entry screen message by initializing and configuring the LCD pins to arduino.

Step 1: *Configure the lcd pins.*

LiquidCrystal lcd(13, 12, 11, 10, 9, 8);

Next, the user is asked to prompt a password. Here the correct password is pre-initialized.

Step 2: Initialize the correct password

char* pass="A1B2C";

Next, the password entered by the user is compared with the correct password. If the password entered by the user matches with the correct password, then the following set of statements will be executed.

**

STEP 3:

myservo.write(90); //The servo motor deflects to an angle of 90 degrees enabling the user to unlock

unlockdoor();// Unlocks the door for a specified amount of time currpos=0;//reset the password enabling the user to enter a new password

myservo.write(0);//after the time exceeds the servo deflects the angle back to zero degrees.

Else, the following set of statements will be executed

myservo.write(0);// Due to the entry of wrong password, the servo does not deflect and hence the door will //be locked

invalidcode();//Message of invalidity will be displayed to the user via lcd and returns to the start

currpos=0;//the password is reset enabling the user to enter a fresh password

In the above case, the door will be unlocked by the movement of servo to a particular angle or remaining still depending upon the user's entered password.

Note: The entered password by the user is converted into '*' to provide strong privacy.

For(l=0;l<=currpos;++l) { lcd.print (`*'); }

Further, the buzzer is provided if the user enters a wrong password and also if the user exceeds the specified limit. Here we have given the specified limit to be 20 secs.

Step 4:

if(i==21){
digitalWrite(19,HIGH);// buzzer beep
lcd.setCursor(0,0);

5.0 HARDWARE OUTPUT SCREEN SHOTS



Figure 9.0. Showing user to enter the password

In the above figure, Fig 9.0. and Fig 9.1 the LCD displays the user "ENTER PASSWORD". The entered password is displayed as "*" on the LCD.

In these figures, fig 10.0., fig 10.1., the user has entered the correct password.

The servo motor deflects thus unlocking the door.



Figure 9.1. Password displayed '*'



Figure 10.0. Showing correct password



Figure 10.1. Door unlocks



Figure 11.0. Timer activated



Figure 11.1. Deadline timer

In these figures, fig 11.0, fig 11.1., the timer activates automatically for fixed duration. The buzzer beeps if the user exceeds the grace period and deadline timer is activated.



Figure 12. Door locks.

In the Fig 12., the door locks when the timer crosses the deadline time. The user is prompted to enter the password once more and the process continues. Fig 9.0.



Figure 13.0. Incorrect password entry.



Figure 13.1. The door remains locked

In these figures, fig 13.0., fig 13.1., the user has entered an incorrect password. As a result the door remains locked and the user is prompted to enter the password once more.

6.0 CONCLUSION

This project is effective in providing enough security as long as the password is not shared. In future this "Arduino based password security locking system" can be provided maximum security by the above enhancements in order to completely satisfy user's needs.

Hence, a common man can afford to purchase such locking system in minimal cost to keep his valuables safely without any worries.

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Motor	-		Micro		LCD		-	Keypad	•
	FR	ТО	FR	ТО		FR	ТО	FR	ТО
1	-ve	Gnd	3.3V		1	VD1	Gnd	COL1	Gnd
2	Pulse	MICRO A2	5V	MOTOR POS,10 K POT,RES	2	VD0	10K POT,5V,RES	COL2	MICRO A0
3	+ve	5V	Vin		3	WD	10K POT CONROL	COL3	MICRO D2
					4	RS	MICRO D13	COL4	MICRO D3
					5	R/W	Gnd	ROW1	MICRO D7
					6	Е	MICRO D12	ROW2	MICRO D6
					7	DB0		ROW3	MICRO D5
			A0	KP COL2	8	DB1		ROW4	MICRO D4
			A1		9	DB2			
			A2	MOTOR Pulse	10	DB3			
			A3	Gnd	11	DB4	MICRO D11		
			A4		12	DB5	MICRO D10		
			A5	Buzzer +ve	13	DB6	MICRO D9		
			N/C		14	DB7	MICRO D8		
			GND	100K POT ,LCDVD1,MOTOR	15	I FD+	RES-5V-100KPOT		
			D0	NEG, Buzzer ve	16	LED	Gnd		
			D1		10	LLD	Gild		
			D2	KPCOL3					
			D3	KPCOL4					
			D4	KPROW4					
			D5	KPROW3					
			D6	KPROW2					
			D7	KPROW1					
			D8	LCDDB7					
			D9	LCD DB6					
			D10	LCD DB5					
			D11	LCD DB4					
			D12	LCD E					
			D13	LCD R5					

Table 1. Connection wiring spot diagram

Secured Data Migration from Enterprise to Cloud Storage – Analytical Survey

Neetu Kishore¹ and Seema Sharma²

Submitted in November, 2015; Accepted in January, 2016

Abstract - Everything in Cloud is an emerging concept, with work in multiple areas right from the Infrastructure, to middleware, to applications and to data security. Every domain has its own flavor of Cloud. Technologies and techniques for Cloud has come a long way and is still evolving. Organizations are fast recognizing the value of migrating to Cloud but the biggest concern is around data security. The migration of sensitive data to a public cloud domain has risks associated with data loss, information theft, confidentiality and other vulnerabilities. There are security measures deployed at multiple points but the question of secured end to end data transmission still remains unanswered. Objective is to understand the security parameters that can help build a framework for secured data transmission. With reference to many research papers and reviews, the analysis is to focus on the security of data in transit. Pragmatic observation is that the data at rest in the Enterprise and the Cloud have fairly good security measures, but the data in transit is vulnerable. There is a future scope to build a security framework for the transit data. This paper will highlight few of the security aspects of Cloud that have been developed and the gap around the security of data being migrated from Enterprise storage to Cloud Storage.

Index Terms – Availability, Cloud, Cyber, Confidentiality, cryptography, encryption, Homomorphism, Integrity, vulnerability.

NOMENCLATURE

IaaS-Infrastructure-as-a-service; PaaS- platform-as-a-service; SaaS- software-as-a-service; CSP- Cloud Service Provider; SSL – Secured Socket Layer, TLS- ; HTTP- Hyper Text Transfer Protocol; VPN- Virtual Private Network; DSLdomain-specific language; EDSL- embedded domain specific language; IP- Intellectual Property; OS- Operating System; DES- Data Encryption Standard; CSA- Cloud Security Alliance.

1.0 INTRODUCTION

Cloud is the new paradigm of traditional data centers with enhanced features to offer services in a shared environment on virtualized systems, capability of multi-tenacity, scalability and pay-per-usage pricing model. Organizations which have non-IT as core business, started looking at these IT services, moving away from their infrastructure investments and IT asset ownership.

Neetu Kishore, M.Tech Student at BIT Mesra, Noida Campus, India. Email – neetukishore31@gmail.com

Seema Sharma, Asst. Professor CSE, BIT Mesra, Noida Campus, India. Email – seema@bitmesra.ac.in

Typical Cloud services started with moving out the Infrastructure layer from in-house to a shared data center environment, followed by platform and now applications. The main objective of cloud computing is to make better use of distributed resources and solve large scale computational problems. [1]

While standardization of the cloud computing is still in progress, an agreed framework for describing cloud computing services has been accepted commonly as "SPI." This acronym stands for the three major services provided through the cloud: software-as-a-service (*S*aaS), platform-as-a-service (*P*aaS), and infrastructure-as-a-service (*I*aaS)" [2].



Figure 1.1 SPI Service Model illustrating the relationship between services, uses, and types of clouds [2]

This framework has helped Cloud computing services get structured in layers of service offering by the CSPs (Cloud Service providers) [3]. The CSP maturity evolved and from the standard services, they started offering customized and value added services in multi-tenant segregation on shared cloud platform. Moving from monolithic onsite data centers, the virtual servers through browser access has provided a substantial throughput and maintenance in the software and hardware environment. [4]

2.0 SECURITY IN CLOUD

In the existing Cloud environment, two areas play critical role for sustainability – Data Security and Standardization. These are still at an early stage and have major scope in future for research, considering the complexity of the Cloud computing architecture. Cloud Security and related research reviews have shown that the area of concern emerged as security of transit data from enterprise to cloud storage. There has been many researches done on how to keep data secured at rest either in the Enterprise or in Cloud, but Organizations are paranoid about security of data during transmission. There are techniques applied for secured data migration for specific requirement but there is a lack of framework to address all types of data migration in a secured way from a private environment to a public domain of cloud.

2.1 Security concerns

In the existing Cloud environment, two areas play critical role for sustainability – Data Security and Standardization. These are still at an early stage and have major scope in future for research, considering the complexity of the Cloud computing architecture. Another important area to understand in the data security is the types of risks to data for the cloud migration. As per Cyber Security literature, there are three threat classes in cyber-attacks – piracy, tampering and reverse engineering. [5] Piracy – This is about the copying of data to unauthorized locations. Tampering – Malicious manipulations of computing logics would impact the businesses. Reverse Engineering – The vulnerabilities in the applications and system software are exploited to steal the Intellectual Property (IP).



Figure 2.1 Graphical depiction of attack on a computing asset [5]

With increasing threats [6], security measured have been applied at various levels, hardware, OS, applications and other protection tools based on hardware or software programming. No one system can counter various attacks and to put all measures together, the impact is on the cost and performance of the system. Organizations worked on criticality of the data and arrived at an optimal solution, understanding the associated risks. Only hardware was sufficient to guard the outer layer and prevent external attacks, but the other systems still remained vulnerable.

2.2 Secured data transmission

The greatest fear of organizations to migrate their Enterprise data to cloud storage is loss of control. Every organization wants to have their data privacy and security at all levels to ensure Confidentiality, Integrity and Availability of Enterprise data. Cyber threats have created the fear that data is highly vulnerable to multiple types of risks during transmission to cloud. Cloud Service Providers have matured to build security models on their hardware and software but the threat at the data access and migration level still remains vulnerable to attacks. Protecting data in motion is a major concern. [7] Primary method of securing data from exposure of network media is encryption, and it could be applied in two main ways: by encrypting the data itself to protect it or by protecting the entire connection. SSL and TLS are often used for web traffic with HTTP (Hyper Text Transfer Protocol). When SSL/TLS are used, the connection between the two systems over the network is encrypted and is very specific to an application or a protocol. The second approach is to encrypt all the traffic through a VPN (Virtual Private Network) connection.

3.0 OBSERVATION ANALYSIS

For the security of data in the cloud computing, there is a need to build a secured framework for the migration of data. The framework should provide guidelines to ensure there is end to end security of data from enterprise to cloud. Additionally, there are technical Issues concerning the data security. There are three parts to be considered – the security at storage level, the security at computation level and the security at migration level. Data from a secured Enterprise computing environment migrated to public cloud has to be ensured for retaining its confidentiality and integrity and once stored in cloud storage has to guarantee the availability without any loss.



Figure 3.1Conceptual model for the framework

The security measures at different levels ensure Security at either periphery, or within system or at applications level. For a comprehensive secured data handling in cloud should have a structure with relevant parameters. A conceptual model in Fig 3.1 would be a starting point of putting the pieces of the Security framework. Through survey analysis, itwas observed that only programming techniques or security at software level cannot protect the data when it moves from one physical environment to another and resides on a shared platform. Any outgoing or incoming data with application based security only could be compromised. This security mechanism could be defeated by attack tools that intercept calls from the software to the operating system (OS) and falsified or altered the outgoing or incoming data [8].

In trusted computing and computation-supporting encryption, life in the cloud can be advantageous from a business intelligence standpoint over the isolated alternative that is more common today. [9]

4.0 SECURITY TECHNIQUES

Cryptography [10] is the science and study of Secret writing. In cloud computing the security concepts are to be understood in depth for relevant application and modification of techniques. Any information that is transmitted over electronic wire is vulnerable in two ways – passive wire-tapping and active wiretapping. Passive does not do any detection, just intercepts the messages where as Active tampers and modifies the data on transit. In the emerging digital world, while secrecy of data is required, authenticity is equally important. DES standards could help in secrecy but cannot guarantee the authenticity.

The Encryption Algorithms use different types of ciphers. Brief explanation of few of the key cipher techniques is as follows. [10] Transposition ciphers rearrange characters according to some scheme. Substitution ciphers are of four types – simple substitution ciphers which replace plaintext with a cypher text with a one to one mapping, Homophonic substitution ciphers are similar but with a one to many mapping, Polyalphabetic substitution cyphers use multiple mapping of plaintext to cipher text and Polygram substitution cyphers allow arbitrary substitution of group of characters.

Vulnerability is the procedural weakness in the hardware or software that allows the attackers to gain access to networks and penetrate into any system inside the network. [11] The security analysis for leakages of data and prevention through various means is very critical for the selection of the parameters.

In the data transmission method, transferred data is encrypted in the upper-layer on top of the transport layer instead of using IPSec or SSL.[12] Without doing any modification on IP layer, encryption can be pre-processed at upper layers. This will improve performance.

5.0 SELECTED PAPER SYNOPSIS

The review details for selected research papers to understand the security of data in the cloud computing environment, common trend has been around securing data at rest, either in the enterprise or in cloud storage. Very limited work has been so far done on the security of data in transit. Different security mechanisms and also vulnerabilities have evolved as the cloud computing trend has progressed.

Using homomorphic encryption [13] and secure multiparty computation, cloud servers may perform regularly structured computation on encrypted data, without access to decryption keys. The core of domain-specific language (DSL) is implemented as a Haskell library, an embedded domain specific language (EDSL). The implementation includes Shamir secret sharing and fully homomorphic encryption; both use SSL network communication between clients and any number of servers. While homomorphic encryption and secure multiparty computation are based on different cryptographic insights and constructions, there is a surprising structural similarity between them. This similarity is also shared by socalled partially homomorphic encryption, in which the homomorphism property holds only for certain operations [14]. In cryptographic domain, the computation on encrypted data needs to be worked without any change in the expected result. The challenge is in the data being transmitted securely through the public transmission media.

One of the emerging trends in cloud storage is the repository of data being captured during web transactions and used for analytics to provide valuable information to the business. With this trend, there is sensitive data that also flows through public network and the concerns are around securing this type of data. Big data has the fear of sensitive information getting leaked out. The mechanisms to protect this data are still not matured for the shared platforms. Big data is an advanced form of storage in Cloud which allows the transaction of data and sharing of information. Research work still undergoing for a complete secured environment for safe data movement. [15] This paper proposes a framework for secure sensitive data sharing on a big data platform, including secure data delivery, storage, usage, and destruction on a semi-trusted big data sharing platform. A proxy re-encryption algorithm based on heterogeneous cipher text transformation and a user process protection method based on a virtual machine monitor, which provides support for the realization of system functions. The framework protects the security of users' sensitive data effectively and shares these data safely. At the same time, data owners retain complete control of their own data in a sound environment for modern Internet information security.

To understand the Security vulnerabilities [16] for data moving across the public and private networks, it is important to analyze the various possible attacks through internal or external sources. There is always a concern on the confidentiality, Integrity and Availability of data where there are security concerns and hence, the best way to observe these risks is through threat attack simulations.

6.0 SURVEY COMPARISION

Some of the factors compared during the survey are as summarized in the table below:

Sr. No.	Factors Compared	Observations	
1	What needs security?	Company Data,	
		personal information,	
2	Threat parameters	Vulnerability,	
		confidentiality, integrity	
3	Shared resources	Concern of data leakage	
4	Data in transit	Greatest risk	
5	Key security	Network protocols,	
	parameters	secured access,	
		cryptography,	

7.0 CONCLUSION AND FUTURE SCOPE

The reviews of the research papers on cloud related security show that end to end security in cloud data storage is a challenge due to complexity of the environment. While there are different security measures for data protection in the common computing environment, the Cloud architecture needs new techniques for security. It is important to realize that from a scientific standpoint, there is no absolute notion of security. [17]

In Cloud computing, data migration from and to the enterprises is very critical. Data constantly needs to be moved from one place to the other either for computation, storage or simple access. This needs a better understanding of the encryption techniques for data at rest and data in motion. Encrypted data, for access at multiple stages, need to ensure that the integrity is maintained throughout. There are multiple active adversaries, against which data has to be guarded while in motion.[18, 19] Cost vs Efficiency need to be well understood for end to end cloud security considering the technology and regulatory challenges. For a higher security, the cost implication is going to be high and also the data at every stage, being run for a security procedure, will impact the efficiency of the system. There is a lack of Framework for data in motion and security against active adversaries has scope of future work.

Cloud Security Alliance (CSA) [20] is gathering solution providers, non-profits and individuals to enter into discussion about the current and future best practices for information assurance in the cloud. The CSA has identified thirteen domains of concerns on cloud computing security [21].

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A First Hand Survey of Frequency Domain Denoising Algorithms and Techniques

Tariq Ahmad Lone¹, Showkat Hassan Malik² and S. M. K. Quadri³

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Abstract- World over, research community is facing the challenge of noise removal in multimedia viz. Images, audio, video etc. Attempts have been made, since long, to identify and remove this noise. Both, Spatial as well as Frequency domains have been thoroughly explored to devise newer and better techniques to remove these foreign bodies from the original signals. This paper is a step to carry forward the literature survey into frequency domain from the previous paper that focused on the spatial domain. It is further expected to be followed by literature survey on denoising in the Artificial Neural Network (ANN) context. The intent is to have a comprehensive survey on image denoising and use it for designing new techniques and extend existing ones to further their performance.

Index Terms- BAYES Shrink, Denoising, ICA, SURE Shrink, Threshold, VISU Shrink, Wavelet.

1.0 INTRODUCTION

The menace of contamination, that has engulfed almost everything, does not even spare images. This contamination occurs at the time of capturing the image, during communication, while being stored and worked upon. This contamination of images by unwanted signals is called Noise. Researchers everywhere are faced with a big challenge of dealing with such contaminated images. A de-contamination process has to be applied to remove the noise. This decontamination process is called Denoising [1]. People have worked extensively on images and often newer techniques are developed and implemented to denoise images.

Various factors have to be considered while a denoising model is being worked upon viz. image capturing devices and instruments, image transmission media, quantization and digitization processes, environmental disturbances and the like. Noise that corrupts the images may be White Gaussian noise, Speckle noise, Salt & Pepper noise or any other type and knowing the type of noise sometimes plays a very vital role in the denoising process.

2.0 EVOLUTION OF THE FREQUENCY DOMAIN DENOISING TECHNIQUES

The process of denoising started with simple filtering techniques discussed previously in [2]. A plethora of algorithms and literature is devoted to this field. Later on the

1, 2 Research Scholars, Faculty of computer science & system studies, Mewar University, Rajasthan; tariq380@gmail.com, shmalik.mca@gmail.com

3 Professor, Department of computer applications, University of Kashmir, J & K; quadrismk@hotmail.com

attention of researchers shifted from filters to frequency domain and here again, as we will see, researchers produced remarkable solutions to get better images after applying newer and newer denoising methods. Newer algorithms were devised and extended and the process still continues.



Figure 1: An outline of Image Denoising Techniques referred in the paper

3.0 DISCUSSION

Denoising in the frequency domain is broadly classified as Data-adaptive and Non-data adaptive as shown in Figure-1 above [3]. Most of the algorithms in this domain have been observed to show much better results than the algorithms in the spatial domain. Refer table-1 for results of a comparative study by the authors [4].

	Table-1 (Adapted)						
		PSNR			MSE		
Denoising Technique	Gaussain Noise	Salt & pepper Noise	Speckle Noise	Gaussain Noise	Salt & pepper Noise	Speckle Noise	Threshold
Mean Filter	12,5796	14.7141	20.5553	3.5902e+003	2.1962e+013	572.1996	-
Median Filter	123491	14.4528	20.5245	3.7859e+003	2.3324e+013	576.2773	-
Weighted Median Filter	12 <i>5</i> 941	14.6827	20.5719	3.5783e+003	2.2121e+003	570.02.53	-
Wiener Filter	14.0288	17.3274	25.5214	2.5716e+003	1.2032e+003	182.3638	-
VISUshrink	38,5863	42,1129	42.1129	9.0044	3.9976	3,9976	35,7865
SUREshrink	421129	42,1129	42.1129	3,9976	3.9976	3.9976	8.0010

3.1 Data Adaptive

Data adaptive transforms like Independent Component Analysis (ICA) have gained a wider acceptance and attention more recently. [5], [6] have implemented ICA successfully on non-Gaussian data. The big drawback associated with ICA is the computational cost.

3.2 Non-Data Adaptive

These transforms have been more popular for they give good results in different noise models [3].

3.2.1 Spatial Frequency Domain

In this method low Pass filters are used in Fast Fourier Transform (FFT). A cut off frequency is adopted using a frequency domain filter to filter out noise [7]. These methods consume more time as they depend on cut off frequency. They sometimes also produce artificial frequencies in the denoised images.

3.2.2 Wavelet Domain

Wavelets have shown better performance in denoising due to their sparsity, multi-resolution structure properties. Many algorithms in this domain have been introduced into the literature during past few decades.

i. Linear filters in the Wavelet Domain

Linear filters, like Weiner filter in wavelet domain give optimal results when Gaussian noise is present and MSE is used for measuring accuracy [8], [9]. Although MSE gets reduced, these filters generally produce visually more damaged images than the noisy ones. One such method has been proposed in [10]. Local adaptive filters were introduced by L. Yareslavsky [11], [12] where noisy image is analyzed in a moving window. The spectrum of the image is computed at each window position and modified, if needed.

ii. Non linear threshold filtering

Noisy coefficients in an image can be modified using certain threshold [13]. In hard thresholding coefficients smaller than a certain threshold are cancelled. This method generates artifacts in the images. To do away with this problem, soft thresholding was introduced in which coefficients larger than a certain threshold are cancelled to denoise the image [14]. Many other thresholding methods, similar to soft thresholding, like Semi soft and Garrote were also introduced later [15].

In thresholding, selecting a threshold value is a tedious job as selecting a smaller or a larger threshold many a times removes important signal/image components. Choosing an optimal threshold is based on whether the threshold is adaptive or nonadaptive to the image.

a. Adaptive Thresholds

A hybrid method of Stein's Unbiased Risk Estimator (SURE) and Universal Threshold has been discussed and used in [13]. This method is called SURE Shrink.

BAYES Shrink [16], [17] minimizes the Baye's Risk Estimation Factor. BAYES shrink performs better than SURE Shrink most of the times [3]. Another thresholding method, Cross Validation [18] replaces coefficients with weighted average of neighborhood coefficients to minimize Generalized Cross Validation (GCV) function.

b. Non Adaptive Thresholds

A nonadaptive threshold depending only on number of data points is VISU Shrink [13]. It consists of applying the soft thresholding operator using universal threshold. VISU Shrink produces a highly smoothed output image but often eliminates important image details because of selecting a large threshold [19]. LEVEL Shrink uses different thresholds for different levels of tree. LEVEL Shrink is more adaptive than VISU Shrink as it adapts to the variability from one decomposition layer to another by suing different thresholds for different levels [19].

Wavelet thresholding methods were improved by Coifman and Donoho [20] by way of averaging the estimation of all translations of degraded signal. This translation invariant Wavelet Thresholding (TIWT) considerably reduces the Gibb's effect. Stair casing, Gibb's effect and wavelet outliers are more efficiently taken care by a variation method given by S. Durand and M. Nikolova [21].

iii. Wavelet Coefficient Model

This model focuses on multi-resolution properties of wavelet transform and identifies close correlation of signal across multiple resolutions. Although computationally expensive and complex, the method gives excellent output.

a. Deterministic Wavelet Coefficient Models

Proposed in [22], this model creates a tree structure of wavelet coefficients. Each scale of transformation is represented by a level in the tree and the wavelet coefficients by every node. Donoho also proposed a deterministic model in [23] based on trees. Lu et al used a tree structure to track wavelet local maxima in scale-space [24].

b. Probabilistic/Statistical Wavelet Coefficient Models

Some properties of wavelet transform viz. Local correlation between neighborhood coefficients and multi-scale correlation between wavelets etc play interesting role in image denoising. The goal is to perfect the exact modeling of image data. [25], [26] provide a review of statistical properties of wavelet coefficients.

c. Marginal Probabilistic Models

Many homogeneous local probabilistic models have been developed to denoise images and these models have shown that marginal distribution of wavelet coefficients are highly kurtotic and often have a marked peak and heavy tails at zero. Amongst these models Gaussian Mixture Model (GMM) [17] and Generalized Gaussian Distribution (GDD) [27] are commonly used to model the distribution of wavelet coefficients. GMM has been seen to be easier to implement whereas GGD shows more accuracy. Maximum A Posteriori (MAP) probability is used to estimate marginal prior distribution of wavelet coefficient variances. A noise estimate is required in all the above methods and many people have proposed methods for such estimates, as in [16], [28].

d. Joint Probabilistic Models

For capturing inter-scale dependencies and inter-scale correlations Hidden Markovian Model (HMM) [26] and Random Markov Field (RMF) [29] are used respectively. Hidden Markovian Chain Model (HMCM) and Hidden Markov Trees (HMT) are respectively used for modeling correlation between coefficients at same scale but in a close neighborhood and correlation between coefficients across the chain.

In a model described in [30], each neighborhood of wavelet coefficients is described as a Gaussian Scale Matrix (GSM) which in turn is a product of Gaussian Random Vector and an independent hidden random scale multiplier.

Jansen and Brethel [31] have used a Markov random field for wavelet coefficients. In [26], a simple HMT, namely uHMT was proposed as a computationally simplified version of HMT.

e. Non-Orthogonal Wavelet Transform

Visual artifacts like Pseudo-Gibb's phenomenon have been dealt with Undecimated Wavelet Transform (UDWT) by way of decomposing the signal to provide better solution. The drawback with UDWT is that it is computationally complex but provides better visual results in images. The method was extended by incorporating normal thresholding in [32]. Shift Invariant Wavelet Packed Decomposition (SIWPD) is exploited in [33]. Here Basis functions are obtained to get small code length for description of the given data. Later on, Thresholding was used to denoise the data.

Multi-wavelets have also been utilized to further the performance at the cost of added complexity. These multi-wavelets are obtained by applying many mother functions to given data set. In [34], a combination of multi-wavelets and UDWT is implemented which give better results in terms of Mean Square Error.

4.0 CONCLUSION

In this paper, the authors have made an attempt to explore the denoising literature, in the frequency domain, from the vast volumes of information available for image processing. An attempt has been made to dig deep into imaging domain to get first hand information especially in the frequency domain. A classification tree has been designed and accordingly techniques of denoising have been identified. There is still a scope to dig further and explore the left out techniques and algorithms. The authors are again working on a comprehensive survey for exploring denoising literature in the context of Artificial Neural Networks. The ultimate aim of the review process is to identify gaps to design newer techniques for better image processing.

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DST's Mission Mode on Program Natural Resources Data Management System (NRDMS) & its Developments at CSIR-NISTADS, New Delhi - A Few Examples

Gagandeep Singh Narula¹, Subhan Khan² and Yogesh³

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Abstract- Natural resources are great asset for an economy. There are various resources that still are unexplored and under-utilized. Keeping this aspect in view, this paper focuses on development of an integrated approach to the exploitation, conservation and management of natural resources as well as to the protection and preservation of environment. The work is carried out by conducting project on Natural Resources Data Management System (NRDMS) which is conceived by the Department of Science and Technology (DST), Govt. of India, New Delhi.

In addition, NRDMS software package called GRIDS (Geo-Encoded Resource Integrated Data System) was developed. It generates maps with reference to geographical system. It leads to spatial database that helps in projection, prediction and planning of natural resources.

The paper also puts light on the district database centre of NRDMS that is set up at Gurgaon by National Institute of Science, Technology and Development Studies (NISTADS). The database is generated electronically by integrating the conventional land based data with data obtained from remote sensing application. The task of planning and utilization of resources is done by a team of scientists in special area called Resource Planning and Utilization for Regional Development (RPURD). After studying this paper, we are able to retrieve any information regarding any land system by using a PC based software package called NRDMS-LIS (Land Information System) that is developed at NISTADS, New Delhi.

Index Terms- Geo- Encoded Resource Integrated Data System (GRIDS), Natural Resources Data Management System (NRDMS), NRDMS-LIS (Land Information System) and Resource Planning and Utilization for Regional Development (RPURD)

1.0. INTRODUCTION

Idea Generation:

In prehistoric time's limited knowledge was available on resources. It was easy to remember and was updated periodically whenever newer and better resources were

 ¹MDS-SGSD Project Fellow, gagan.narula87@gmail.com
 ²Chief Scientist, CSIR- NISTADS (Retd.) & Patron, Mewat Development Society (MDS), drsubhankhan@gmail.com
 ³ Student Trainee, Lala Lajpat Rai Institute of Engineering and Technology, Moga, Punjab) found. However, with the development of settled economy and division of labor, the volume of information and data on resources increased at an volatile rate. For proper planning and management of resources, land population was divided into different administrative units, viz., villages, tehsils, districts and states. The government collected enormous volumes of data and stored them in the form of tables, ledgers and files.

It has became imperative for a government to develop a database on the resource it has, the locations where they are available, their spatial distribution, and the human requirements, so that multifaceted retrieval and analysis exercises can be carried out for optimal management. Keeping these aspects in view, the project on the Natural Resources Data Management System (NRDMS) has been conceived by the Department of Science and Technology, Government of India, New Delhi. This project is operationalization of Natural Resources Data Management System (NRDMS).

NRDMS is a multi-disciplinary and multi-agency science and technology project geared to integrate the natural resources and socio-economic databases on different spatial connotations.

2. 0. AIMS & OBJECTIVES

The main aim of NRDMS is to facilitate conductance of area specific and decentralized planning and monitoring exercises by providing data at various level - village, block and district. It specifically seeks to:

- Establish an area specific data management system for decentralized planning.
- Adapt the methodology for island system, such as natural disasters in specific areas and other ecologically sensitive areas.
- Establish linkages with the programmes of National Natural Resources Management System, National Informatics Centre Network and other sectoral information systems.
- Generate development profiles of different regions.
- Support specific studies to develop regional development perspectives using NRDMS as an aid.

3.0. FILE STRUCTURE OF NRDMS:

Following file structure is created under NRDMS district database:

- Natural Resources
- Energy
- Environment,
- Demography,
- Agro-economic,
- Socio-economic,

- Remote sensing,
- Sectoral
- Infrastructure,
- Block information,
- Village information, and
- Household information.

4.0. GRID REFERENCE SYSTEM IN NRDMS *Problem*:

The basic problem in developing an integrated multidisciplinary database is that the data collected by different methods in different forms have to be integrated, superimposed and registered properly, so that unique addressing keys can be given for proper referencing of the data. Geographical coordinates are being used normally to draw the resources maps and to identify any location or to mark an area, etc.

Solution:

Hence, the most suitable choice of a referencing system for registration, addressing and accessing land resources data would be a grid reference system based on latitudes and longitudes. The grid reference system has the following advantages:

- As the geographic units are of equal sizes, comparison among them becomes easier.
- The system remains unchanged, being not subject to changes in the boundaries of administrative divisions.
- The data required for a given area can be obtained by aggregating the concerned data of the grids contained in it.
- It becomes easy to identify locations and data relating to land configuration and distances can be easily obtained.

The disadvantages of a grid reference system are:

- As original data are not usually collected on grid basis, compilation of data on grid basis requires readjustment of the data collected for irregularly shaped real units of unequal sizes; this may involve high labor input and may introduce certain errors.
- The use of grid system as a surveying unit may be difficult.
- The grid size has to be chosen in such a way that it should be a good approximation for storing the relevant data,

5.0. REMOTE SENSING APPLICATION IN NRDMS

Proper management and utilization of known resources and identification, delineation and quantification of new natural resources in a short time span has become the need of the day. As the conventional field survey methods are costly and timeconsuming, they are not suited for precise monitoring of new natural resources. Space technology in general and remote sensing supplemented with limited field surveys in particular appears to be the ideal technology for identifying new locations and estimating potentials in a short period. The advantages of utilizing satellite digital data and imagery include their repetitive coverage, broad synoptic view, negligible distortion, suitability for computer processing, cost effectiveness and time efficiency. At present, in India, the following remote sensing data products are available for studying natural resources: (A) Aerial data - (1) Panchromatic photographs, (2) Color photographs, (3) Color infrared photographs.(4) Thermal photographs, (5) MSS photographs, and (6) SAR photographs (B) Satellite data (imagery as well as digital data in the form of CCTS) - (i) Multispectral sensor data, (ii) Thematic Mapper, (iii) SPOT, (iv) IRS, (v) SAR, (vi) Sea Sat, and (vii) Mat Sat.

In addition, the following ground data products are available: (a) survey toposheets, (b) survey maps, (c) manually collected data (like meteorological data).

The accuracy of this data as of today for Land sat products in terms of mapping accuracy is about 250 m for MSS and about 100 m for TM data. With the improvement of technology, mapping accuracy (i.e. resolution) is improving (spot data).

6.0. GENERATION OF VILLAGE CODE IN NRDMS

To establish the computer-aided database covering various sectors of each village, a numeric code has been designed to uniquely cover each village using the database software package. For example, at Gurgaon district database a five-digit numeric code has been generated as identification code for villages. In the first step, the names of the blocks have been sorted alphabetically and a one-digit numeric code has been allotted to each block. In the second step, the names of the villages belonging to each block have been sorted and a three-digit code has been allotted to each village. All the NRDMS files have block code and village code as their common references, so that they can be joined for any interdisciplinary query and for studying the facilities of a particular village in detail.

7.0. NRDMS SOFTWARE

NRDMS computer software is available to generate thematic maps compatible with the geographic referencing system. Maps of different scales ranging from 1:1,000,000 to 1:250,000 or 1:50,000 may be generated. The primary source of data collection decides the analytical level of the thematic maps which have interpolated components. An attempt has also been made to develop and adopt a spatial data management system, in which polygonal and point referencing have been used. The thematic map so generated in the system would present a single variable within a sub-aerial zonation and would be similar to the maps generally prepared by economists and planners.

The integrated composite software package called "GRIDS stands for "Geo-Encoded Resource Integrated Data System". This is a special software package which is operational on a cost effective microprocessor based system. GRIDS takes into its fold the conventional databases which are available at various state and central levels coupled with data generated from canvassing of structured questionnaires at various levels for specific studies. An innovation in the system is the integration of high technology like remote sensing, computeraided data processing, computer graphics and instrumentation surveys with the classical data sources. The package consists of a number of programmes which may be classified into four categories:

- Thematic map generation for different sets of data like natural resources, demography, agro-economy, socio-economy, infrastructure, remote sensing, etc. and selection of areas suitable for specific applications or developmental programmes.
- Determination of development indices and potential indices for blocks or districts.
- Remote sensing application programmes.
- Analysis programmes for geophysical parameters for such essential purposes as ground water evaluation.

8.0. USE OF NRDMS IN PROJECTIONS

The database can help in specific projections, predictions, zoning and planning. Population projection and flood zoning and planning are two examples cited below.

8.1 Case I

Population projections comprise one of the basic pre-requisites for predicting and planning for future needs in such areas as food, energy, employment, community facilities and social services. It would be ideal to have a single forecast of population on which there is general agreement. However, since the factors influencing population trends—fertility, mortality and migration—are not perfectly predictable, projections usually represent individual or collective judgments that differ greatly, even among experts. There is often disagreement about the data as the base for projections.

In view of these inherent difficulties, it is better to present the population estimates in terms of an illustrative base, i.e. representing the highest and the lowest population counts that may have a reasonable chance to occur. The important question with the projections is not how accurate they are but how the users can cope with the inevitable uncertainty. The main projection methods are:

- Mathematics
- Component,
- Economic, and
- Analytical

8.2 Case II

Flood plain zoning and planning includes in its purview disaster evaluation and mitigation, and, therefore, requires varied inputs and information. Technological inputs like remote sensing and automated natural resources data acquisition models would provide a large database, which would otherwise not be possible from conventional sources and surveys. Such technological inputs would be of consider-able importance for flood plain studies. For instance: (a) the advance/recession of floods can be effectively monitored by satellite and other remote sensing techniques; (b) large scale computer maps generated from air borne MSS (1:25,000) and Land Sat data (1:50:000) demarcate, quite accurately, features like water

bodies (deep and shallow), road, railway lines, canals, settlements, agricultural lands, forest areas, etc. Information on permeability, parameters like soaking potential of surface deposits, geomorphic details, micro-relief and manmade features like embankment, earthen builds, rails, roads which cause formation of local pools of water is important in the execution of disaster mitigation plans. There is a requirement to have information and topographic maps having elevation contours of 0.25-0.50 m interval in specific areas. It is possible to divide the flood plain areas of the country into different segments with varying requirements of resolution on topographic levels.

The strength of the district database depends on its building up and use through the active participation of all data generators and users at state and national levels in general and district, block and village levels in particular. In fact, it is a joint venture of experts, academicians and government officials. Active participation of district administrators and field functionaries is a prerequisite for successful operationalization of the computerized database. The district administrators may require social and cultural profiles of the district, blocks, tehsils and villages to identify the problems, set priorities and take remedial measures. Computerized database can go a long way in helping the district planner in almost all these specific situations.

9.0. NRDMS DISTRICT DATABASE

For decentralized planning, a program on the setting up of district databases in different agro-climatic regions has been launched under its project; "Natural Resources Data Management System (NRDMS)". The main function of a district database is to manage various items of information (both natural resources and socio-economic data) for each grid for the entire district. The demarcation of the grid is based on the Survey of India (SOI) toposheets. In these toposheets, the grid interval is 5 minutes. Thus, each SOI grid is sub-divided into four equal grids for the purpose of the NRDMS project.

The Principal application areas of a district database pertain to:

- Land use for agricultural development;
- Area affected by soil erosion and type of treatment needed;
- Soil and water analysis;
- Estimation of forest covers to plan for forestry, including social forestry;
- Location of water resources for agriculture, drinking and other uses;
- Identification of water bodies for irrigation and fisheries,
- Demarcation of flood plain zones;
- Carving of catchment areas for watershed planning in drought prone areas;
- Location and estimation of biomass;
- Thematic mapping;
- socio-economic status of the people;
- intra-district migration;

10.0. STATUS OF NRDMS- District Database, Gurgaon (Haryana)

The database centre at Gurgaon is set up by the National Institute of Science, Technology and Development Studies (NISTADS), a constituent establishment of Council of Scientific and Industrial Research (CSIR), New Delhi at district Headquarters of Gurgaon (Haryana), under the Department of Science and Technology, Govt. of India's national mission mode project titled, "Natural Resource Data Management System (NRDMS)".

In the district computerized database is created by the integration of conventional land based data with data secured from remote sensing sensors. The secondary conventional data were collated from district and state agencies, census reports, topographic, hydrological and geological maps, aerial and satellite products while the primary data were generated for specific studies and to fill up data gaps through undertaking limited primary surveys. Natural resources data are collected and stored on a grid basis to provide spatial connotation to thematic information. Maps were generated on 2.5 x 2.5' (21 sq. km) and 30" x 30" (0.9 sq. km) in consonance with universal latitude and longitude system. Various indicators of development and potentiality are calculated. Outputs are taken in various forms including thematic maps, tables, projections, graphics, reports, etc. The thematic maps facilitated overlaying of parameters and permitted the study of interrelations and correlations. With the close interaction with administration information requirements of various users are identified.

The existing information flow structure and information gaps are studied. Data collection formats are developed, tested and standardized for this purpose. About 300 attributes are stored on various aspects such as forests, land use, cropping pattern, water resources, mineral resources, meteorology, environment, agriculture, industry, demography, and infrastructure. Required software packages are developed for storage, analysis and retrieval of data. Specific test application exercises to demonstrate utility of database for developmental planning are undertaken. Some of these exercises are: preparation of model district and block plans, computerization of land records and electoral rolls, setting up of databases on wastelands and water resources and bringing out planning atlases. Specific files are created which contain data on drinking water mission, national literacy mission, poverty alleviation programmes and industries, etc. Data are organized into a specified file structure - agro-economic data file, infrastructural data file (educational, medical amenities, drinking water facilities, communication, transportation and electricity), household data file, remote sensing data file and sectoral data file (agricultural implements, land revenue, wasteland, industrial resources).

A study was conducted at NRDMS Database, Gurgaon, on "Drought Condition Assessment" with a view to facilitating the district authorities by providing required data through NRDMS district database at micro level and in a manner it is easily and timely accessible to take appropriate action for alleviating the drought suffering. The information was collected on daily basis and reports were generated weekly to access the impact of drought in terms of rainfall, starvation deaths both in human beings and animals, current prices of wheat and fodder, drinking water supply during morning and evening, power supply for domestic and agricultural purposes and water availability for animals.

Since the study had two fold aims, viz providing data of value and required analysis to Deputy Commissioner, Gurgaon, to effectively tackle the severe drought conditions in the district and to develop and test the methodology of NRDMS Database in such a situation.

At the instance of Planning Commission, Govt. of India, the exercise of preparation of model district plan - Gurgaon (1988-2000 A.D.) was undertaken in collaboration with NRDMS district database, Gurgaon within a short period of 3 weeks. The document thus produced contains the perspective, objectives, resource inventory, allocation priorities, sectoral programmes and strategies. The plan states that in future computerized micro level database for the district developed under the Project NRDMS will be put to full use for undertaking decisions, at household, village, block, tehsils, sub-divisional and district levels.

10.1 Problems during NRDMS Database Center

The major problems envisaged during the operationalization of NRDMS Database, Gurgaon, are:

- Channels of inflow and outflow of the data to be on sustainable basis are yet to be identified.
- District Planners are yet to find out what are their data requirements particularly for district planning. Mechanism for updating of database is not devised.
- Questions relating to the legal validity of data kept in storage system form rather than as records of papers as currently understood by the administrative and local system may arise.
- Aspects relating to data security will have to go into.

11. RESOURCE PLANNING AND UTILIZATION FOR REGIONAL DEVELOPMENT (RPURD)

In NISTADS, CSIR a full fledge research theme/area was developed by the research workers and scientists with the theme known as, in short, RPURD. A brief content of the same includes the following contents:

11.1 Overview

Sustainable Development requires Planning for the Utilization of Regional Resources in a Decentralized Mode. In this context, the Resource Planning and Utilization for Regional Development (RPURD) team is actively pursue research at the National Institute of Science, Technology and Development Studies (NISTADS), with focus on the use of spatial technology for ensuring the rational utilization of resources.

11.2 Management of Natural Resources Using Spatial Technology

Resources fall within four broad categories:

• Biological - human, animal, plant and microorganism

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- Physical water, minerals, land and forest
- Infrastructural
- Financial.

Knowledge on resource base and the capabilities to utilize and conserve the resources in a region are indicators of the socioeconomic and political strengths of a region. Regions that lack the capability to develop the capacity to exploit their resources rationally, as also those whose resources are over - exploited by others, are backward, the socio-economic institutions developed in the framework of inadequate utilization of resources, in turn, become obstacles to development. Better resource management is, therefore, a matter of prime importance.

Studies on natural resources management have brought out the basic concept that the methods of recovery and use of natural resources are closely interrelated with many human dimensions. Planning and management are facilitated by the application of spatial technology based primarily on Geographic Information System (GIS) and Remote Sensing (RS) techniques, Spatial technology is a powerful too/ for conducting spatial analysis and presenting the dynamics of various spatial features.

11.3 Objectives

The main objectives of RPURD are:

- Elucidation of Theoretical concepts and the analytical framework required for planning and management of utilization of regional resources;
- Undertaking studies on application of development planning in areas like land use, agriculture and allied activities, forestry water management, wasteland development, environmental pollution and urbanization;
- Providing technical services to government agencies/Institutions and NGO's on preparation of Thematic maps for various uses in policy formulation and management in respect of regional development;
- Organizing training facilities relating to data management, software packages and concepts and skills of spatial management, and
- Demonstrating / evolving technology delivery systems for rural areas.

11.4 Main Facilities

- Advanced computer systems
- Scanning, digitization and reproduction facilities
- Reading and interpretation of remote sensing data products visually as well as digitally
- GPS use, map-making and advanced computerized cartography
- Testing and application of GIS and RS software packages like ARC/INFO and ERDAS
- Development of software's like LIS, MIS and DSS
- Creation of natural and socio-economic resource databases

- Audio-visual and multimedia facilities
- Library of specialized publications and documents
- Spatial technology application training kits.

12.0. USEFULNESS OF NRDMS

NRDMS would be handy in:

- Providing a sound information base for a district at one point for decision-making;
- Facilitating assessment of resource potential and extent of development of different sectors in different regions;
- Making available the resource and opportunity profiles in different sectors for entrepreneurial initiatives;
- Assisting in identification of target groups, specific location and situations;
- Supplying information for taking suitable measures for managing natural disasters like droughts, floods., earthquakes, cyclones, landslides and avalanches;
- Assisting in agro-economic services by providing ready information on commodity prices and their trend, crop yields, cropping pattern, soil characteristics, moisture content, etc.

13.0. NRDMS LIS – SOFTWARE

NRDMS LIS: NRDMS - Land Information System is a PCbased Software Package for land records computerization, developed at NISTADS, New Delhi under NRDMS Project of DST, Govt. of India.

- It allows input, storage, integrations, analysis, retrieval and printing of different data given in a typical land record viz. *Jamabandi* (record of rights) ; *Khasra Girdawari* (record of land use & crops); *Intkal* (mutation); *Lal Kitab*(village statistics) registers and *Sizra* (cadastral map) etc.
- It handles and facilitates integration of geo-graphical (spatial), statistical (non- spatial), and textual data.
- It allows single, multiple and conditional queries, display of information and query in map, graphics, tabular and textual modes.
- This facilitates thematic map preparation, super imposition and zooming.
- It works in user-friendly, interactive, menu driven, easy-to-read and simple-to-operate environment.
- This provides on-line help to the user regarding revenue terminology and other trouble-shooting aspects.
- Effective implementation of land reforms. Bringing uniformity of procedure and standardization of formats of land data maintenance
- Increasing reliability of land information
- Distinguishing Features

14.0. CONCLUSION AND FUTURE SCOPE

The developed LIS software allows storing, editing, retrieval, formatting and integration of spatial, non spatial and textual data in an easier manner. It is used to scale and zoom map

Cartesian points and making it available in different sectors for entrepreneurial initiatives.

15.0. FUTURE SCOPE

In addition to remote sensing and GIS, the spatial data can be integrated by using semantic web technologies to provide diversity of information and enhance process of knowledge management in domains like industrial applications, identification of household databases and many more.

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The main conclusions of the study may be presented in a short Conclusion Section. In this section, the author(s) should also briefly discuss the limitations of the research and Future Scope for improvement.

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ACKNOWLEDGEMENT

If desired, authors may provide acknowledgements at the end of the article, before the references. The organizations / individuals who provided help during the research (e.g. providing language help, writing assistance, proof reading the article, sponsoring the research, etc.) may be acknowledged here.

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[1] I. J. Cox, J. Kilian, T. Leighton, and T. Shamoon, "Secure spread-spectrum watermarking for multimedia", *IEEE Transactions on Image Processing*, Vol. 6, No. 12, pp. 64 – 69, December 1997.

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 [2] J. G. Proakis and D. G. Manolakis – Digital Signal Processing – Principles, Algorithms and Applications; Third Edition; Prentice Hall of India, 2003.

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