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CONTENTS

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Editorial

It is a matter of both honor and pleasure for us to put forth the second issue of BIJIT; the BVICAM's International Journal of Information Technology. This issue of the journal presents a compilation of twelve papers that span a broad variety of research topics in various emerging areas of Information Technology and Computer Science. Some application oriented papers, having novelty in application, have also been included in this issue, hoping that usage of these would facilitate the overall economic growth. This issue 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"*.

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, for blind review(s) of the manuscripts received, was a painstaking process, but it helped us to ensure that the best of the received manuscripts are showcased and that too after undergoing multiple review cycles, as required.

The twelve papers that were finally published were chosen out of more than seventy two papers that we received from all over the world for this issue. We understand that the confirmation of final acceptance, to the authors / contributors, 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 wish to express our sincere gratitude to our panel of experts in steering the submitted manuscripts through multiple cycles of review and bringing out the best from the contributing authors. We thank our esteemed authors for having shown confidence in BIJIT and considering it a platform to showcase and share their original research work. We would also wish to thank the authors whose papers were not published in this issue of the Journal, probably because of the minor shortcomings. However, we would like to encourage them to actively contribute for the forthcoming issues.

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

Editors

C O N T E N T S

Obstacle Avoidance through Visual Teleoperation

Muhammad Usman Keerio

Abstract - ***This paper presents a novel controlling approach for Humanoid Robot to work safely in critical situations like bad light environment using Visual Teleoperation. In this regard modeling environments for Humanoid Teleoperation System is developed. Here virtual reality modeling environment includes development of virtual Humanoid BHR-2, and virtual objects like table etc. The main goal of this work is to enhance our visual teleoperation system for BHR-2 in order to avoid any collision during real time operation. Software Maya is used for modeling and simulations. Maya plug-ins in VC++ provides efficient modeling rule, real time interaction, and time saving rendering approach in a virtual environment. In this paper the validity of proposed scheme is shown by conducting experiments using offline step over trajectory to avoid obstacle in bad light environment.***

Index Terms - Virtual Reality, Step over Trajectory, Visual Teleoperation

1. INTRODUCTION

In Teleoperation system, a human operator can control and monitor a remote robot and interacts with an environment while relaying information back to the human. Fundamental requirement for Teleoperation is high-fidelity video information. Cameras are usually unable to provide complete vision feedback especially in case of bad lighting environment. Virtual Reality (VR) can be a better approach for controlling the robot in such situation. If a computer- generated picture is substituted for the video picture, the viewer can be made to fell present (virtual presence, virtual environment, or virtual reality).

Work related to modeling within virtual reality [1] that displays the capability of VR to serve as a creative tool. Method includes drawing 3D lines using a tracker, surfaces based on 3D curves, and 3D objects based on 2D sketches.

In [2] the hardware components to implement teleoperator presence with head-mounted display were developed and evaluated. Head position was measured within a worksite. This drove a 7-DOF telemanipulator. To implement on whole body it is very difficult.

Use of virtual reality in both the modeling and animation process is described in [3].

In order to plan motions a 3D knowledge of the environment is needed. Humanoid robot needs 3D representation of the world, can step on and over obstacles [4], [5], and go through narrow spaces and craw [6]. Main goal is to enhance the information available for the remote operator.

In teleoperation, it is necessary the perceptions from a physically remote environment conveyed to the human operator in a realistic manner. This differs from virtual reality in which the perception from a simulated environment is conveyed to the user. Thus virtual environments and teleoperation share many of the same to user interface but in teleoperation the need for detailed world modeling is less fundamental [7], [8].

For better performance of the Humanoid teleoperation, it is desired to provide a complete scene of the robot and its worksite to the operator. One approach used the feedback real video images [9]. Some other teleoperation systems for humanoid robots displayed the real images captured by the cameras on the robot [10], [11], etc. These systems are easy to develop but are not suitable in the case of environment (e.g. full of smoke) camera can not shoot the images clearly for the operator to complete the task.

A better visualization of teleoperation information i.e. a continuously available 3D graphics can be displayed for the robot's location and its environment using Virtual reality. Researchers focused on building virtual models of the robot and rendering their configuration [12], [13]. But these two systems did not render the robot external data relative to its worksite.

Many types of software are available for VE. Maya can widely be used as visual modeling tool. Maya uses MEL scripting language for components such as dialog boxes and tools, propriety file formats and plug-ins to simplify modeling and animation. This technique helps to ensure the data is updated in an efficient and control manner [14].

In virtual reality based Teleoperation system, real data from the environment experienced with a telaoperator and simulated data that experienced via a VE simulation can be fused via digital processing to produce intermediate environment of real and simulated objects. In this work, modeling refers to the data that are used to record the geometrical information for the environment. This information includes the shape of the objects in the environment, physical properties, and their interaction in the environment and the user for visual presentation of the environment. The main goal of building virtual environment is to describe interactions as well as the visualization of the environment.

The existing Humanoid BHR-2 teleoperation system has four feedbacks which are: body sensors data of the robot, feedback by the robot vision system, real scene of the overall workspace and virtual scene monitoring system based on motion capture system [15]. In this virtual scene monitoring system data feedback to operator without simulation, it will be difficult to monitor the robot in critical situation.

In this paper, work of [16] has been enhanced to develop a complete graphical simulation environment/ visual

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environment using software Maya to teleoperate and monitor real Humanoid under such circumstances where robot vision is not enough to avoid obstacle like in bad light environment, thus our system becomes through the visualisation choice a teleoperation system.

This paper is organised as under: The virtual scene modeling technique is described in the section 2. In Section 3 method of building a virtual Humanoid is described while section 4 describes the procedure to develop virtual objects. In section 5 motion capture system is discussed. Section 6 presents Simulation Environment and the experimental results and in section 7 conclusions are presented

2. VIRTUAL SCENE MODELING

In this section, virtual scene modeling method is discussed. Maya software is selected for this work. It has the model function and rendering function. Building the surface and the skeleton of the role, it can render any motion of the virtual scene. It has the interface to add the function of data processing or other. Virtual scene includes virtual BHR-2 and virtual furniture like table, chair, cupboard, stool, and simply any block etc for visual teleoperation system.

2.1 Modeling Transformation

3D Modeling transformations represented by 4x4 Matrices for scale, rotate, translate; shear, etc are used. For example: to rotate around Z-axis the following matrix shown in (1) can be used.

$$P = \begin{bmatrix} c & -s & 0 & x \\ s & c & 0 & y \\ 0 & 0 & 1 & z \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (1)$$

Animation of a rigid body can be defined as arrangement of two transforms or a hierarchy of transforms as under:

$$\text{positionMatrix} * \text{rotationMatrix} \quad (2)$$

$$positionMatrix = \begin{bmatrix} 1 & 0 & 0 & x \\ 0 & 1 & 0 & y \\ 0 & 0 & 1 & z \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (3)$$

$$rotationMatrix = \begin{bmatrix} Tx^2+c & Txy+sz & Txz-sy & 0 \\ Txy-sz & Ty^2+c & Tyz+sx & 0 \\ Txz+sy & Tyz-sx & Tz^2+c & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \quad (4)$$

Where x, y and z showing the components of the unit vector along the axis and $s = \sin\alpha$, $c = \cos\alpha$ and $T = 1 - c$. See for more details [17].

3. VIRTUAL HUMANOID BHR-2

Firstly, a virtual skeleton model (the two skeletons model) like the BHR-2 has been developed which has 32 DOF. And the setup of the DOF is similar as the real robot. In the Maya software the value of each DOF can be changed, so it can display the mutual movement of two adjacent skeletons. Position and attitude data are accepted by a robot skeleton itself.

After building the skeleton system, the surface of the robot is built by the Maya Tools, attached on the skeleton, the whole robot model is built completely (See fig.1). After developing the robot model, the attributes are added to accept the values. The model can render the robot motion and use the motion data of robot.

The data processing plug-ins is developed using Maya to obtain the motion data from a data file which is updating in time by the teleoperation platform feedback module. In the plug-in the motion data are evaluated to attribute the model joints

The state of the robot can be rendered using Real-time joint angle data and Real-time position and attitude data. The body sensor data feedback to the platform while executing the order. Then the data can be used directly in the virtual scene.

In the motion capture system markers/sensors are used to determine the coordinate's data of the markers on the robot body. Coordinates data of only 3 markers which are attached on the robot body can be used to obtain the position and the attitude data of the robot body.

The virtual scene of the robot helps operator in following manner:

I. The most important function of the virtual scene is to monitor the robot real-time. By rendering the real-time feedback from the robot; the virtual scene expresses the real situation of the robot and parts of its environment instead of the video picture from real camera.
II. The operator can change the view point easily to see the detail of the robot in environment. The exact state of the robot will be known

4. VIRTUAL OBJECTS

Procedure to make (a) virtual model of furniture like table etc and to track them in teleoperation is discussed here.

The following modeling operations are used to make 3D shape of table:

Sculpting (either the NURBS or Polygon sculpting tool or by moving vertices, faces, CVS, or edit points), lofting, revolving (lathing), and extruding.

Following steps are involved while drawing a virtual table in Maya.

Step1: Using "Create Curve" tool to draw a curve. This curve is just the sample of a proportioned object. For drawing this curve, choose the "CV Curve" or "EP Curve" tool from "Create" and then, sketch the outline of one side of a table leg on the right hand side of the Y axis in the "Side (XY)" view. After finishing the line, press enter (See Fig.2).

Step 2: To make objects (as in this case a leg of table) that are symmetrical around one axis the Revolve tool is used. The results can be edited of the "revolve" by changing the attribute in the channels window by clicking the "revolve1" under the input labels. Thus a table leg appears (fig. 3).

Using Lofting Tool a surface between two or more curves can be created. To create a few curves that are in different planes, easy way is to create one curve and then duplicate it and move duplicate away from each other (See fig.4).
Objects can be easily bent, twisted, tapered and sheared etc. Select Deform > Create Nonlinear > Bend. Now click and drag to bend the object around the axes in the view as dragged in.
Step 3: Create a table top and position it over the table legs by creating a cube and scaling it accordingly, or changing the values under the inputs in the channel window (See Fig.5).
Step 4: Give a sufficient amount of thickness to the table top so that the legs penetrate in to the table top. Select only the top edges of the table top for beveling the top of the table. Finally a table is created as shown in Fig.6. Using this technique, the other models can be developed.

5. MOTION CAPTURE SYSTEM

Motion capture system can be used to track objects. The real time server processes the data from the motion capture hardware to provide client applications with Cartesian coordinates of the markers. Client code interact how the markers and rigid body define the position and orientation of tracked objects. A motion capture system records the position and orientation of a performer using a number of sensors attached to the body. The sensors may be mechanical, magnetic, or optical. The client can then make calls to the tracked object to receive rigid body motion capture system to be captured and translated to a digital character. Tracked objects based around marker data require clients to specify how the view, up and define a vector. By combining two markers client define a vector. These vectors are added as constraint to the view, up or right vectors of the tracked object using cross product or average mode. Client will specify the position of the tracked object by specifying a list of markers and an associate mode. The server requires at least three markers to track a rigid body.
For instance: moving a virtual chair by placing markers on a physical chair.
The marker based scheme supports tracking/ rendering the shape of rigid and non rigid bodies and is much more flexible. A plug-ins system in Maya allowed user to save data for a virtual environment with the same ease saving a document from a word processor.
By motion capture system, we can obtain the robot motion data. The data is expressed as the coordinates of markers which are attached to the body.
Data structures that are used to record the geometrical information for the environment include the shape of the objects in the environment, their moving parts and physical properties, and the behaviors that they can perform (how they interact with other objects in the environment and with the user). Data-server device is used to get this data. A plug-ins system is developed to save the data for a virtual environment.
Using teleoperation platform, the data of the robot joint angle can be sent back to the operator real-time. The real-time body sensor data and the motion data are transferred to teleoperation platform. By the real-time data fusion module, these feedbacks will be processed to integrate data which the 3D interface can render. By the virtual model they are finally rendered as the animation. With fusing the feedback data, the strategy is that the robot body sensor data be rendered directly. In fact, by more than 3 markers motion data attached to the rigid body, we can calculate the whole robot position and attitude data. After calculating this data it will be rendered. For more details refer [15].
The joystick can be interfaced to allow user to specify the location of key frames and to modify the current time.
Here the simple method has been discussed for loading and interacting with 3D models of robot environment in order to operate and monitor easily.

6. SIMULATION ENVIRONMENT

Fig.7 shows the simulation environment for humanoid BHR-2 Teleoperation. Virtual/ Simulation environment shows that through simulation, the overall behavior of the robot system can be visualized and tested under a variety of circumstances.
By this platform, operator watches the virtual scene displayed in a plat screen and can remotely control the humanoid robot to complete the task like walking, etc i.e. stepping over an obstacle by using the control interface.
The goal is to visualize robot model for collision free maneuvering to avoid obstacle in case of poor visibility situation

6.1 Evaluation and experimental results

The motion capture system based on 8 infrared cameras is equipped in the working site to get the motion data of the humanoid robot. There are two computers in the working site. The left one is the remote cockpit computer and the right one is virtual scene computer. The virtual scene will fuse the multiple kinds of real feedback data from the robot, and render the result to the virtual model of the robot.
In the experiment, the robot begins using offline walking trajectory for a task and is commanded with a safe step over trajectory (a trajectory which will bring the robot to step over obstacle) for reaching to a ball from table safely. Such a trajectory we refer to as a Safety Stopping Trajectory. The operator input the walking instruction to the robot by keyboard/ joystick. The new motion is calculated and will bring the robot to a stop/ step over. A simulated behaviour of the walking system is shown in Fig.8. When operator detects a potentially dangerous collision, then using step over command causes the robot to follow a step over trajectory. Experimental timing results a step over trajectory can be per formed in roughly 10-20 msec. Simulation scene is shown in fig. 8 whereas the corresponding snapshots of experiment are shown in fig. 9.
From start to step over, figure 9 depicts snapshots for:
1. The beginning of walking motion with stepping starting from the left foot over obstacle.
2. Ending of the walking motion, after stepping over the right foot obstacle.

The results of these experiments proved the effectiveness of the controlling method for visual humanoid teleoperation system.
By the real time stability control, the actual motion trajectory differs from the design trajectory. The virtual scene renders the two kinds of data in the simulation scene and in the real monitoring scene. The difference can be distinguished as the operator observing the details of the robot in the two scenes.

7. CONCLUSIONS

In this paper visual environment for Humanoid BHR-2 Teleoperation System is developed for safe/ collision free manoeuvring. The scene modeling procedure has been described to create the 3D models of objects in the scene. The interface between the virtual BHR-2 and real BHR-2 was developed for rendering the data using teleoperation. Simulation environment shows that through simulation, the overall behavior of the robot system can be visualized and tested under a variety of circumstances. Experiment results proved that the operator sense of presence enhanced for a task in case of poor visibility.

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Figure 1: Virtual BHR-2

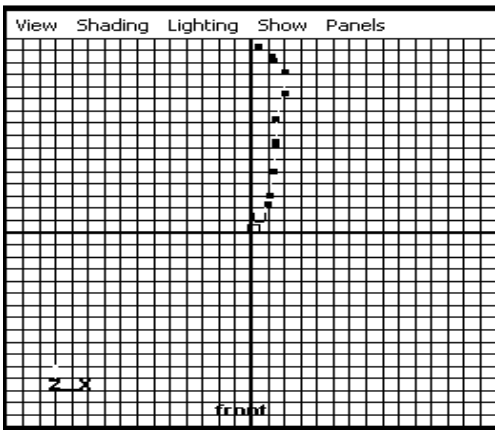

Figure 2: the curve or simply the cross-section of a symmetrical object

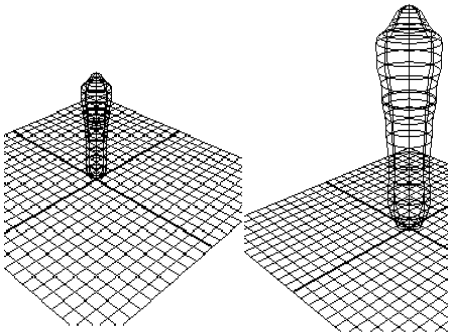

Figure 3: The 3D shape of original curve

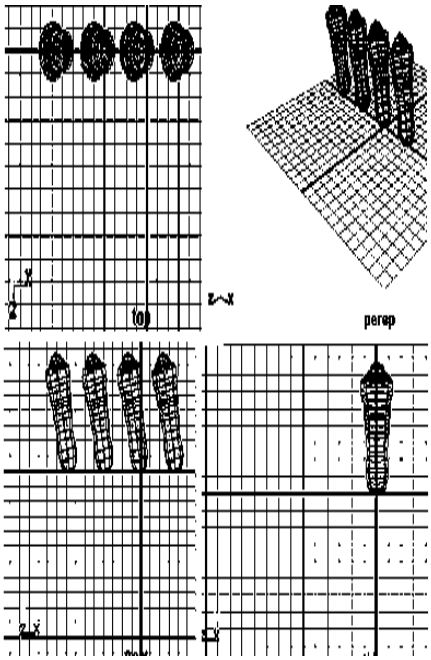

Figure 4: Position of legs of the table after duplicating

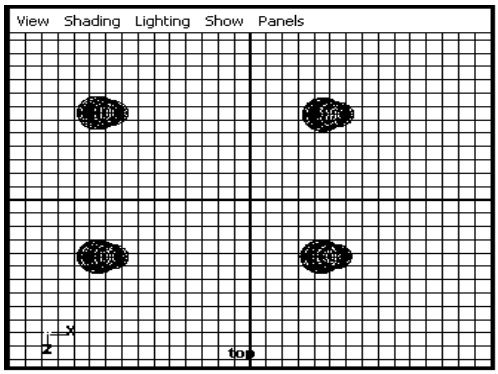

Figure 5: Position of legs to support table top

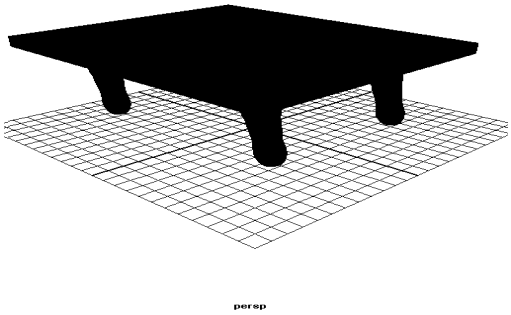

Figure 6: 3D model of table in Maya

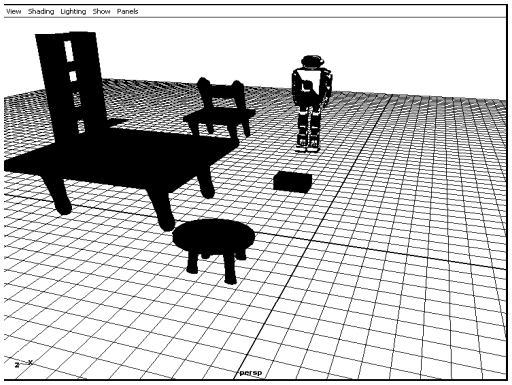

Figure7: Simulation environment

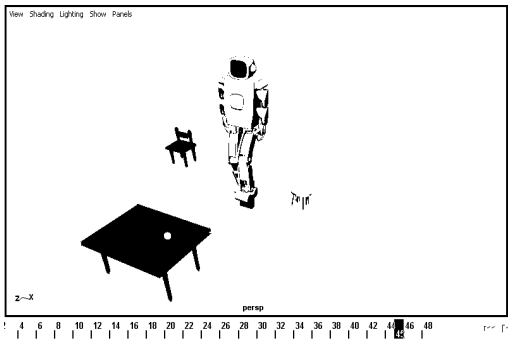

Figure 8: Visual Environment for BHR-2 following step over trajectory

Figure 9: Snapshots for step over obstacle

Robust Source Coding Steganographic Technique Using Wavelet Transforms

S. K. Muttoo[1] and **Sushil Kumar**[2]

Abstract - Information hiding has emerged as an important research field to resolve the problems in network security, quality of service control and secure communications through public and private channels. Keeping the network in a desired state is the utmost requirement of network communications. The work is being done in different fields to achieve this goal. Strganography is one of the branches of information hiding that is used to solve this problem. In this paper we present a Steganographic algorithm based on wavelet transforms. Our algorithm first uses the Best T-codes to encode the message before embedding into a cover image. The one of the advantage of this is that we can embed high capacity messages into the cover objects. The second advantage of using T-codes is self-synchronization attained at decoding stage. To achieve better imperceptibility of stego-image, we have embedded the encoded message into the cover image using wavelet fusion technique more than once, by selecting each time the wavelet block pixels using the pseudo random permutations. From the experimental results we have observed that the algorithm is imperceptible and can have 100% embedding capacity.

Index Terms - Steganography, SSVLC, DWT, PSNR

1. INTRODUCTION

In this information era, either a public network or private network, one requires a tool that can allow communicating over these channels and as well providing the security and robustness of the hiding data. The information hiding has emerged as a useful and important field for resolving the problems of public network security and secure communications. There are three main streams of research areas over which this field is focused at present and they are *Steganography, Watermarking and Cryptography*. In Cryptography, the data is encrypted so that it cannot be understood by anyone else. The encrypted data is unreadable but is not hidden from the eavesdroppers. Though the purpose of *Cryptography* is to protect the data (or information) from unwanted attackers, it does not ensure covertness on the channel. The Steganography solves this problem by embedding data in the cover object so that it is hard to detect. The branch of Watermarking is to embed a watermark for the purpose of copyright protectction, authentication and temper proofing.

There are mainly four requirements of any information hiding technique, namely, Imperceptibility, Capacity, Security and Robustness. Imperceptibility means that human eyes cannot distinguish the difference between the steg-image and the original image. Capacity refers to the amount of data that can be embedded in the cover object. Security means that an eavesdropper cannot detect the hidden data, and Robustness requires that the hidden data can be recovered within certain acceptable errors even when the steg-image has endured some signal processing or noises.

Now-a-days Cryptography or Source encoding methods have also been used in conjunction with *Steganography* to provide an additional layer of security. Over time the information hiding techniques have improved to meet the desired goal. Digital steganography provides privacy for intelligence and military personnel and for people who are subject to censorship.

There are various domains of information hiding viz., *spatial domain*, t*ransform domain and spread spectrum domain*. The transform domain based hiding techniques has not only the potential to achieve higher capacity than the spatial domain based techniques, they are also found to be more robust.

Apart from text, images have been used widely as cover objects for the purpose of information hiding as their digital representation provide high degree of redundancy. The most popular transform hiding techniques Steganography systems are based on *discrete Fourier transform* (DFT), *discrete cosine transform* (DCT), *discrete wavelet transform* (DWT), *singular value decomposition* (SVD) *transform* and *discrete Hadamard transform* (DHT). These techniques are independent of an image formats and hide data in more significant areas of the transformed image. The details about these techniques can be found in [1-3, 9,10, 19, 21, 29].

In this paper we present a Steganographic method based on wavelet transform. We have first used best self-synchronizing T-codes to encode the original text. The purpose of using the T-codes is lying in the inherent self-synchronizing property of T-codes. According to [25], T-codes require anything between 1.5 to 3 symbols to attain synchronization following a lock loss. Also, by sending the message in the cover image in compressed form increases its security as well as embedding capacity. The secret message is then embedded into the cover image using wavelet-fusion technique [26] with a stego-key. To increase the quality (hence, PSNR value) of the stego-image to meet the imperceptible attribute of the steganography we embed the message in the cover image number of times but each time we use pseudo random number generator to select the pixel locations in the block. In the extracting algorithm we obtain the hidden message by taking the average of the messages extracted from the stego-image using the stego-key. To

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check the robustness of the algorithm, we have analyzed our algorithm against noise such as Salt and Pepper, Gaussian and Speckle and found satisfactory results.

2. SELF-SYNCHRONIZING VARIABLE LENGTH CODES

The categories of coding that minimize redundancy of information are Entropy coding, Source coding and Hybrid coding. Entropy coding is a lossless process whereas source coding is a lossy process. Most multimedia systems apply Hybrid coding techniques. The popular *variable length* most *codes* (VLC) for loss less compression used is Huffman codes. However, when an uncorrected error occurs in the encoded data it may propagate to the extent that all subsequent data are lost. Thus, one requires VLC with the property that data may resynchronize automatically after an error occurs in a minimum delay. There can be another problem of slippage which occurs However, if the number of symbols decoded before resynchronization are found to be different from the actual number of data symbols which have been encoded, raises the problem known as *Slippage problem* [16]. The slippage problem may leads to misinterpretation of the remaining data that howsoever may have been received correctly.

There are number of methods proposed to find the solution of synchronization problem. Some of the proposed techniques used restart markers but they increases overhead, i.e., bit rate. Thus, researchers realized that the VLC that provides the synchronization without the increase in overhead is needed. Gavin R. Higgie [7], Mark R. Titchner [23] and A.C.M. Fong [5] proposed a self-synchronizing VLC, viz., T-code. According to Titchener [25] , T-codes re-synchronize within one to three code words. G. Ulrich [27] and P.Reddy [20] have shown that T-codes exhibit better synchronizatjion properties when compared to Huffman codes. A.C.M. Fong et al have proposed the application of minimal sync-delay T-codes for information source coding. G.Y. Hong et al [8] have also investigated the application of self-synchronizing VLC (SSVLC).

S.K.Muttoo and Sushil kumar [11-13] have shown the application of Best T- codes in the two popular steganographic algorithms, Jpeg-Jsteg [28] and OutGuess 0.1 [17].

A. T-codes

T-codes are families of VLCs that exhibit extraordinarily strong tendency towards self-synchronization. The concept of 'simple T-codes' was given by M.R.Titchner[23]. He proposed a novel recursive construction of T-codes known as the '*Generalized T- codes'* that retain the property of self-synchronization [24]. Each T-augmentation step is characterized by two parameters: *a 'T-prefix' p*, a codeword from the existing T-code and *a 'T-expansion parameter' k,* a positive integer. Starting at augmentation level 0 with initial set S= {0, 1}, the construction of T-codes at augmentation level 1, 2 and 3 are summarized in the table below:

There can be many possible code sets matching a source depending on the parameters (p, k) chosen [24]. Apart from the generalized class of self-synchronizing efficient codes, T-codes show the best synchronization performance amongst the most efficient VLC's and require anything between 1.5 to 3 characters to attain synchronization following a lock loss. Among the subgroups of T-codes, the search for a best T-code set means those T-code sets that are optimally efficient and at the same time exhibits the least synchronization delay. Different T-codes exhibit different degree of synchronization performance, even if they have the same average code word length. The *Expected (or Average) synchronization delay* (ESD or ASD) is normally used as measure of synchronization performance. The ESD is defined as the average number of symbols in S that the decoder has to receive before it can conclude that it has achieved synchronization with respect to its largest level set. A number of attempts have been made to quantify the synchronization performance of different T-codes [25, 27, 5].

Ulerich Gunther [27] in his thesis has given a recursive search algorithm that yields the T-codes set with the minimum redundancy for a given source. This search algorithm utilizes equivalence and feasibility criteria to significantly restrict the search space. The best T-codes used in our algorithms in this paper are based on the breadth-first search algorithm proposed by Ulrich Gunther [27]. Ulrich chooses the least redundant set from a pool of all possible T-code sets by calculating redundancy for each of them. The search process is optimized by certain proposed constraints. The algorithm returns a group of code sets with least redundancy. To choose the best code set with least synchronization delay, we test each code set against very long test message string (composed of source symbols) by calculating ESD.

3. THE PROPOSED STEGANOGRAPHIC ALGORITHM

A large number of image Steganographic methods have been proposed over the last few years to achieve better perceptibility, best data hiding rate, survivability and security. The most of these embedding algorithms in a transform domain make use of DFT, DCT, DWT or DHT. Eric A. Silva and Sos S. Agaian [22] have embedded data in different transform domains and observed that the Haar wavelet transform is the best choice as compare to FFT, DCT or DHT for their method. However they observed that the relative performance of each of the transforms used were uniform across all images tested.

Our proposed method is a high capacity image steganogrphic method using Wavelet-fusion- method proposed by M. Fahmy Tolba and Al-said Ghonemy [26]. The proposed algorithm consists of four parts: Encoding, Embedding, Extraction and Decoding. Our algorithm

provides multi-level securities. First in encoding stage, we apply Best T-codes on the message for source coding. An encoded key is used for this purpose. The secret (encoded) message is then embedded in the cover image using wavelet-fusion-technique. To enhance the quality of stego-image we have embedded the message in the cover image number of times. The stego-key is used to select random pixels for embedding message. We require the stego-key to extract the hidden message. Finally, in the decoding stage, the original message is obtained with the help of encoded key. The steps of these algorithms are described in the figures 3.1 and 3.2.

The Embedding algorithm can be summarized as follows:

0. Input the Cover image and original text (or message)
1. Normalize the cover image. i.e., the pixel values made to lie between 0.0 and 1.0.
2. Apply preprocessing on cover image: choose 'alpha' (preferably between 0 and 0.1) and reconstruct pixels to lie in the range [alpha, 1 – alpha]. This will ensure that pixels from the fused coefficients (during embedding) would not go out of range and hence the secret message will be recovered correctly.
3. Apply 2D Haar transform on each color plane separately.
4. Encode the original message using best T-codes. The resulting secret message is a bit-stream of 0 and 1, denoted by (m_1 m_2…. m_n), where n is the embedding message length.
5. Generate pseudorandom permutation, using a stego-key, of the size equal to the length of cover image.
6. Enter the number of times the message to be embedded, num.
7. for i = 1 to num do

7.1 Select wavelet coefficient of the transformed image randomly, say f(j, k)

7.2 Embed the secret message bit, m (i), into the transformed image in the following way:

```
if   m(i) = '1'
   f (j,k) = f (j,k) + alpha;
else
   f (j,k) = f (j,k) – alpha;
```

8. Apply the inverse 2D Haar transform on each color plane separately.
9. Denormalize the image
10. Output: the Stego-image.

The Extraction algorithm is just the reverse process of the embedding method. We can summarize it as follows:

1. Apply 2D Haar transform on each color plane of the stego-image
2. Enter num, number of times message bwing embedded
3. Initialize the hiddenmessage to zero.
4. for j= 1 to num do

4.1 Select the embedded coefficients, i, using the PRNG based on the stego-key same as used in the embedding procedure.

4.2 Extract the embedded value of alpha by subtracting the original cover image from the stego image in the wavelet domain.

4.3 Obtain the secret message bit, m(i) as follows:

```
If alpha >0
   m(i) = '1'
else
   m(i)='0';
```

5. hiddenmessage += m(i);
6. end; /*for(j)*/
7. hiddenmessage /=num;
8. Decode the hiddenmessage using best T-code using the encoded key.

Output: Original message.

4. EXPERIMENTAL RESULTS

For testing our algorithm we have used 256 x 256 pixels images[1]. The values of alpha are taken from 0.05 to 0.5 and number of embeddings taken from 5 to 15. For measuring the imperceptibility we make use of the measure PSNR defined as follows:

$$PSNR = 10 \log_{10} (255^2 / MSE),$$

$$MSE=(1/N)^2 \sum\sum (x_{ij} – x'_{ij})^2 ,$$

where x denotes the original pixel value, and x' denotes the decoded pixel value.

Some of the results are summarized beow in the table 4.1 and figure 4.1.

5. CONCLUSION

We observe that choosing the value of alpha between 0 and 1, preferably 0.05, we can achieve best perceptibility. We also observe that the PSNR values decrease as we increase the number of times of embedding of message in the cover image, but still remains in the acceptable range of 35 to 40.

Our algorithm provides maximum embedded capacity in the cover image. The embedding capacity is equal to 3 times the number of pixels contained in the color image, i.e., capacity percentage is 100%.

There are multi-level securities proposed in our algorithm. We have encoded the message using self-synchronizing T-codes with a key and the encoded message is embedded in the Haar wavelet transform coefficients of image using another key, called stego_key. The Wavelet-fusion-technique further uses a value of alpha. This value is secret and shared by the sender and receiver. The value of alpha is used to adjust the normalized cover's pixels. The advantage of Best T-codes is seen at the decoding stage where due to its self-synchronizing property we obtain the original message even after if signal processing noise being added to stego_image.

6. NOISE ANALSIS

We have analyzed our algorithm for robustness by adding noise to stego-images of .jpg format. The results of their

[1] 'jpg'

PSNR so obtained are summarized in table 6.1 and figure 6.1.

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Alpha	num	PSNR	message received	Imperceptibility
0.05	5	45.8007	Y	Good
0.05	10	42.7976	Y	Good
0.05	15	40.9844	Y	Good
0.0^{2}7	15	38.1697	Y	Good
0.08	10	38.3816	Y	Good
0.09	5	39.9127	Y	Good
0.09	8	37.9525	Y	Good
0.09	10	37.0252	Y	Good
0.09	15	35.4170	Y	Good
0.1	10	35.9868	Y	Good
0.1	15	34.3201	Y	Good
0.15	10	35.9868	Y	Fair
0.25	5	38.7904	Y	Poor
0.25	10	35.9868	Y	Poor
0.5	5	38.7904	N	Zero

Table 4.1: Image : lena.jpg ; Embedding message length = 2734

Images	PSNR without noise	PSNR After Salt&Pepper	PSNR After Gaussian	Number Of Embeddings
I1	42.7976	34.1478	36.8520	3
I2	42.1442	33.6824	36.5151	3
I3	44.9595	33.8505	37.7551	3
I1	38.6900	32.4668	34.1898	8
I2	38.0618	31.9876	33.6815	8
I3	40.7435	32.8145	35.5421	8

Table 6.1: alpha = 0.07; I1='jaan'jpg'; I2='lena.jpg'; I3='Tulips.jpg'

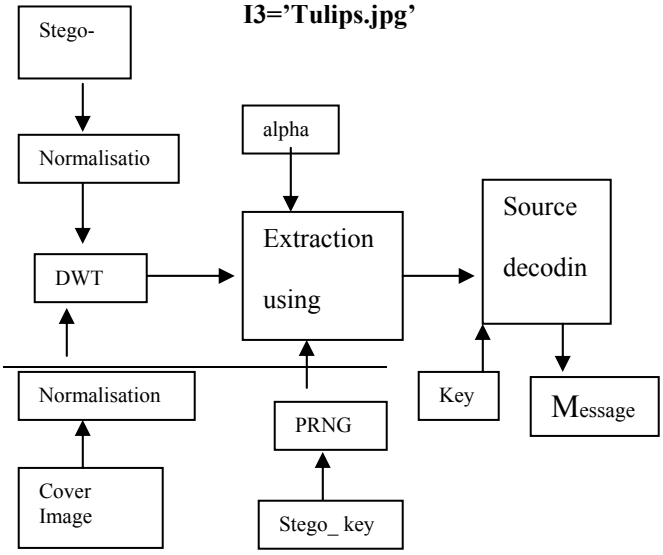


Figure 3.2: The block diagram of the message extraction

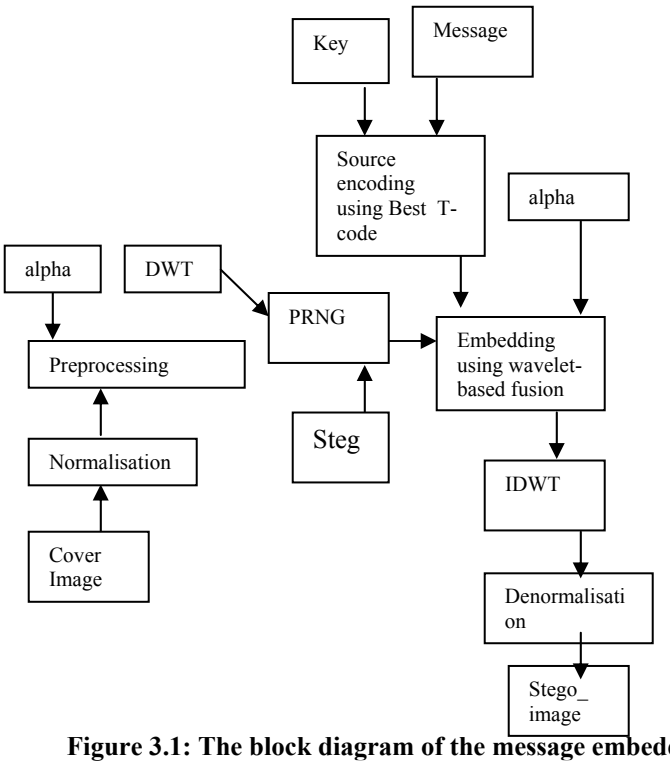


Figure 3.1: The block diagram of the message embedding

Figure 4.1: Stego_images of lena.jpg (in black and white)

(a)

(b)


(c)

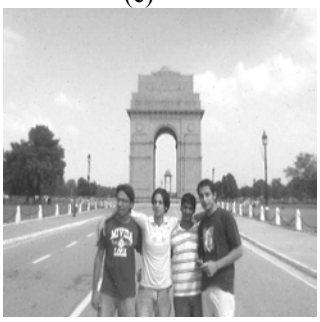

(d)


(k)


(l)


(e)


(f)


(g)


(h)


(i)

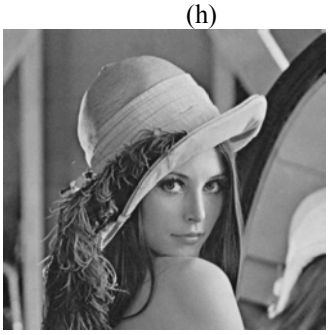

(j)

Figure 6.1: (a), (c), (e): after adding Salt & Pepper & noofembedding=3; (b), (d), (f): after adding Gaussian & noofembedding=3; (g), (i), (k): after adding Salt & Pepper & noofembedding=8; (h), (j), (l): after adding Gaussian & noofembedding=8;

Comparative Study of Distributed Computing Paradigms

Harvendra Kumar[1] and **A. K. Verma[2]**

Abstract - The mobile agent paradigm has revolutionized the distributed computing environment. There are different paradigms used in distributed computing, such as - client-server paradigm, remote procedure paradigm and mobile agent paradigm. The client-server is based upon the concept of a server, which serves the various request of the clients and in remote procedure call approach, a machine can connect to another machine and retrieve the information remotely. The mobile agent technology is built upon the advancement in computing and communication technology over the wired and wireless networks. Mobile agents are the software programs that can migrate from one machine to another machine in a homogeneous as well as heterogeneous environment. It can migrate in connected as well disconnected network. On each machine, the agent interacts with stationary service agents and other resources to accomplish its task. Mobile agents are particularly attractive in distributed information retrieval applications. By moving to the location of an information resource, the agent can search the resource locally, eliminating the transfer of intermediate results across the network, by this property, mobile agent reduce the end-to- end latency. In this paper, we try to point out the benefits and limitations of these paradigms.

Index Terms - Mobile agents, Client-Server, Remote Evaluation.

1. INTRODUCTION

A mobile agent is a software program that can migrate during execution from one machine to another machine in a homogeneous as well as heterogeneous network. In other words, we can say that an agent can suspend its execution, migrate to another machine, and then resume execution on the new machine from the same point at which it left off.

Mobile agent are the platform dependent, so platform should be needed on each machine, the agent interacts with stationary agents and other resources to accomplish its task. There are two alternative approaches [1] to retrieve the data – the code to data approach and the data to code approach. The mobile agent paradigm performs better if the code size is small enough; this model is being extended to support different migration strategies resulting in less network traffic and better response time. Mobile agents are not always better than client-server calls. Mobile agent is only beneficial, if the space overhead of the mobile agent code is not too large or if the wireless link connecting the mobile user to the fixed servers.

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In this paper, we compare mobile agents with classical client-server techniques and other mobile-code systems. The implementation of mobile-agent is easy than traditional client-server implementation. But one question arises, which distributive computing paradigm is better and why? So, let us consider these paradigms one-by-one.

2. CLIENT - SERVER (CS) PARADIGM

The examples of traditional client-server middleware like CORBA, RMI and DCOM.

In a classical CS paradigm, processing of the data mainly takes place in the host client. In fact, the job of the server is limited. Server executes only some basic procedures for the data retrieval and storage. Before being sent to the client, data only undergo a soft initial filtering.

The host server behaves as a simple remote storage system. Together with all of the other servers and the interconnection network, makes the whole system to form a "big repository" of information available to the different clients. The server usually makes available some procedures for handling the stored data which are designed for responding to criteria of general effectiveness. The actual data processing is therefore left to the host client, where the user can execute procedures for the kind of processing desired. This type of CS scheme is used when we want to create a very simple system from the management point of view, or structures with a high level of security. Such a paradigm depicted in Figure 1. An advantage of this architecture is the possibility of controlling the type and the ways of access to the data stored in the server. Consequently, security in the CS architecture is very high. Here, in this paper, we consider the following question- is the mobile agent paradigm "better" than traditional client-server paradigm? In the next section, we will try to find out why the mobile agent is better to other paradigms.

In fact, if the user has specific requests concerning the modes of data processing, and if the server does not provide for that specific type of operations, the only possibility commits in retrieving much more data than needed, and then to perform the operations of processing and selection in the client. In these cases, the server provides a huge amount of documents, in order to assure a wide basis of selection. Of course, all that causes an overload of both the server and the communication system. In fact, the amount of data exchanged may be considerable. Consequently, the host client must have its own processing capability.

3. REMOTE EVALUATION (REV) PARADIGM

Unlike the typical Client - Server, Remote Evaluation (REV) paradigm implies that server receives not only the processing requests from the client, but also the whole code needed for performing operations of selection on the data stored. The response of the server, with no additional overhead, is limited to

sending the information that can be actually used and required by the client. The REV is based on the code to data strategy therefore it better to CS paradigm.

Besides, since the user can use a customized code in the server, the data sent in output are ready for the use, and they only need negligible additional processing. From this point of view we can also think of an environment, host clients equipped with minimum processing potentialities. The initial cost is therefore higher in comparison with the CS paradigm, and is localized in the opening stage of sessions.

In fact, the code for the data processing can be of considerable size and we can easily assume that its size is higher than a simple retrieval request. Of course, this cost is counterbalanced by the reply stage (transmission of search results from the server to the client), because the amount of data passing through the network is more limited. During the stage of design, a system with REV must be created by considering more detailed aspect in comparison with the CS paradigm. In fact, the processing architecture of the different servers must be similar (or very well known), so that the code sent by the client can be easily executed on all of the hosts. From this point of view, we can think of a common platform for code execution. This also implies the need for creating protection elements that could assure a high level of security.

4. MOBILE AGENT (MA) PARADIGM

A Mobile Agent (MA) is an executable code that can move from a host to another host, according to the mobile agent itinerary, which may be static or dynamic itinerary. Basically Mobile agent consists of three components [2], code statement, data state, and execution state. Code is transferred during the migration; even some data state can also transfer. But execution state cannot transfer in the network. This way, there is a kind of suspension of the execution of the program, waiting for the subsequent resume state [5] on a remote machine. Both (Mobile Agent and Remote Evaluation paradigm) use the same strategy code to data. The system of Remote Evaluation is a more limited approach than the MA.

In fact, a code migration is present in the REV, but there is always a direct interaction between the client and the server. This means that the code sent by the client returns the data directly to the source. Besides (when this operation is done), the process is completed, so the context of execution of the program is limited to the single host. Conversely, the mobile agent system can be used for performing the research operations more effectively. In fact, the agent has the procedures for operating on the database according to the ways desired by the user, and can also make independent decisions, such as migration to other sites or returning the results obtained to the user, if they are considered sufficient. In this sense, the interaction between the user and the agent is limited to the stages of transmission and return of data. What takes place within this time limit depends only on the way the agent was designed.

By moving the code to the data (see in Figure. 3), a mobile agent can reduce the latency of individual steps, avoid network transmission of intermediate data, continue work even in the presence of network disconnections, and complete the overall task much faster than a traditional client/server solution.

We can therefore expect that the amount of data transferred in each migration tends to increase. The agent can decide to limit the data considered interesting for the user dynamically, even by discarding the data selected in the previous hosts. Agents with a maximum quota of user data, which can be moved in each migration, can therefore be designed.

A MA, shown in Figure 3 is an autonomous transportable program (or object) that can migrate under its own or host control from one node to another in a heterogeneous network. In other words, the program running at a host can suspend its execution at an arbitrary point, transfer itself to another host (or request the host to transfer it to its next destination) and resume execution from the point of suspension.

A MA migrates from one host to other host on the behalf of itineraries [3, 4]. It may be either static or dynamic. Itinerary defined by some parameters such as Agent_Id, State_Type, Time and Place.

When the agent reaches a server, it is delivered to an agent execution environment. Then, if the agent possesses necessary authentication credentials, its executable parts are started.

Mobile Agent paradigm of the distributed computing is different for other paradigms. In other

paradigms, independent processes collaborate by exchanging data over their network links. With Mobile agents, a process is transported, carrying with it the shared data as it visits individual processes on its itinerary.

4.1 LIFE CYCLE

The model of mobile agent paradigm is based on the migrating workflow [6, 7] system model. The resuming instance is the task executor in the migrating workflow system; it is a mobile agent in essence. Our workflow-oriented life cycle model consists of five life states, (creating, running, deleting, suspending, resuming) and a number of transitions (active, suspend, dispatch, resume, terminate) between these states. The workflow-oriented life cycle model of mobile agent is shown in Figure. 4.

To accomplish its task, the mobile agent can transport itself to another server in search of the needed resource/service, spawn new agents, or interact with other stationary agents. Upon completion, the mobile agent delivers the results to the sending client or to another server.

1. In the creating state, the agent is created but not activated yet.
2. In the running state, the agent is running, performing actions and solve it pursue.
3. In the deleting state, the agent is terminated;
4. In the suspending state, the agent can not run and still stay within the agent server;
5. In the resuming state, the agent is travelling between two server instances.

4.2 MOBILE AGENT LIFE STATE LOG STRUCTURE

The life cycle of MA begins at the moment when it is created. When MA migrating from one host to another host in order to achieving its goals; and the MA returns its server on which it was created. Two or more than two states, in life cycle of MA, may be occurred at the different time or place. The mobile agent life state log structure [7] can be defined in four-tuple:
Life_State_Log_Structure= (Agent_ld, State_Type, Time, Place), Where,

1. 'Agent_ld' identifies a log item belongs to which mobile agent;
2. 'State_Type' indicates the type of mobile agent life state, with
3. State_Type € STATUS={Creating, Running, Suspending, Migrating, Deleting }.
4. 'Time' indicates the time when the mobile agent (Agent_ld) came to the current State Type;
5. 'Place' identifies the agent server where the mobile agent (Agent_ld) came to the current State-Type at the specific time.

4.3 APPLICATION AREAS OF MOBILE AGENTS

Mobile agents provide effective and flexible mechanisms for structuring distributed systems. The Mobile agent paradigm can be exploited in a variety of ways, ranging from low level system administrator tasks, to middleware to user-level applications. They can be mapped directly to real life situations.
The concept of a mobile agent can be applied to the Information Retrieval Systems (IRS), Distributed File System Clinical Data analysis for medical diagnosis, Distributed Data Mining, Distributed Real-time systems, Mobile Wireless Environment, Mobile Smart Databases, Peer-to-Peer Computing, Network monitoring and management, Intrusion Detection System, Network routing, Performing location-dependent computations, Load balancing, Service customization, Wireless Sensor Networks(WSN)/ Remote Sensing, Wireless Ad hoc Network (WAHN), Manufacturing, Command & Control, Grid Computing/Cluster Computing, and Information dissemination etc.

5. COMPARISONS

Paradigms/ Attributes	**Mobile Agent**	**Remote Evaluation**	**Client-server**
Implementation	Hard	Easy	Very easy
Security	Very low	Low	Very high
Performance	high	Very high	Low
Elements a) Data b) Code **c)** Stack	 semimobile mobile mobile	static mobile static	mobile static static

Paradigms/ Attributes	**Mobile Agent**	**Remote Evaluation**	**Client-server**
Itinerary	Static/Dynamic	Both	Static
Mobility	Code to data	Code to data	Data to code
Platform	Dependent	Dependent	Indepedent
Programming code	Hard	Hard	Easy
Examples	Aglet	Aglet	CORBA

Table 1: Comparison between various Distributed Computing Paradigms

5. CONCLUSION

Here, in this paper we have discussed the three basic paradigms of distributive computing, namely: Client-Server, Remote Evaluation and Mobile Agent. CS implementations are suitable for small applications where a amount of information is retrieved from a few remote servers having low processing delays. However, most real-world applications require a large amount of information to be retrieved and significant processing at the server. MA's scale effectively as the size of data to be processed and the number of servers the data is obtained from increases.
We conclude that mobile agent paradigm is the best as other paradigms, it consume lesser resources but have the limitation on the size of the code. So, it can be used extensively in a code-to-data environment. This paradigm can be exploited in many application areas, such as data mining, weather forecasting etc.

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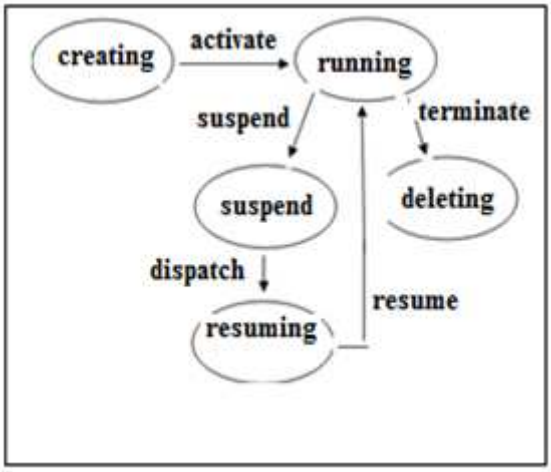

Figure 4: Life cycle of Mobile Agent

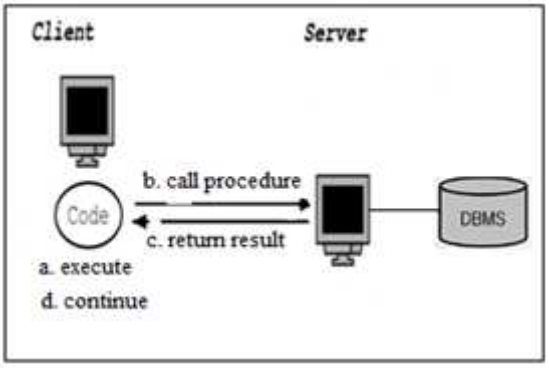

Figure 1: Client Server Architecture

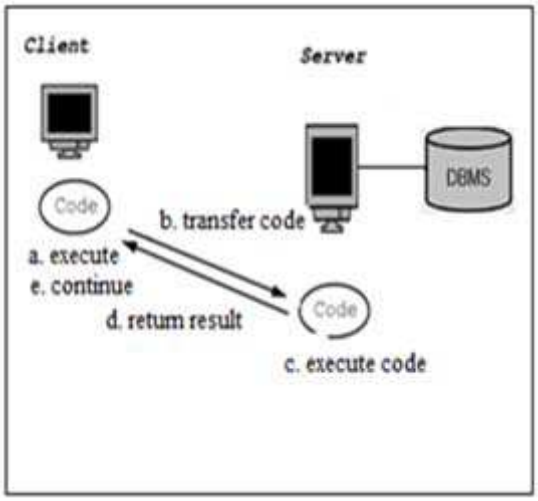

Figure 2: Remote Evaluation Architecture

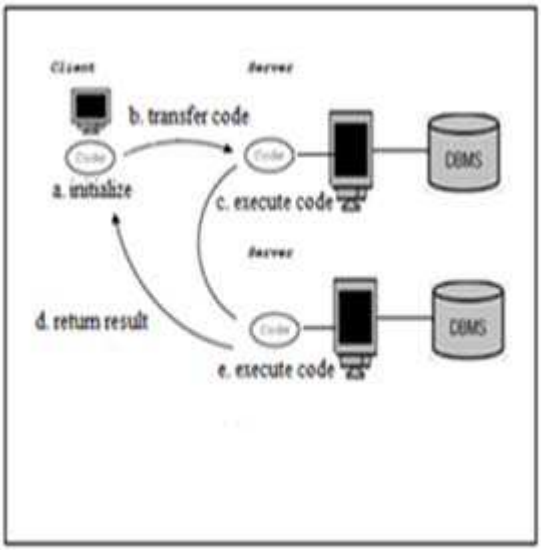

Figure 3: Mobile Agent Architecture

Service Oriented Architecture for Business Dynamics: An Agent Based Business Modeling Approach

O. P. Rishi

Abstract - In today's rapidly changing environment the industries are interested in executing business functions that has scope in multiple applications. Business dynamics and technological innovations have felt organizations to comply with a disparate mix of operating systems, applications and databases. This makes it difficult, time-consuming and costly for IT departments to deliver new applications that integrate heterogeneous technologies. It demands high inter-operability and more flexible and adaptive business process management. The inclination is to have systems assembled, from a loosely coupled collection of Web services, which are universal and integrated. This technical area appears to have scope where the Agent Technology can be exploited with significant advantages. With Service Oriented Architecture a decomposable architecture, and associated set of development and IT management disciplines, composed of loosely coupled services communicating via pre-established protocols, these services can be assembled ad-hoc to form customized applications that address a wide variety of business requirements.

In the present paper, we propose a conceptual framework for agent-based Service Oriented Architecture (SOA). In which we try to integrate Service Oriented Architecture with the agent technology & other tactical technologies like web services, business workflow services, Business meta-rules, search optimization of services and semantic Web technology for business service mappings.

Index Terms - Multi-agent systems; Service oriented architecture; Business workflow & services; Business dynamics.

1. INTRODUCTION

Today the technology world believes that adoption of a Service Oriented Architecture (SOA) paradigm is strategic and should be part of the most software projects. Agent technology is considered to be the most successful technology supporting Service Oriented Architecture. It is known that Agent technology is used to implement complex systems and applications that are communication-centric, based on distributed computational and information systems, and requiring autonomous components readily adaptable to changes. Agent plays the role of efficiently supporting distributed computing and allows the dynamically composition of Web services [10, 11]. Now it is desired that agent technology integrate with other enterprise computing technologies to improve the computational proficiency.

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There are several unseen technical issues and the existing technology has significant limitations. Yet, the prototype systems based on the underlying infrastructure can help to increase awareness of these issues and to set down possible solutions.

In an agent based Service Oriented Architecture approach the scenario would be characterized mainly by three actors: Service Providers, Business Process Manager and Users as shown in figure 7.

2. SERVICE ORIENTED ARCHITECTURE AND ITS ROLE IN ORGANIZATIONAL COMPUTATION

Service Oriented Architecture is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different domains. SOA is an approach or strategy in which applications rely on services available in a network such as the World Wide Web. And it can be considered as a way of sharing functions (typically business functions) in a widespread and flexible way. In other words we can say, SOA is a service-oriented architecture and can be defined as a group of services, which communicate with each other. It uses services available in a network and promotes loose coupling between software components so that they can be reused. Applications in SOA are built based on services; where service is an implementation of business functionality, and such service can then be consumed by clients in different applications or business processes [11].

In SOA framework, Service modeling includes [4]:

1. Service Oriented Enterprise
2. Service Oriented Architecture
3. Service Oriented Computing

SO Enterprise: The Service Oriented Enterprise (SOE) is a new model for architecting software and IT infrastructure. It allows a business to view itself from the perspective of its customers, suppliers and other trading partners. The business value derived from this approach includes cost savings, flexibility and the ability to respond more quickly to marketplace changes.

SO Architecture: A service-oriented architecture is essentially a collection of services. These services communicate with each other. The communication can involve either simple data passing or it could involve two or more services coordinating some activity. Some means of connecting services to each other is needed.

SO Computing: Service-oriented computing provides a way to create a new architecture that reflects components' tendencies toward autonomy and heterogeneity.

Normally the business process environments which do not use the service oriented architecture lack the interaction of multiple

services at the same time to exchange messages or to perform some task. Using the SOA environment the following benefits can be drawn [4, 11]:

1. Reuse of services enabled by the decoupling of service providers and service consumers
2. Structured description of interfaces
3. Discoverability of services through the registry
4. Incremental deployment and maintenance
5. Architectural partitioning that allows the service provider to be modified or even replaced without impact to the service consumer
6. Flexibility and agility is facilitated by allowing multiple services to be composed quickly into more complex services and allowing the process flow between services to be configured dynamically

Service-Oriented Architecture is preferred when there is a need for request-reply, real time integration between systems, and more than two systems are involved in the integration. Similarly Service-Oriented Architecture is also preferred when a service being provided is a likely candidate for reuse, & service implementation requires no advanced knowledge of the service client [10].

Many challenges are faced when we adopt SOA. Managing services metadata which includes exchange of messages to perform tasks, generating millions of messages, managing and providing information on how services interact is a complicated task. Lack of testing in SOA space, as today sophisticated tools are not available that provide testability of all headless services (including message and database services along with web services), no testing framework is available that would provide the visibility required to find the fault in the architecture and no provision for appropriate levels of security [6].

The need of the proposed model / framework is arisen from the above challenges. Usually the design framework of SOA does not maintain or use agents, but in our proposed model we have tried to incorporate the service oriented architecture (SOA) based on various business processes agent. Thereby making a model, which comprises of agent based service oriented architecture.

In Agent based SOA framework the following architectural principles for design and service definition focus on specific themes that influence the innate, behavior of a system [4, 6]:

Many web-services are **encapsulated** to be used under the SOA Architecture.

Services maintain a relationship that minimizes dependencies hence exhibiting the behavior of **loose coupling**.

Services adhere to a communications agreement as defined in **service contract**.

Logic of service is hidden / **abstracted** from the outside world.

Logic is divided into services with the intention of promoting **reuse**.

Collections of services can be coordinated and assembled to form **composite** services.

Services have control over the logic encapsulated thereby exhibiting service **autonomy**.

High-quality services are preferred than low-quality ones for service **optimization**.

Figure 1 shows the service components of service oriented architecture in business process.

The functionality of SOA rotates around business processes and packaged as interoperable *services*. SOA also describes IT infrastructure which allows different applications to exchange data with one another as they participate in business processes. The aim is to have loose coupling of services with operating systems, programming languages and other technologies. Web Services are the set of protocols by which Services can be published, discovered and used in a technology neutral, standard form. *Services* are what you connect together using Web Services. A service is the endpoint of a connection. Also, a service has some type of underlying computer system that supports the connection offered. Service is the important concept [8, 13]. Figure 2 shows the connection between services and service providers where as figure 3 shows the mapping of Services between Business Partner.

SOA separates functions into distinct units, or services, and makes them available on a network so that they can be combined and reused in the business applications. These services communicate with each other by passing data from one service to another, or by coordinating an activity between two or more services. SOA concepts usually built upon older concepts of distributed computing and modular programming [14].

3. SERVICE ORIENTED ARCHITECTURE AND WEB TECHNOLOGY

The technology of Web services is connection technology for service-oriented architectures. The service provider returns a response message to the service consumer. The request and subsequent response connections are defined in a way that is understandable to both the service consumer and service provider. A service provider can also be a service consumer.

The term Web Services refers to the technologies that allow for making connections. Services are what we connect together using Web Services [2, 4]. A service is the endpoint of a connection and has some type of underlying computer system that supports the connection offered. The combination of services - internal and external to an organization - makes a service-oriented architecture. The relation between organizational services and web Technologies is shown in figure 4.

In general, business entities offer capabilities and act as service providers [3, 8]. One who makes use of services is referred to as service consumers. The service description allows prospective consumers to decide if the service is suitable for their current needs. Although SOA is commonly implemented using web services, services can be made visible, support interaction, and generate effects through other implementation strategies. Web service-based architectures and technologies are specific and concrete [15].

4. WEB SERVICES AND AGENT BASED SERVICE ORIENTED ARCHITECTURE

In web service-based architectures the service providers can register the instance of the service in the registry making it available to service consumers. The service consumer may then query the registry in order to retrieve the binding information required to access the service. The service consumer then invokes the service. The relationship between a service provider and consumer is dynamic and established at runtime by a binding mechanism. Dynamic binding minimizes the dependencies between the service consumer and the service provider. Service Oriented Environment is based on the following major principals [1, 6]:

Service is the important concept. Web Services are the set of protocols by which Services can be published, discovered and used in a technology neutral, standard form.

SOA is not just architecture of services seen from a technology perspective, but the policies, practices, and frameworks by which we ensure the *right* services are provided and consumed.

With SOA it is critical to implement processes that ensure that there are at least two different and separate processes—for provider and consumer.

Rather than leaving developers to discover individual services and put them into context, the Business Service Bus is instead their starting point that guides them to a coherent set that has been assembled for their domain.

The value of SOA is derived from the runtime and design/development/configuration activities [2]. The web architecture of SOA is shown in figure 5, where as enterprise architecture of service model is shown in figure 6.

The development process gains speed by the reuse of services. Dynamic discovery and binding at runtime supports loose coupling leading to more stable and reliable applications. Today, agents are being applied in a wide range of industrial applications [15]. Most of the technology and market research companies, which provide their clients with advice about technology's impact on business and consumers, agree on the fact that the adoption of a SOA paradigm is strategic and should be part of the most forward-looking software projects. Agents who require a service from another agent enter into a negotiation for that service to obtain a mutually acceptable price, time, and degree of quality. Successful negotiations result in binding agreements between agents [9, 10]. This agent-based approach offers a number of advantages over more typical workflow solutions to this problem. The proactive nature of the agents means services can be scheduled in a just-in-time fashion (rather than pre-specified from the beginning), and the responsive nature of the agents means that service exceptions can be detected and handled in a flexible manner [5, 12].

5. PROPOSED MODEL OF SERVICE ORIENTED ARCHITECTURE FOR ORGANIZATIONS

A service-oriented architecture (SOA) is an application topology in which the business logic of the application is organized in modules (services) with an identity, purpose and access interfaces. Services behave as "black boxes" where their internal design is independent of the nature and purpose of the requestor [7]. In SOA, data and business logic are encapsulated in modular business components with documented interfaces. This helps to understand the design better and facilitates incremental development and future extensions. A SOA application can also be integrated with heterogeneous, external legacy and purchased applications more easily than a monolithic non-SOA application. Applications that have separate business layers are more suitable to access a SOA environment [10, 11].

The proposed system is based on the emergent and more established technologies which we aim at integrating with agent technology, the need for SOA in organizations & agent-based SOA for business dynamics followed by the Business process and the Behavior of system in SOA and the architecture related to web services. The proposed system consists of a number of specialized agents with different expertise. It comprises of the Web agent and Communication Service Agent (CSA), Application Interface Agent (AIA), Data Adaptation Agent (DAA), Application agent and different Business Process and Data Retrieval agent and communication agent which are architected in order to work together for the optimized working using SOA.

The system architecture would be used in communities consisting of different kinds of agents like service providers, personal assistants and middle agents (e.g. service brokers, user profile managers, workflow managers, etc) and other agents like Communication Service Agent (CSA), Application Interface Agent (AIA), Data Adaptation Agent (DAA). These autonomous agents should be able to perform their tasks in cooperation or in competition with other agents and be able to interoperate with external entities (e.g., legacy software systems) for achieving their goals (semantic matching, service contracting etc.). They should have reasoning capabilities and support for dynamic behavior modification based on business rules. They should also be able to build workflows, compose the external Web services and monitor their execution. A distributed management should support the complete process. The use case of SOA scenario is shown in figure 7.

The multiple agents that we have used have specific work and they work in co ordination with each other. When the user surfs on World Wide Web, he uses an agent to contact the Service Provider that in turn is using the Services associated with it in order to provide assistance. In our proposed model the Service Provider takes help of the Business Process Manager whose task is to authenticate for services to Service Provider and define the Services for Business process.

We are defining the following agents to comprise services and connections between the services.

5.1 CSA (Communication Service Agent)

Aim: to provide interface between Web server and the Website

Task (action) of the agent:

1. establish Communication between the Web server and the web site
2. provides Exchange of Services between the two

3. transfers the data (request)

(The above task is accomplished by Communication Switching Agent)

Procedure Sequence:

1. a web user on selecting a particular site establishes the connection with the web server of that site
2. communication is established between the two by the Communication Switching Agent

5.2 AIA (Application Interface Agent)

Aim: to provide interface between Web server and the application

Task (action) of the agent:

1. establish Interface between the web server and the application
2. check for adaptive environment (operating system and application platform)
3. passing of information from one website to the other as required with the help of Communication Service Agent

(The above task is accomplished by Interface Switching Agent)

Procedure Sequence:

1. the web server collects the information being searched and the selected site
2. an interface is established between the web server and the selected application through any adaptive environment by the Interface Switching Agent

5.3 DAA (Data Adaptation Agent)

Aim: to help exchange and passing of data between Server and the Database

Task (action) of the agent:

1. to exchange the available / required data
2. to help in adding of new data
3. to modify the existing data
4. to delete the unwanted data

(The above task of Updating of data is accomplished by Data Exchange Agent)

Procedure Sequence:

1. the selected and required matter is made available of the huge repository available for the particular application from the data storage
2. this data up-dation is performed by Data Exchange Agent

In the SOA configuration of our agent based system the user's request is processed with the help of an agent which searches for the contents in the web server which in turn takes help of the agent to look for the adaption with the application being asked for and another agent which searches for the data being searched from the database storage.

Along with these agents there are few agents, which is also useful for SOA. These are as follows:

1. WEB AGENTS : these agents act as the interface between various requestors and responders on the world wide web
2. APPLICATION AGENTS : these agents refer to various independent applications available which can be contacted through world wide web with other heterogeneous and homogeneous applications
3. DATA RETRIEVAL AGENTS : these are agents which serve as repository of the data a requestor is requesting for , to an application
4. COMMUNICATION AGENTS: these are agents who help in establishing connection between various agents (viz. between web agent and application agent, application agent and data retrieval agent etc.)

6. FUTURE WORK AND CONCLUSION

A framework prototype of the Service Oriented Architecture for Business dynamics is currently under development where a SOA based model is being designed and developed. The implementation result shall be presented in a sequential publication.

Future work under this research will focus on the following issues:

1. Design of a conceptual framework for agent based SOA, to provide decisions for the best communication between services
2. Implementation of agents for SOA in distributed Environment.
3. Design and development of agents for SOA
4. Algorithm best agent based SOA practices

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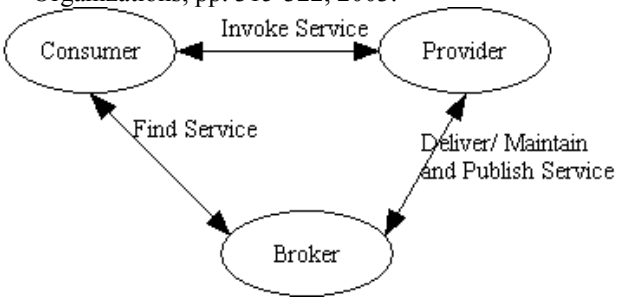

Figure 6: Enterprise Architecture Service Model

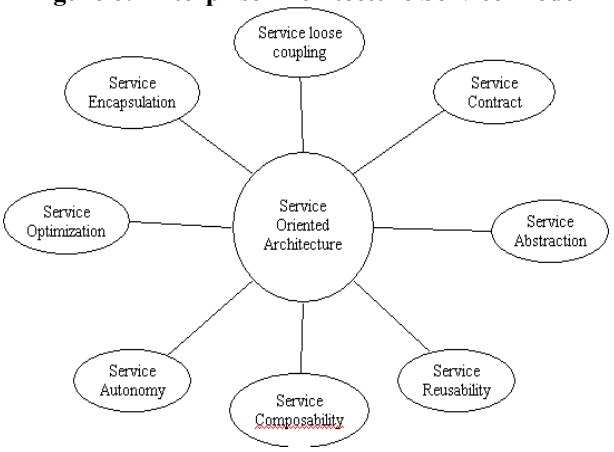

Figure 1: Service Components of SOA in Business Process

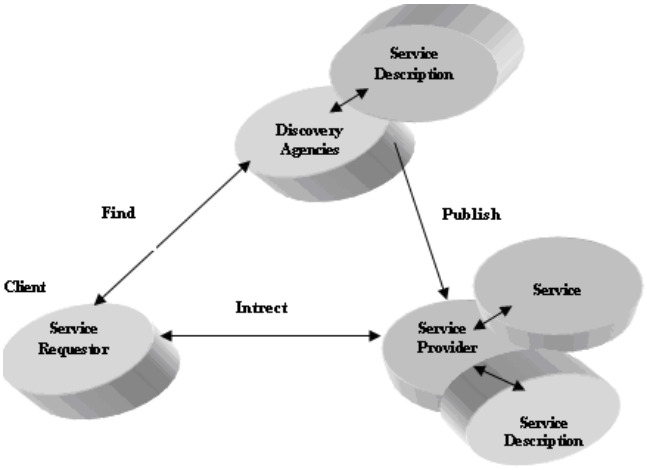

Figure 2: Services & Service Providers

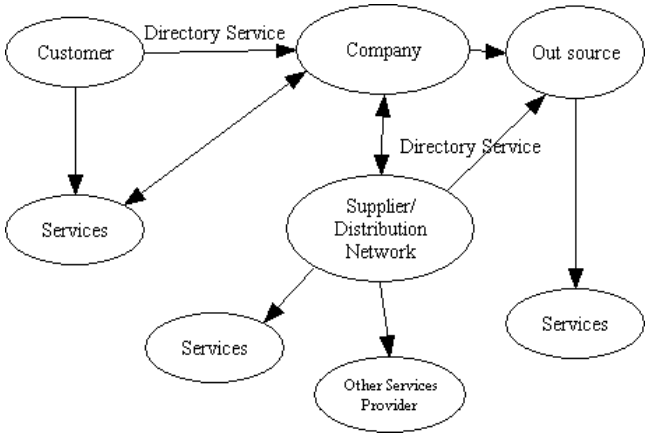

Figure 3: Services between Business Partners in SOA Framework

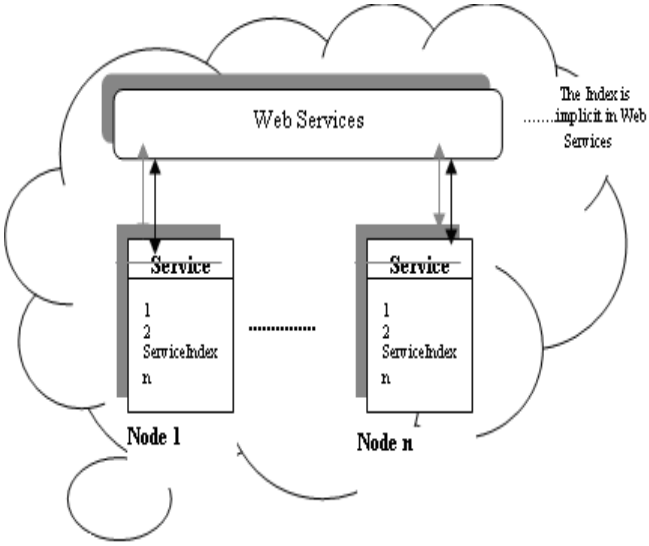

Figure 4: Organizational Services and Web Technology

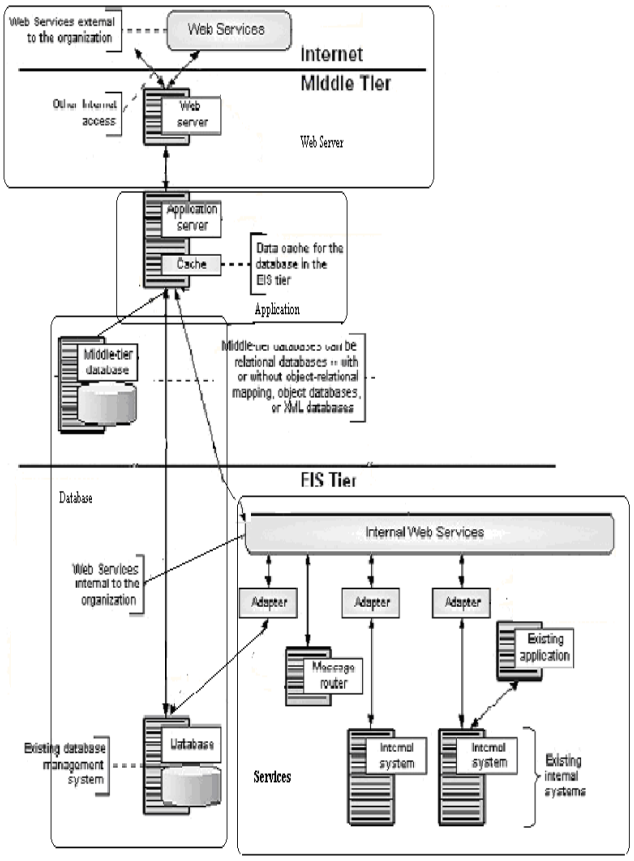

Figure 5: Web Architecture of SOA

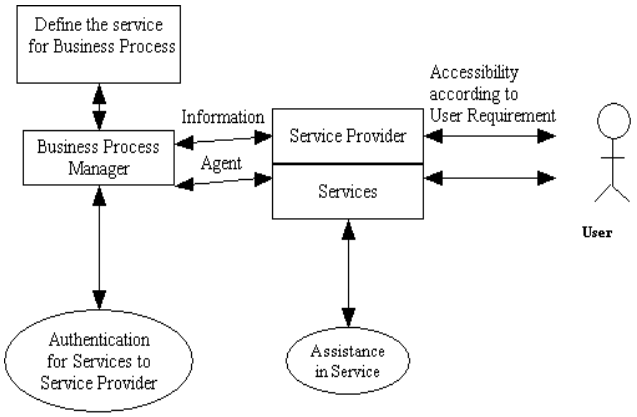

Figure 7: SOA Scenarios with Actors

Solving Sequence Alignment Problem using Pipeline Approach

Pankaj Agarwal[1] and **S. A. M. Rizvi**[2]

Abstract - ***This paper presents two models based on pipeline approach for determining pair-wise sequence alignment of two molecular sequences. One of the models considers a variation of Needleman-Wunsch method as a basic algorithm and other is based on the use of scoring matrix for alignment. The basic purpose of using the pipelines is to reduce the time-complexity of alignment significantly. Paper also discusses the design & implementation of the basic linear version of the algorithms in our software tool by the name "Sequence Comparison and Analysis Tool [SCAT]". Our tool also provides the option of sequence alignment on the basis of common grouping like chemical, functional & structural etc. The software tool is implemented using Visual Basic-6 package with user-friendly windows environment.***

Index Terms - Sequence Alignment, Pipeline, Needleman-Wunsch Algorithm, Scoring Matrix etc.

1. INTRODUCTION

Sequence comparison can be defined as the problem of finding, which parts of the sequences are similar and which parts are different **[1,4,5]**. It is regarded as the building block for many other, more complex problems such as multiple alignments (the comparison of a group of related sequences) and the construction of phylogenetic trees that explain the evolutionary relationship among species. Sequence comparison is actually a well-know problem in computer science. For the computer scientist, bimolecular sequences are just another source of data. Indeed, one that has experienced a tremendous growth in interest to the point that it has spawned an interdisciplinary field of its own; generally know as *bioinformatics*, *computational molecular biology* or just *computational biology* **[4,5]**. As biological databases grow in size, faster algorithms and tools are needed **[6-15]**.

Our interest is to identify similarities and differences between two sequences by comparing them with each other. Generally, a measure of how similar they are is also desirable. A typical approach to solve this problem is to find a good and plausible *alignment* between the two sequences. If two sequences in an alignment share a common ancestor, mismatches can be interpreted as point mutations and gaps as indels (that is, insertion or deletion mutations) introduced in one or both lineages in the time since they diverged from one another. The objective is to *match* identical subsequences as far as possible. An alignment can bee seen as a way of transforming one sequence into the other. Once the alignment is produced, a *score* can be assigned to each pair of aligned letters, called *aligned pair*, according to some chosen scoring scheme such as PAM and BLOSUM **[4,5]** that take into account physicochemical properties or evolutionary knowledge of the sequences being aligned.

Computational approaches to sequence alignment generally fall into two categories: *global alignments* and *local alignments*. Calculating a global alignment is a form of global optimization that "forces" the alignment to span the entire length of all query sequences. By contrast, local alignments identify regions of similarity within long sequences that are often widely divergent overall. Local alignments are often preferable, but can be more difficult to calculate because of the additional challenge of identifying the regions of similarity.

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2. BACKGROUND

In our proposed method we have applied a multi-Pipeline approach to the standard global alignment algorithm referred as Needleman-Wunsch method. So let us first understand the working principle behind Needleman-Wunsch algorithm **[2]**. It computes the similarity between two sequences A and B of lengths m and n, respectively, using a dynamic programming approach. Dynamic

Pogramming is a strategy of building a solution gradually using simple recurrences **[3]**. The key observation for the alignment problem is that the similarity between sequences A[1..n] and B[1..m] can be computed by taking the maximum of the three following values:

1. The similarity of A[1..n −1] and B[1..m −1] plus the score of substituting A[n] for B[m];
2. The similarity of A[1..n −1] and B[1..m] plus the score of deleting aligning A[n];
3. The similarity of A[1..n] and B[1..m −1] plus the score of inserting B[m].

From this observation, the following recurrence can be derived:

match (A[1..i], B[1..j]) = match (A[1..i −1], B[1..j −1]) + sub (A[i], B[j]);

max{match (A[1..i −1], B[1..j]) + Del (A[i]);

match (A[1..i], B[1..j −1]) + Ins (B[j]) }

Where match (A, B) is a function that gives the similarity of two sequences A and B, and sub (a, b), Del (c) and Ins (c) are scoring functions that give the score of a substitution of character 'a' for character 'b', a deletion of character 'c', and an insertion of character 'c', respectively.

This recurrence is complete with the following base case:

match (A[0], B[0]) = 0; where A[0] and B[0] are defined as empty strings.

To solve the problem with this recurrence, the algorithm generally builds an (n +1) × (m +1) matrix where each M[i, j] represents the similarity between sequences A[1..i] and B[1..j]. The first row and the first column represent alignments of one

sequence with spaces. M[0, 0] represents the alignment of two empty strings, and is set to zero. All other entries are computed with the following formula:

M[i, j] = M[i −1, j −1] + Substitute (A[i], B[j]); // *if A[i]=B[j]*
Max{ M[i −1, j] + Del (A[i] ; M [i, j −1] + Ins (B[j] }
// *if A[i]<>B[j]*

The matrix can be computed either row by row (left to right) or column by column (top to bottom). In the end, M[n, m] will contain the similarity score of the two sequences. Since there are (m+1) · (n+1) positions to compute and each take a constant amount of work, this algorithm has time complexity **[3]** of $O(n^2)$. Clearly, it has also quadratic space complexity since it needs to keep the entire matrix in memory.

Once the matrix has been computed, the actual alignment can be retrieved by tracing a path in the matrix from the last position to the first. The trace is a simple procedure that compares the value at each M[i, j] to the values of its left, top and diagonal entries according to the formula given above. For instance, if M[i, j] = M [i, j −1] + Ins (B[j]), the trace reports an insertion of character B[j] and proceeds to entry M[i, j −1]. Alternatively, pointers can be saved on each entry during the computation of the matrix so that this evaluation step can be avoided at the cost of more memory usage. Since the path can be as long as $O(m + n)$, this procedure has linear time complexity. Note that sometimes more than one path can be traversed and, as a result, multiple high-scoring alignments can be produced. In the matrix of Figure 1, two optimal alignments can be retrieved

A = A C A A G A C A G – C G T
| | | | | | | | |
B = A G A A C A – A G G C G T

It is often useful to see the dynamic programming solution for the sequence alignment problem as a directed weighted graph with (n +1) × (m +1) nodes representing each entry (i, j) of the matrix, and having the following edges:

- ((i −1, j −1), (i, j)) with weight equals to sub (A[i], B[j]);
- ((i −1, j), (i, j)) with weight equals to Del (A[i]);
- ((i, j −1), (i, j)) with weight equals to Ins (B[j]);

A path from node (0, 0) to (n, m) in the *alignment graph* corresponds to an alignment between the two sequences, and the problem of retrieving an optimal alignment is converted to the problem of finding a path in the graph with highest weight.

Needleman-Wunsch method works fine for short sequences but for longer sequences the performance of the algorithm degrades quite considerably due to its $O(n^2)$ behavior. Our proposed method improves the time complexity to O(n) which is a significant improvement.

3. PROPOSED METHODOLOGY

Problem 3.1: Sequence Alignment of two molecular sequences

In recent years use of parallel algorithms and methods **[18,19,20]** has gained a lot of attention by researchers particularly in the area of sequence comparison related problems in molecular biology. We have proposed a multi-Pipeline strategy with two-stages per pipeline for alignment of two sequences. A delay of one unit time is inserted in each of the successive pipelines as each next pipeline is data dependent on its previous pipeline and thus delay enables the availability of data for each successive pipeline. Thus pipelines do not work concurrently with each other; rather they follow a sequential order while execution i.e. with the start of initial clock pulse pipeline-1 comes into play; at the second clock pulse pipeline-2 takes off and in similar fashion each of the other pipelines starts in successive clock pulses following a delay of one unit every time.

In spite of this forced delay of one unit in each successive pipeline time-complexity of the algorithm improves significantly. The computation involved in the two stages employed in each pipeline is given below with a general assumption that each stage consumes one unit of cycle time.

The time complexity of the general algorithm given as below will take O(m*n) which becomes quite significant as the size of the sequences grows and thus is not feasible at all.

For i=1 to m
  For j= 1 to n
    If A[i]=B[j] then
    M[i,j]=M[i-1,j-1]+Sub[A(i),B(j)],
      Else
    M[i,j]=Max{M[i-1,j]+Del[A(i)], M[i,j-1]+Ins[B(j)}

Consider two short sequences
ACAAG----------length 5
AGAAC----------Length 5
We need to compute M[5,5]
M[0,j] and M[i,0] are initialized

Figure 3 shows the result of applying the general algorithm which in this case will take 25 units of time to align two sequences each of length 5. Figure 4 shows how the matrix of order O (m*n) is filled by applying the proposed method allowing a delay of one unit at the beginning of each pipeline. Use of five pipelines has been depicted. Clearly there is significant improvement in the time complexity where it only takes 10 units of cycle-time to complete the process. In general the time complexity can be given as O(c*n) where 'c' is a constant term which is a very significant improvement over O(m*n)

Figure 5 given above shows the general architecture of the proposed pipeline-model with N functional units including Fetch units [F_i], Decoders [D_i], Execution unit with Adders [A_i], Comparators [C_i] and Storage units [S_i]

Problem 2: Determining the longest Continuous Subsequence with no gaps in given two sequences.

Some times we are more interested in finding the longest conserved region from two given molecular sequences. The proposed model based on pipeline approach is an attempt to solve the above stated problem. Again we propose a two stage multi-Pipeline model. Input to the pipeline is two DNA sequences which are converted in all the six-reading frames into corresponding protein sequences and thus resulting in six pairs of amino acid sequences. For each of the sequence pairs; matrix of order m*n is constructed based on some scoring matrix where m & n are the lengths of the sequences respectively.

Here we have proposed the use of six-pipelines each with two stages where all the six pairs of obtained sequences are input to one pipeline. All the six-pairs of sequences can be aligned concurrently with each other and thus improving the time complexity significantly. Figure 9 shows how the pipeline works for the given prepared matrix in figure 7.

Traditional algorithms would have taken O(6*n*m) time in the worst case and even the best algorithm would have taken O(6*n) time-complexity. However our strategy provides a better time complexity of O(n) in the worst-case with some overhead on the required resources in the form of multiple functional units. This is indeed a very significant improvement. Method does require the existence of multiple functional units like loaders, adders etc.

All the six pairs of obtained sequences can be mapped on to the six pipelines simultaneously as shown in figure 9 (here we have not shown the six pairs of obtained sequences converted in all the six reading frames). Scoring matrices are constructed for each pair of all the six sequences where values in the matrix are identified by the taken variables a_{ij}, b_{ij}, c_{ij}, d_{ij}, e_{ij} and f_{ij}. Each of the pipelines has global variables by the names S_i, T_i, Q_i, W_i, X_i and Z_i respectively that computes the sum starting from the residues positions a_{i1} to a_{ik} for each of the six sequences. Then we look for the maximum of the obtained sum values in each of the sequence pairs. For example in the above taken sample sequence the sum $S2=S2+a_{21} + a_{32} + a_{43} + a_{54}=10+7+6+8=31$ is the maximum sum among the sum values S1, S2, S3, S4, and S5.

The best alignment corresponding one of the obtained pairs of sequences (one of the six reading frames) is a_{21}, a_{32}, a_{43}, a_{54} i.e. at pipeline 1.

D A L T N
| | | |
T **D A L T**

Where aligned characters are marked by pipe symbols. Similarly the alignment for the other pairs of sequences can be obtained simultaneously reducing the time complexity of the algorithm significantly.

X_i and Z_i respectively that computes the sum starting from the residues positions a_{i1} to a_{ik} for each of the six sequences. Then we look for the maximum of the obtained sum values in each of the sequence pairs.]

4. IMPLEMENTATION

Here we have shown the screen formats of the implementation of the linear versions of the presented algorithms in our tool named as '*Sequence Comparison and Analysis Tool*'. The tool actually provides the solution to number of sequence comparison problems prevalent in molecular biology. Figure 10 show the interface that captures all the input details for aligning two sequences. As it can be seen sequence alignment can be done in four ways i.e. between nucleotide-to-nucleotide, nucleotide to proteins, Proteins to proteins and proteins to nucleotide. For a given input DNA sequence, one can not only consider it's upper & lower strands but also the reverse strand in either case. Alignment can be done for all the sequences obtained in six reading frames. Both the local and global alignments are possible. One can also provide the values for residue match mismatch and gap value. A number of algorithms including standard and self developed {algorithms are a part of our research papers already published in various journals and conferences **[21-27]** } are implemented in our tool (description of these algorithms are beyond the scope of this paper). One can align the sequences based on various scoring matrices also such as PAM & BLOSUM . Four types of alignment have been considered i.e. exact alignment, gap alignment, alignment based on groupings and ends-free alignment. Result window is quite user-friendly showing the alignment score and % of matched residues.

5. CONCLUSIONS AND FUTURE WORK

The proposed models can be easily implemented on parallel computers with multiple functional pipelines and will improve the time complexity of aligning the sequences. Assumption of multiple pipelines and functional unit improves the time complexity of the standard algorithms quite considerably from $O(n^2)$ to O(n). The most significant part of the algorithm is its ability to align more than one pair of sequences simultaneously with no additional overhead. Use of data-flow computers can be quite useful for the discussed sequence alignment problem and can provide even a better solution for sequence comparison types of jobs. we hope to come up with a better solution in our next paper by using the strategy data flow computing.

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		0	1	2	3	4	5	6	7	8	9	10	11	12
		-	A	G	A	A	C	A	A	G	G	C	G	T
0	-	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12
1	A	-1	1	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
2	C	-2	0	0	-1	-2	-1	-2	-3	-4	-5	-6	-7	-8
3	A	-3	-1	-1	1	0	-1	0	-1	-2	-3	-4	-5	-6
4	A	-4	-2	-2	0	2	1	0	1	0	-1	-2	-3	-4
5	G	-5	-3	-1	-1	1	1	0	0	2	1	0	-1	-2
6	A	-6	-4	-2	0	0	0	2	1	1	1	0	-1	0
7	C	-7	-5	-3	-1	-1	1	1	1	0	0	2	1	0
8	A	-8	-6	-4	-2	0	0	2	2	1	0	1	1	2
9	G	-9	-7	-5	-3	-1	-1	1	1	3	2	1	2	1
10	C	-10	-8	-6	-4	-2	0	0	0	2	2	3	2	1
11	G	-11	-9	-7	-5	-3	-1	-1	-1	1	3	2	4	3
12	T	-12	-10	-8	-6	-4	-2	0	0	0	2	2	3	5

Figure 1: Standard dynamic programming matrix for the global alignment of sequences A=ACAAGACAGCGT and B=AGAACAAGGCGT with paths to retrieve optimal alignments indicated with arrows.

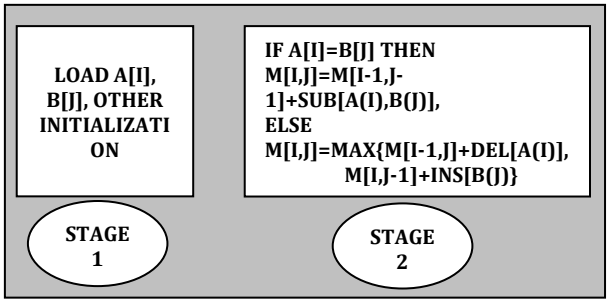

Figure 2: Two stage single pipeline

A_i/B_j	--	A	G	A	A	C
--	0	-1	-2	-3	-4	-5
A	-1	1	0	-1	-2	-3
C	-2	0	0	-1	-2	-1
A	-3	-1	-1	1	0	-1
A	-4	-2	-2	0	2	1
G	-5	-3	-1	-1	1	1

Figure 3: Result of alignment [Algorithm will take 25(5*5)

		1	2	3	4	5	6	7	8	9	10	
P1	S1	Load A[1],B[1]	Load A[1],B[2]	Load A[1],B[3]	Load A[1],B[4]	Load [1],B[5]						
	S2		M[1,1]=1	M[1,2]=0	M[1,3]=-1	M[1,4]=-2	M[1,5]=-3					
P2	S1		Load A[2],B[1]	Load A[2],B[2]	Load A[2],B[3]	Load A[2],B[4]	Load [2],B[5]					
	S2			M[2,1]=0	M[2,2]=0	M[2,3]=-1	M[2,4]=-2	M[2,5]=-1				
P3	S1			Load A[3],B[1]	Load A[3],B[2]	Load A[3],B[3]	Load A[3],B[4]	Load A[3],B[5]				
	S2				M[3,1]=-1	M[3,2]=-1	M[3,3]=1	M[3,4]=-2	M[3,5]=-3			
P4	S1				Load A[4],B[1]	Load A[4],B[2]	Load A[4],B[3]	Load A[4],B[4]	Load [4],B[5]			
	S2					M[4,1]=-2	M[4,2]=-2	M[4,3]=0	M[4,4]=2	M[4,5]=1		
P5	S1					Load A[5],B[1]	Load A[5],B[2]	Load A[5],B[3]	Load A[5],B[4]	Load A[5],B[5]		
	S2						M[5,1]=-3	M[5,2]=-1	M[5,3]=-1	M[5,4]=1	M[5,5]=1	

Figure 4: Result of the proposed model with one unit of delay in each successive pipeline

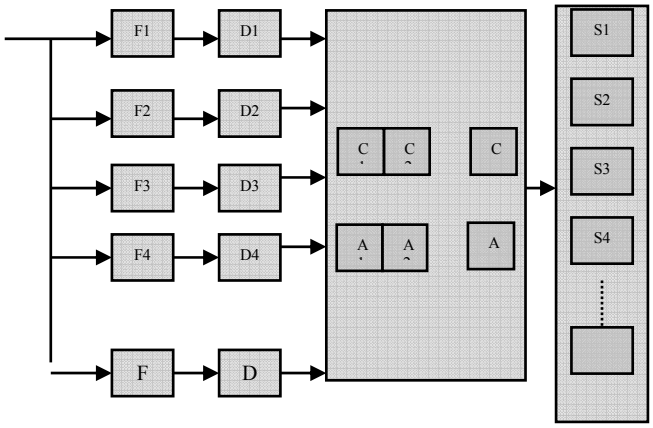

Figure 5: General architecture of the proposed-Pipeline [F: Fetch unit, D: Decode Unit, C: Comparator, A: adders, S: store units]

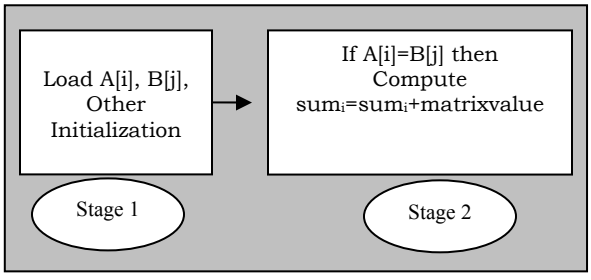

Figure 6: Two stage single pipeline.

A_i/B_j	D	A	L	T	N
T	$-2[a_{11}]$	$0[a_{12}]$	$-3[a_{13}]$	$8[a_{14}]$	$0[a_{15}]$
D	$10[a_{21}]$	$-3[a_{22}]$	$-7[a_{23}]$	$-2[a_{24}]$	$2[a_{25}]$
A	$-3[a_{31}]$	$7[a_{32}]$	$-3[a_{33}]$	$0[a_{34}]$	$-3[a_{35}]$
L	$-7[a_{41}]$	$-3[a_{42}]$	$6[a_{43}]$	$-3[a_{44}]$	$-6[a_{45}]$
T	$-2[a_{51}]$	$0[a_{52}]$	$-3[a_{53}]$	$8[a_{54}]$	$0[a_{55}]$

Figure 7: Alignment scores using BLOSUM-80

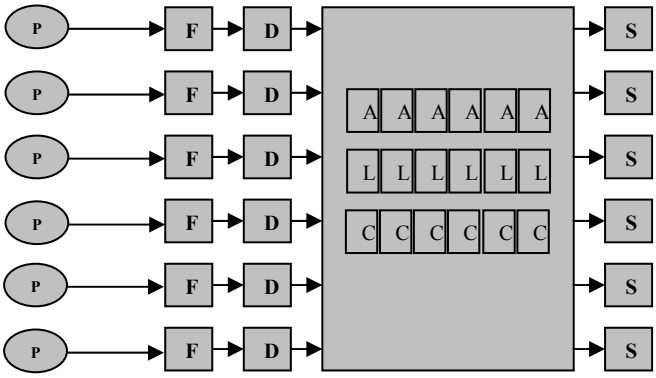

Figure 8: Architecture with multiple Functional Unit {P: Pipeline, F: Fetch Unit, D: Decode unit, A: adder, L: Loader, C: Comparator, S: storage unit}

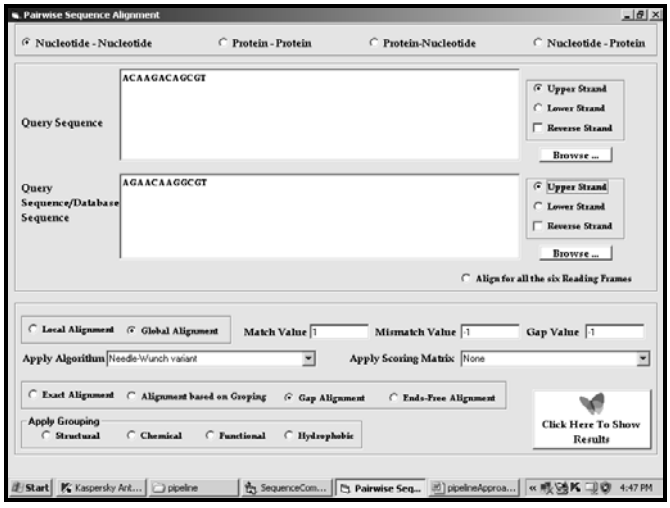

Figure 10: Interface that captures the inputs for aligning

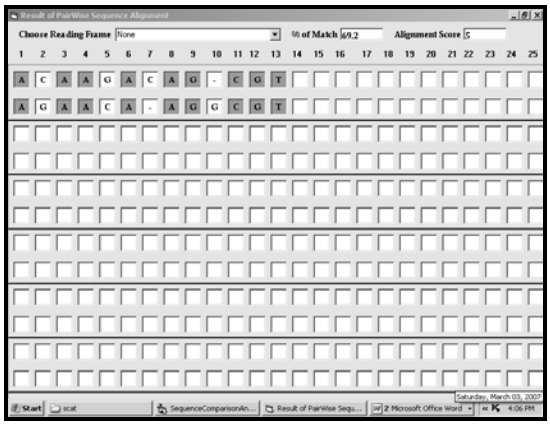

Figure 11: Showing alignment of the two input sequences with alignment score.

	1	2	3	4	5
Pipeline 1	Load a_{11} S1=0	Load a_{21} S2=0	Load a_{31} S3=0	Load a_{41} S4=0	Load a_{51} S5=0
		Load a_{22} S1=S1+ a_{22}	Load a_{32} S2=S2+ a_{32}	Load a_{42} S3=S3+ a_{42}	Load a_{52} S4=S4+ a_{52}
			Load a_{33} S1=S1+ a_{33}	Load a_{43} S2=S2+ a_{43}	Load a_{53} S3=S3+ a_{53}
				Load a_{44} S1=S1+ a_{44}	Load a_{54} S2=S2+ a_{54}
					Load a_{55} S1=S1+ a_{55}
Pipeline 2	Load b_{11} T1=0	Load b_{21} T2=0	Load b_{31} T3=0	Load b_{41} T4=0	Load b_{51} T5=0
		Load b_{22} T1=T1+ a_{22}	Load b_{32} T2=T2+ b_{32}	Load b_{42} T3=T3+ b_{42}	Load b_{52} T4=T4+ a_{52}
			Load b_{33} T1=T1+ b_{33}	Load b_{43} T2=T2+ b_{43}	Load b_{53} T3=T3+ a_{53}
				Load b_{44} T1=T1+ b_{44}	Load b_{54} T2=T2+ b_{54}
					Load b_{55} T1=T1+ b_{55}
Pipeline 3	Load c_{11} Q1=0	Load c_{21} Q2=0	Load c_{31} Q3=0	Load c_{41} Q4=0	Load c_{51} Q5=0
		Load c_{22} Q1=Q1+ c_{22}	Load c_{32} Q2=Q2+ c_{32}	Load c_{42} Q3=Q3+ c_{42}	Load c_{52} Q4=Q4+ c_{52}
			Load c_{33} Q1=Q1+ c_{33}	Load c_{43} Q2=Q2+ c_{43}	Load c_{53} Q3=Q3+ c_{53}
				Load c_{44} Q1=Q1+ c_{44}	Load c_{54} Q2=Q2+ c_{54}
					Load c_{55} Q1=Q1+ c_{55}
Pipeline 4	Load d_{11} W1=0	Load d_{21} W2=0	Load d_{31} W3=0	Load d_{41} W4=0	Load d_{51} W5=0
		Load d_{22} W1=W1+ d_{22}	Load d_{32} W2=W2+ d_{32}	Load d_{42} W3=W3+ d_{42}	Load d_{52} W4=W4+ d_{52}
			Load d_{33} W1=W1+ d_{33}	Load d_{43} W2=W2+ d_{43}	Load d_{53} W3=W3+ d_{53}
				Load d_{44} W1=W1+ d_{44}	Load d_{54} W2=W2+ d_{54}
					Load c_{55} W1=W1+ c_{55}
Pipeline 5	Load e_{11} X1=0	Load e_{21} X2=0	Load e_{31} X3=0	Load e_{41} X4=0	Load e_{51} X5=0
		Load e_{22} X1=X1+ e_{22}	Load e_{32} X2=X2+ e_{32}	Load e_{42} X3=X3+ e_{42}	Load e_{52} X4=X4+ e_{52}
			Load e_{33} X1=X1+ e_{33}	Load e_{43} X2=X2+ e_{43}	Load e_{53} X3=X3+ e_{53}
				Load e_{44} X1=X1+ e_{44}	Load e_{54} X2=X2+ e_{54}
					Load c_{55} X1=X1+ c_{55}
Pipeline 6	Load f_{11} Z1=0	Load f_{21} Z2=0	Load f_{31} Z3=0	Load f_{41} Z4=0	Load f_{51} Z5=0
		Load f_{22} Z1=Z1+ f_{22}	Load f_{32} Z2=Z2+ f_{32}	Load f_{42} Z3=Z3+ f_{42}	Load f_{52} Z4=Z4+ f_{52}
			Load f_{33} Z1=Z1+ f_{33}	Load f_{43} Z2=Z2+ f_{43}	Load f_{53} Z3=Z3+ f_{53}
				Load f_{44} Z1=Z1+ f_{44}	Load f_{54} Z2=Z2+ f_{54}
					Load c_{55} Z1=Z1+ c_{55}

Figure 9: Working of the Proposed Pipeline [Each of the pipelines has global variables by the names S_i, T_i, Q_i, W_i,

Distribution Based Change-Point Problem with Two Types of Imperfect Debugging in Software Reliability

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Abstract - Software testing is an important phase of software development life cycle. It controls the quality of software product. Due to the complexity of software system and incomplete understanding of software, the testing team may not be able to remove/correct the fault perfectly on observation/detection of a failure and the original fault may remain resulting in a phenomenon known as imperfect debugging, or get replaced by another fault causing fault generation. In case of imperfect debugging, the fault content of the software remains same while in case of fault generation, the fault content increases as the testing progresses and removal/correction results in introduction of new faults while removing/correcting old ones. During software testing fault detection /correction rate may not be same throughout the whole testing process, but it may change at any time moment. In the literature various software reliability models have been proposed incorporating change-point concept. In this paper we propose a distribution based change-point problem with two types of imperfect debugging in software reliability. The models developed have been validated and verified using real data sets. Estimated Parameters and comparison criteria results have also been presented

Index Terms - Non-homogenous Poisson process, software reliability growth model, hazard rate, imperfect debugging.

NOTATION

- $m(t)$: the mean value function or the expected number of faults detected or removed by time t.
- $a(t)$: total fault content of software dependent on time.
- p : the probability of fault removal on a failure (i.e., the probability of perfect debugging).
- α : the rate at which the faults/errors may be introduced during the debugging process.
- b : fault removal/correction rate.
- $\lambda(t)$: intensity function for NHPP models or fault detection rate per unit time.
- $F(t)$: distribution functions for fault removal/correction times.
- $f(t)$: density functions for fault removal/correction times.
- $z(t)$: hazard rate function.
- β : learning parameter in logistic function.

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1. INTRODUCTION

Computer software is embedded in systems of all kinds: transportation, medical, telecommunications, military, industrial processes, entertainment, office products….the list is almost endless. Software is virtually inescapable in a modern world. And as we move into the twenty-first century, it will become the driver for new advances in everything from elementary education to genetic engineering. Software development consists of different phases: requirement analysis, design, coding, testing, implementation and maintenance called SDLC. Research has been conducted in software reliability engineering over the past three decades and many software reliability growth models (SRGM) have been proposed. The Software Reliability Growth Model (SRGM) is the tool, which can be used to evaluate the software quantitatively, develop test status, schedule status and monitor the changes in reliability performance.

Research has been conducted in software reliability engineering over the past three decades and many software reliability growth models (SRGM) have been proposed. The pioneering attempt in non-homogenous Poisson process based on SRGM was made by Goel and Okumoto (G-O) [1]. The model describes the failure observation phenomenon by an exponential curve. There are also SRGM that describe either S-shaped curves or a mixture of exponential and S-shaped curves (flexible). Some of the important contributions of these type of models are due to Yamada *et al.* [27], Ohba [18], Bittanti *et al.* [3], Kapur and Garg [16], Kapur *et al.* [17], Pham [24] etc.

In most of the models discussed above it is assumed that whenever an attempt is made to remove a fault, it is removed with certainty i.e. a case of perfect debugging. But the debugging activity is not always perfect because of number of factors like tester's skill/expertise etc. In practical software development scenario, the number of failures observed/detected may not be necessarily same as the number of errors removed/corrected. Kapur and Garg [16] have discussed in their error removal phenomenon model that as testing grows and testing team gains experience, additional numbers of faults are removed without them causing any failure.

The testing team, however, may not be able to remove/correct fault perfectly on observation/detection of a failure and the original fault may remain leading to a phenomenon known as imperfect debugging, or replaced by another fault resulting in fault generation. In case of imperfect debugging the fault content of the software is not changed, but because of incomplete understanding of the software, the original detected fault is not removed perfectly. But in case of fault generation, the total fault content increases as the testing progresses

because new faults are introduced in the system while removing the old original faults.

Model due to Obha and Chou [18] is an fault generation model applied on G-O model and has been also named as Imperfect debugging model. Kapur and Garg [22] introduced the imperfect debugging in G-O model. They assumed that the FDR per remaining faults is reduced due to imperfect debugging. Thus the number of failures observed/detected by time infinity is more than the initial fault content. Although these two models describe the imperfect debugging phenomenon yet the software reliability growth curve of these models is always exponential. Moreover, they assume that the probability of imperfect debugging is independent of the testing time. Thus, they ignore the role of the learning process during the testing phase by not accounting for the experience gained with the progress of software testing. Pham [24] developed an SRGM for multiple failure types incorporating fault generation. Zhang et al. [26] proposed a testing efficiency model which includes both imperfect debugging and fault generation, modeling it on the number of failures experienced/observed/detected, however both imperfect debugging and fault generation are actually seen during fault removal/correction. Recently, Kapur et al. [12] proposed a flexible SRGM with imperfect debugging and fault generation using a logistic function for fault detection rate which reflects the efficiency of the testing/removal team.

We execute the program in specific environment and improve its quality by detecting and correcting faults. Many SRGM assume that, during the fault detection process, each failure caused by a fault occurs independently and randomly in time according to the same distribution Musa et al. [21]. But the failure distribution can be affected by many factors such as running environment, testing strategy, defect density and resource allocation. On the other hand, in practice, if we want to detect more faults for a short period of time, we may introduce new techniques or tools that are not yet used, or bring in consultants to make a radical software risk analysis. In addition, there are newly proposed automated testing tools for increasing test coverage and can be used to replace traditional manual software testing regularly. The benefits to software developers/testers include increased software quality, reduced testing costs, improved release time to market, repeatable test steps, and improved testing productivity. These technologies can make software testing and correction easier, detect more bugs, save more time, and reduce much expense. Altogether, we wish that the consultants, new automated test tools or techniques could greatly help us in detecting additional faults that are difficult to find during regular testing and usage, in identifying and correcting faults most cost effectively and in assisting clients to improve their software development process. Thus, the fault detection rate may not be smooth and can be changed at some time moment τ called change-point. Many researchers have incorporated change point in software reliability growth modeling. Firstly Zhao [28] incorporated change-point in software and hardware reliability. Huang et al. [7] used change-point in software reliability growth modeling with testing effort functions. The imperfect debugging with change-point has been introduced in software reliability growth modeling by Shyur [25]. Kapur et al. [9,14] introduced various testing effort functions and testing effort control with change-point in software reliability growth modeling. Goswami et al.[6] and Kapur et al.[15] proposed a software reliability growth model for errors of different severity using change-point. The multiple change-points in software reliability growth modeling for fielded software has been proposed by Kapur et al. [11]. Later on SRGM based on stochastic differential equations incorporating change-point concept has been proposed by Kapur et al. [10].

2. BASIC ASSUMPTION

The NHPP models are based on the assumption that the software system is subject to failures at random times caused by manifestation of remaining faults in the system. Hence NHPP are used to describe the failure phenomenon during the testing phase. The counting process $\{N(t), t \geq 0\}$ of an NHPP process is given as follows.

$$\Pr\{N(t) = k\} = \frac{(m(t))^k}{k!} e^{-m(t)}, \qquad k = 0,1,2... \tag{1}$$

and

$$m(t) = \int_0^t \lambda(x)\, dx \tag{2}$$

The intensity function $\lambda(x)$ (or the mean value function $m(t)$) is the basic building block of all the NHPP models existing in the software reliability engineering literature.

The proposed models are based upon the following basic assumptions:

1. Failure fault removal phenomenon is modeled by NHPP.
2. Software is subject to failures during execution caused by faults remaining in the software.
3. Failure rate is equally affected by all the faults remaining in the software.
4. When a software failure occurs, an instantaneous repair effort starts and the following may occur:
   (a) Fault content is reduced by one with probability p
   (b) Fault content remains unchanged with probability $1-p$.
5. During the fault removal process, whether the fault is removed successfully or not, new faults are generated with a constant probability α.
6. Fault detection / removal rate may change at any time moment.

Assumption 4 and 5 captures the effect of imperfect debugging and fault generation respectively.

3. MODEL DEVELOPMENT

In this section, we formulate distribution based software reliability growth models incorporating change-point and two types of imperfect debugging. Since the faults in the software

systems are detected and eliminated during the testing phase, the number of faults remaining in the software system gradually decreases as the testing procedure goes on. Thus under the common assumptions for software reliability growth modeling, we consider the following linear differential equation.

$$\frac{dm(t)}{dt} = b(t)\big(a - m(t)\big) \qquad (3)$$

Where b(t) is a fault detection rate per remaining faults at testing time t. Here we consider the fault detection rate as hazard rate z(t), initial fault is not the constant but the function of time and incorporating the imperfect debugging. So the above equation can be written as

$$\frac{dm(t)}{dt} = z(t)\,p\big(a(t) - m(t)\big)$$

We assume that faults can be introduced during the debugging phase with a constant fault introduction rate α. Therefore, the fault content rate function, *a(t)*, is a linear function of the expected number of faults detected by time *t.* That is $a(t) = a + \alpha m(t)$, above equation becomes

$$\frac{dm(t)}{dt} = z(t)\,p\big(a + \alpha m(t) - m(t)\big) \qquad (4)$$

In the proposed model we assume that the hazard rate $z(t) = \dfrac{f(t)}{1 - F(t)}$, the fault introduction rate α and probability of perfect debugging p, may be changed at some time moment τ called change point.

After incorporating change-point, we get the following form of fault detection /removal, probability of perfect debugging and fault generation rate.

$$z(t) = \begin{cases} \dfrac{f_1(t)}{1 - F_1(t)} & for\ t \le \tau \\ \dfrac{f_2(t)}{1 - F_2(t)} & for\ t > \tau \end{cases} \qquad (5)$$

Where F_1, f_1 and F_2, f_2 are the distributions, density functions before and after change point respectively.

The equation (5) can be rewritten as

Probability of perfect debugging rate will be

$$p = \begin{cases} p_1 & for\ t \le \tau \\ p_2 & for\ t > \tau \end{cases} \qquad (6)$$

and fault content rate

$$a(t) = \begin{cases} a + \alpha_1 m(t) & for\ t \le \tau \\ a + \alpha_1 m(\tau) + \alpha_2\big(m(t) - m(\tau)\big) & for\ t > \tau \end{cases} \qquad (7)$$

The Equation (5) can be rewritten as

$$z(t) = \frac{f_1(t)}{1 - F_1(t)} U(\tau - t) + \frac{f_2(t)}{1 - F_2(t)} U(t - \tau)$$

Using unit step function give by

$$U(x) = \begin{cases} 0 & if\ \ x < 0 \\ 1 & if\ \ x > 1 \end{cases}$$

Similarly equation (6) & (7) can also be rewritten as

$$p = p_1 U(\tau - t) + p_2 U(t - \tau)$$

$$\& \; a(t) = a + \alpha_1 m(t) U(\tau - t) + \big(a + \alpha_1 m(\tau) + \alpha_2\big(m(t) - m(\tau)\big)\big) U(t - \tau)$$

Now using equation (5), (6) and (7), the equation (4) can be rewritten as,

$$\frac{dm(t)}{dt} = \begin{cases} \dfrac{f_1(t)}{1 - F_1(t)} p_1\big(a + \alpha_1 m(t) - m(t)\big) & for\ t \le \tau \\ \dfrac{f_2(t)}{1 - F_2(t)} p_2\big(a + \alpha_1 m(\tau) + \alpha_2\big(m(t) - m(\tau)\big) - m(t)\big) & for\ t > \tau \end{cases} \qquad (8)$$

After solving the above equations, we get the following solutions

$$m(t) = \begin{cases} \dfrac{a}{(1-\alpha_1)}\Big[1 - \big(1 - F_1(t)\big)^{p_1(1-\alpha_1)}\Big] & for\ t \le \tau \\ \dfrac{a}{(1-\alpha_2)}\left[1 - \big(1 - F_1(\tau)\big)^{p_1(1-\alpha_1)}\left(\dfrac{\big(1 - F_2(t)\big)}{1 - F_2(\tau)}\right)^{p_2(1-\alpha_2)}\right] + \left(\dfrac{(\alpha_1 - \alpha_2)}{(1-\alpha_2)}\right) m(\tau) & for\ t > \tau \end{cases} \qquad (9)$$

SRGM-1

The following exponential distribution function is used to model SRGM-1:

Let T~ exp(b_1) $\quad for\ t \le \tau$

$$i.e \quad F_1(t) = 1 - e\exp\big(-b_1 t\big) \quad for \le \tau \qquad (10)$$

and

Let T~ exp(b_2) $\quad for\ t > \tau$

$$F_2(t) = 1 - \exp\big(-b_2 t\big) \ for\ t > \tau \qquad (11)$$

Substituting the value of $F_1(t)$ and $F_2(t)$ from Equation (10) and (11) into Equation (9), we get:

$$m(t) = \begin{cases} \dfrac{a}{(1-\alpha_1)}\Big[1 - \exp\big(-b_1 p_1 (1-\alpha_1) t\big)\Big] & for\ t \le \tau \\ \dfrac{a}{(1-\alpha_2)}\Big[1 - \exp\big(-b_1 p_1 (1-\alpha_1)\tau - b_2 p_2 (1-\alpha_2)(t-\tau)\big)\Big] & \\ \quad + \dfrac{(\alpha_1 - \alpha_2)}{(1-\alpha_2)} m(\tau) & for\ t > \tau \end{cases} \qquad (12)$$

The above model can be reduced to the model given by Shyur [25] if we consider the perfect debugging and no fault generation.

SRGM-2

Let *F(t)* be a two-stage Erlangian distribution function i.e. ,

T~ Erlang-2(b_1) $for\ t \le \tau$

$$i.e.\ F_1(t) = 1 - (1 + b_1 t)\exp(-b_1 t)\ for\ t \le \tau \quad (13)$$

And

T~ Erlang-2(b_2) $for\ t > \tau$

$$i.e.\ F_2(t) = 1 - (1 + b_2 t)\exp(-b_2 t)\ for\ t > \tau \quad (14)$$

Substituting the value of $F_1(t)$ and $F_2(t)$ from Equation (13) and (14) into Equation (9), we get:

$$m(t) = \begin{cases} \dfrac{a}{(1-\alpha_1)}\left[1 - \left((1+b_1 t)\exp(-b_1 t)\right)^{p_1(1-\alpha_1)}\right] & for\ t \le \tau \\ \dfrac{a}{(1-\alpha_2)}\left[1 - (1+b_1\tau)^{p_1(1-\alpha_1)}\left(\dfrac{(1+b_2 t)}{(1+b_2\tau)}\right)^{p_2(1-\alpha_2)} \exp\left(-b_1 p_1(1-\alpha_1)\tau - b_2 p_2(1-\alpha_2)(t-\tau)\right)\right] & \\ + \dfrac{(\alpha_1-\alpha_2)}{(1-\alpha_2)} m(\tau) & for\ t > \tau \end{cases} \quad (15)$$

The above model can be reduced to the model given by Archana [2] if we consider the perfect debugging and no fault generation.

SRGM-3

Let *F(t)* be a logistic distribution function i.e. ,

T~ logistic distribution (b_1, β_1) $for\ t \le \tau$

$$i.e.\ F_1(t) = \frac{\left(1 - \exp(-b_1 t)\right)}{\left(1 + \beta_1 \exp(-b_1 t)\right)}\ for\ t \le \tau \quad (16)$$

And

T~ logistic distribution (b_2, β_2) $for\ t \le \tau$

$$i.e.\ F_2(t) = \frac{\left(1 - \exp(-b_2 t)\right)}{\left(1 + \beta_2 \exp(-b_2 t)\right)}\ for\ t > \tau \quad (17)$$

Substituting the value of $F_1(t)$ and $F_2(t)$ from Equation (16) and (17) into Equation (9), we get:

$$m(t) = \begin{cases} \dfrac{a}{(1-\alpha_1)}\left[1 - \left(\dfrac{(1+\beta_1)}{(1+\beta_1\exp(-b_1 t))}\right)^{p_1(1-\alpha_1)} \exp\left(-b_1 p_1(1-\alpha_1)t\right)\right] & for\ \ 0 \le t \le \tau \\ \dfrac{a}{(1-\alpha_2)}\left[1 - \left(\dfrac{(1+\beta_1)}{(1+\beta_1\exp(-b_1\tau))}\right)^{p_1(1-\alpha_1)} \left(\dfrac{(1+\beta_2\exp(-b_2\tau))}{(1+\beta_2\exp(-b_2 t))}\right)^{p_2(1-\alpha_2)}\right. & \\ \left. * e\exp\left(-b_1 p_1(1-\alpha_1)\tau - b_2 p_2(1-\alpha_2)(t-\tau)\right)\right] & \\ + \dfrac{(\alpha_1-\alpha_2)}{(1-\alpha_2)} m(\tau) & for\ \ t > \tau \end{cases} \quad (18)$$

For further simplifying the estimation procedure we may assume $\alpha_1 = \alpha_2 = \alpha$ *and* $p_1 = p_2 = p$.

4. MODEL VALIDATION, COMPARISON CRITERIA AND DATA ANALYSES

Model Validation

To illustrate the estimation procedure and application of the SRGM (existing as well as proposed) we have carried out the data analysis of real software data set. The parameters of the models have been estimated using statistical package SPSS and the change-point of the data sets have been judged by using change-point analyzer.

Data set 1(DS-1)

The first data set (DS-1) had been collected during 35 months of testing a radar system of size 124 KLOC and 1301 faults were detected during testing. This data is cited from Brooks and Motley [4]. The change-point for this data set is 17th month.

Data set 2(DS-2)

The second data set (DS-2) had been collected during 19 weeks of testing a real time command and control system and 328 faults were detected during testing. This data is cited from Ohba [19]. The change-point for this data set is 6th week.

5. COMPARISON CRITERIA FOR SRGM

The performance of SRGM are judged by their ability to fit the past software fault data (goodness of fit) and predicting the future behavior of the fault.

Goodness of Fit criteria

The term goodness of fit is used in two different contexts. In one context, it denotes the question if a sample of data came from a population with a specific distribution. In another context, it denotes the question of "How good does a mathematical model (for example a linear regression model) fit to the data"?

The Mean Square -Error (MSE):

The model under comparison is used to simulate the fault data, the difference between the expected values, $\hat{m}(t_i)$ and the observed data y_i is measured by MSE as follows.

$$MSE = \sum_{i=1}^{k} \frac{(\hat{m}(t_i) - y_i)^2}{k} \quad (19)$$

where k is the number of observations. The lower MSE indicates less fitting error, thus better goodness of fit [17].

Coefficient of Multiple Determination (R2):

We define this coefficient as the ratio of the sum of squares resulting from the trend model to that from constant model subtracted from 1.

$$\text{i.e. } R^2 = 1 - \frac{\text{residual SS}}{\text{corrected SS}}.$$

R^2 measures the percentage of the total variation about the mean accounted for the fitted curve. It ranges in value from 0 to 1. Small values indicate that the model does not fit the data well. The larger R^2, the better the model explains the variation in the data [17].

Bias

The difference between the observation and prediction of number of failures at any instant of time i is known as PE_i(prediction error). The average of PEs is known as bias. Lower the value of Bias better is the goodness of fit [8].

Variation

The standard deviation of prediction error is known as variation.

$$Variation = \sqrt{\left(1/N-1\right)\sum\left(PE_i - Bias\right)^2}$$

Lower the value of Variation better is the goodness of fit [8].

Root Mean Square Prediction Error

It is a measure of closeness with which a model predicts the observation.

$$RMSPE = \sqrt{\left(Bias^2 + Variation^2\right)}$$

Lower the value of Root Mean Square Prediction Error better is the goodness of fit [8].

Data Analyses

For DS-1

The parameter estimation and comparison criteria results for DS-1 of all the models under consideration can be viewed through Table I(a) and I(b). It is clear from the table that the value of R^2 for SRGM-3 is higher and value of MSE is lower in comparison with other models and provides better goodness of fit for DS-1.

For DS-2

The parameter estimation and comparison criteria results for DS-2 of all the models under consideration can be viewed through Table II(a) and II(b) . It is clear from the table that the value of R^2 for SRGM-3 is higher and value of MSE is lower in comparison with other models and provides better goodness of fit for DS-2.

Models	a	b_1	b_2	β_1	β_2	p	α
SRGM-1	1686	.060	.072	-	-	.377	.515
SRGM-2	1650	.098	.101	-	-	.910	.001
SRGM-3	1335	.123	.243	2.03	26.9	.724	.001

Table I(a): Model Parameter Estimation Results (DS-1)

Models	R^2	MSE
SRGM-1	.974	5608.09
SRGM-2	.988	2544.43
SRGM-3	.999	207.4532

Table I(b): Model Comparison Results (DS-1)

Models	a	b_1	b_2	β_1	β_2	p	α
SRGM-1	388	.202	.222	-	-	319	.368
SRGM-2	467	.602	.562	-	-	.156	.001
SRGM-3	362	.352	.281	5	3	.567	.063

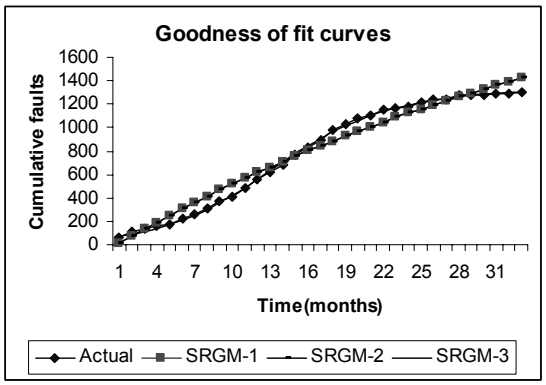
Table II(a): Model Parameter Estimation Results (DS-2)

Models	R^2	MSE
SRGM-1	.988	122.666
SRGM-2	.990	104.906
SRGM-3	.992	83.111

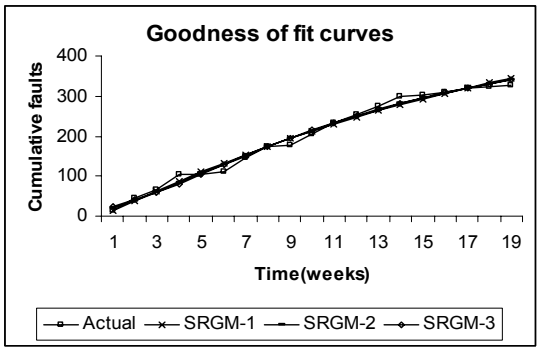
Table II(b): Model Comparison Results (DS-2)

6. GOODNESS OF FIT CURVES

For DS-1



For DS-2



7. CONCLUSION

In this paper we have developed a distribution based change-point problem with two types of imperfect debugging in software reliability. With this approach, we can derive existing models and propose new model. All these models have been validated and verified using real data sets. Parameter estimates, comparison results and goodness of fit curves have also been presented.

8. FUTURE SCOPE

In future, we will try to develop more models in the same line by using Erlang normal, weibull and gamma distribution functions. Models can be extended for multiple change-points problem..

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Evolution of Home Automation Technology

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Abstract - In modern society home and office automation has become increasingly important, providing ways to interconnect various home appliances. This interconnection results in faster transfer of information within home/offices leading to better home management and improved user experience. Home Automation, in essence, is a technology that integrates various electrical systems of a home to provide enhanced comfort and security. Users are granted convenient and complete control over all the electrical home appliances and they are relieved from the tasks that previously required manual control. This paper tracks the development of home automation technology over the last two decades. Various home automation technologies have been explained briefly, giving a chronological account of the evolution of one of the most talked about technologies of recent times.

Index Terms - Home Automation Network, Wireless Control, Internet based Control

1. INTRODUCTION

At the advent of 1990s the average house started to have interaction with many electronic devices. There were regular electric appliances such as refrigerator, electronic appliances such as television, communication appliances such as telephone, and information appliances, such as computer. The functioning of all these appliances required dedicated wiring system so a normal residential environment had various wiring systems including power wiring, telephone wiring, and cable TV wiring. Some homes also had additional wiring for home security and PC local area network etc. All these systems used different types of communication media and carried different types of signals completely independent of each other. At the same time due to great advancements in IC technology the computing costs experienced a sharp decline and miniaturization process gained momentum making dedicated microprocessor a common part of home appliances which resulted in enhanced intelligence level of home appliances.

But this intelligence had not been utilized to its true potential as these appliances operated in complete isolation from each other. Under this scenario the need of a unified "home network" was felt keeping in mind various advantages it will offer such as (i) ease of use convenience, as an appliance can be controlled from different locations (ii) sharing of information, and (iii) minimum wiring confusion and low cost [1].

The working principle of an automated home is explained in section 2 of the paper. Some of the early developments in the field of home automation technology are detailed in section 3. Section 4 is focused on the recent developments in home automation. As the home automation technology is growing there are serious concerns arising about it's security. Section 5 of the paper is dedicated to the work done for enhancing security of the automated home.

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2. WORKING OF AN AUTOMATED HOME

The key to control of appliances, in an automated home lies, in the ability of the products to communicate. The nature of these devices in a home network is very similar to that of other networks such as a computer network. Each switch or module has a unique "address". When a control signal is broadcast through the network, all of the modules in the network can hear the commands, but only those to which the signal is addressed will respond to it.

The majority of commands in conventional homes are passed on to the device in question through the use of a physically operated switch. Generally pressing a switch or turning a dial directly alters the supply of electricity to a device. The switch or knob opens or closes an electrical connection or varies the resistance of that connection. Fig.1 illustrates this using the example of a typical lighting circuit. The lamp in the circuit is linked to a separate switch that is able to interrupt the flow of electricity to the light fittings.

In an automated home the switch takes on a different function. Rather than regulating the flow of electricity, the switch merely sends a signal to a communication network, called a bus system, informing the network of the new position of the switch as shown in Fig. 2. A controller fitted to a single light fitting, or a number of light fittings, receives this signal, recognizes that the message is intended for it and responds, in this example by turning on the light. Therefore the regulation of electrical flow takes place at the controller rather than at the switch. If the bus system connects more than just lights, it is possible to radically change the way the home is controlled. The switch is no longer directly related to any particular device so it can operate any device on the network that has been told to respond to the signal from the switch [3]. So multiple lights, possibly in different rooms, could be controlled and even dimmed to different levels as illustrated in Fig. 3. In addition, it can also be seen from fig.3 that a single switch may be used to control various home appliances.

3. EARLY DEVELOPMENTS

Sensing the advantages associated with home automation network research and development projects started on a large scale around the world but the absence of a standard for the networking of home appliances appeared as the major roadblock which was removed in 1992 with the development of Consumer Electronic Bus or CEBus by the Electronic Industries Association of America [2].

The CEBus standard includes specifications for a layered network architecture based on the Open Systems Interconnection model, with network layer protocols for the Physical, Data link, Network, and Application layers. The main advantage of this standard is that the Physical Layer supports six different transmission media, namely twisted pair, coaxial cable, power line, infrared, radio frequency, and fiber optics. Thus the best physical medium for a given application can be selected. Cross & Douligeris [4, 5] proposed that fiber optics may be the best medium for home automation network because with fiber, the capabilities of the home automation system can be expanded to include many more functions, leading to complete home integration. They observed that although CEBus includes fiber optics as one of the physical media but it does not specify the configuration of the fiber optic network. Therefore they designed a fiber optics based home automation which offered various advantages such as (i) increased bandwidth, (ii) immunity to electromagnetic noise, (iii) ease of installation, and (iv) safety from electric shock hazards. As the designed network also had some drawbacks such as its higher cost and that optical fiber cannot carry direct current, so an alternate source of energy was required.

During early part of 1990s, the consumer electronics devices evolved into digital format, therefore the need was felt to interconnect these home appliances through digital links to preserve the fidelity of information transmitted. Chen [6] proposed a home automation network with the above stated purpose. Apart from digital link the main feature of the proposed home automation network was the Digital Aceess system which allowed the home network to communicate with the outside world also. Chen advocated the use of IEEE 1394 for the proposed network as it can handle both data and isochronous traffic well at a data rate above 100 Mbps.

Untill 1993, the home automation networks developed employed guided or wired media for interconnection of appliances. However Fujieda [7] felt that for achieving complete marketability, home networks should be easily installed not only to newly built houses but also to existing houses. So it would be desirable to build up networks without any extra wiring. Therefore he advocated the use of wireless media for home networking and called the network as wireless home networks. For the wireless home network he proposed the use of 400 MHz specified low power (SLP) band. Fujieda developed a low power and small size RF section of SLP band and communication protocol and demonstrated the proposed wireless network to be viable. Using the prototype he also implemented a couple of application systems, a maintenance system for instantaneous gas water heaters and a health promotion system with chronic disease prevention.

4. RECENT DEVELOPMENTS

Early generation appliances typically relied on a hard wired connection to a desktop computer in order to communicate with the outside world but during the past decade great advancements in Internet, Mobile telephony and TCP/IP technologies have resulted into many appliances having their own inbuilt communication transceivers; Infra Red, 802.11b, Bluetooth and GSM/GPRAS. Also development of new physical layer technologies has resulted into reliable transfer of data at a much faster rate. All these developments have changed the face of home automation technology also.

A critical analysis of some of the recent research and development efforts in the field of home automation is presented in this section.

In 2003 Hiroshi Kanma and others [8] observed that although the rapid spread of Internet at home may provide a convenient way of implementing a home network and its control, however there were certain hindrances to be removed to make home automation common such as (i) initial cost of introducing the home network system and the control terminal equipment, (ii) difficulty in simultaneously replacing all home appliances for networking , and (iii) the lack of mobility in the control terminal. To solve all these problems Kanma proposed the use of Bluetooth as communication medium and a cellular phone as the terminal equipment. A communication adapter was attached to the home appliances in order to provide a Bluetooth communication functionality which eliminated the need of purchasing new appliances for the home network. A simplified overview of the proposed network is shown in fig.4. In addition they postulated that the cellular phone will provide short start up time and its ability to access internet can provide certain other useful functionalities and services. Hardware and software for these adapters, Java applications running on the cellular phone and the interface software between the Java applications and the adapter were made for the prototype. Further developments in this direction have been done on various Bluetooth kits/boards produced by Man n Tel, Korea [9,10].

At the same time Tajika and others [11] articulated that the home network technology was focused primarily on how data and access protocols on the Internet can be utilized in the home network by converting them into in-house protocols through a home gateway. However they felt that apart from control only, other novel services can be provided to home through the Internet resulting in better user experience with out any enhanced complexity and without any loss of flexibility and portability. The system proposed by them composed of networked home appliances such as refrigerators, microwave ovens, air conditioners, and washing machines, Bluetooth access point and home terminal in a home. Bluetooth units were embedded within all the appliances and these wee connected to the Internet. Home terminal was connected to the home network and the Internet and it provided a well designed GUI to the user through touch panel and voice recognition and it also worked as a gateway between the home network and the Internet service provider. The overview of the proposed network is shown in fig.5. The authors developed some actual functions for each home appliance, such as cooking mode/timer settings for a microwave oven or monitoring stocks through a sensor in the refrigerator. ECHONET ver3, a specification for control/monitoring a function in home appliances was included in the system. It defines control/monitoring interface of

functions for white appliances, sensors and healthcare appliances.

In 2005 Hayong Oh and others [13], highlighted the importance of energy efficient routing scheme for the sensors placed in the home. According to the authors, in the emerging automated home, sensors are required to be placed everywhere in the house to collect various physical data such as temperature, humidity, and light to provide information to various appliances. For example, the heating system senses the temperature of the home and controls it according to the weather. The authors argued that in the conventional sensor routing scheme each sensor node detects an event and broadcasts the event to all sensor nodes within one hop range from where all the nodes broadcast the message to the next nodes. This process is recursively performed until the event reaches the base station. This scheme leads to excessive drain of battery power and as these sensor nodes have limited battery power, an energy efficient sensor routing scheme is critical for the successful implementation of home network. Therefore they proposed a new sensor routing scheme for home automation networks and called it as RDSR (Relative Direction based Sensor Routing). The proposed scheme divides the home area into sectors and locates a manager node to each sector. The manager node receives collected data from sensor devices in its sector and then transfers the data to the base station through the shortest path of the 2-dimensional (x, y) coordinates. The proposed scheme was shown to be energy efficient.

In 2006 Mario Kolberg and Evan H. Magill [14] addressed the control of complex networked appliances. Currently a standard computer interface is most often used to configure and remotely control these appliances. However the authors argued that this is unsuitable for the target audience which is often inexperienced with the use of computers. Therefore they proposed Anoto-enabled pen and paper as a suitable alternative as users are highly familiar with pen and paper and they will find it suitable for control. In the proposed system Bluetooth and mobile telecommunication network is used to transfer data to a service provider where it is processed and sent to the user's home. It was shown that the approach can be used to control a number of different appliances in the home and also outside the home.

5. SECURITY ISSUES

In 2003 H. Nakakita and others [12] addressed the problem of security of wireless home network. They observed that considering the advantages offered by Bluetooth as communication medium in wireless home networks, it is expected to be applied to all the home networks in near future. However they felt that its wide spread acceptance will result into multiple home networks placed close to one another and they will operate simultaneously in an overlapped area. In these circumstances, a wireless home network may encounter serious security problems like eavesdropping from outside the home or masquerading as a member of the network. The authors proposed several requirements for a secure home network such as (i) separation of communication between inside and outside of home network, (ii) prevention of eavesdropping from outside the network, (iii) an easy method of adding new wireless appliances to the network, (iv) a way of deregistering unused, stolen, or discarded appliances from the home network.

The authors proposed a system fulfilling the above security requirements. The proposed network was a server based system to manage the wireless home appliances through the use of existing frameworks with encryption function in the data link layer. The system assigned a unique master key to each appliance and some shared network keys. The shared network key was periodically updated in order to ensure the security of the home network.

6. CONCLUSIONS AND SCOPE FOR FURTHER WORK

The journey of home automation technology has been critically investigated in this paper. It is observed that from simple interconnection and combination of household appliances it has evolved into a powerful technology for the networking of home appliances for the purpose of not only remote control but also for adding intelligence to the home and providing novel services resulting in great improvement in user experience. Furthermore, the revolutionary developments in the fields of high speed computing devices along with TCP/IP based internet, wireless and mobile communication have really helped in the rapid growth of home automation. The use of these technologies in home automation and networking is definitely going to increase in the years to come. In Indian context, this field is still in an infancy stage and deserves to be pursued rigorously.

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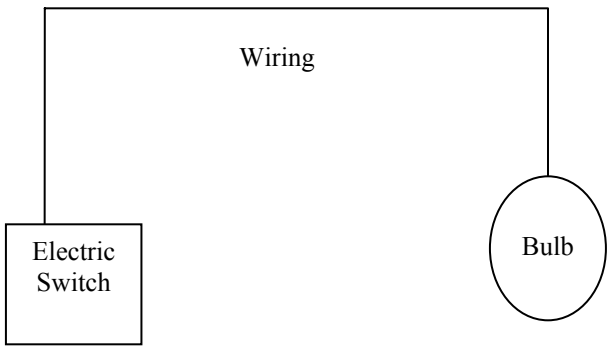

Figure 1: A Conventional Lighting Circuit

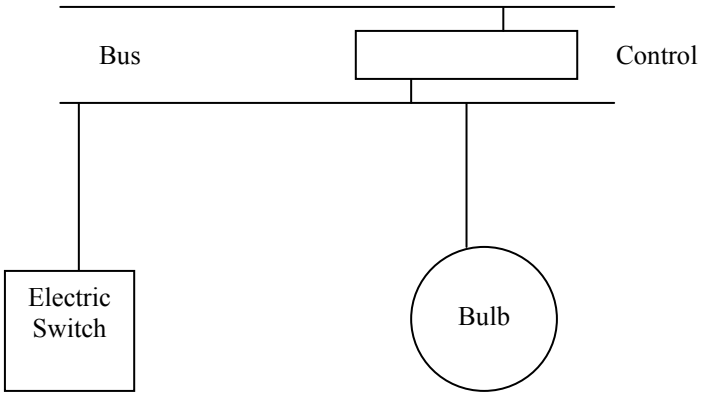

Figure 2: A Bus Controlled Lighting Circuit

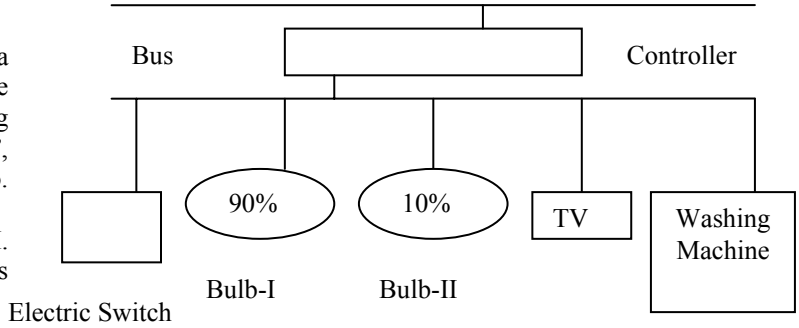

Figure 3: Bus System Controlling a Variety of Home Appliances

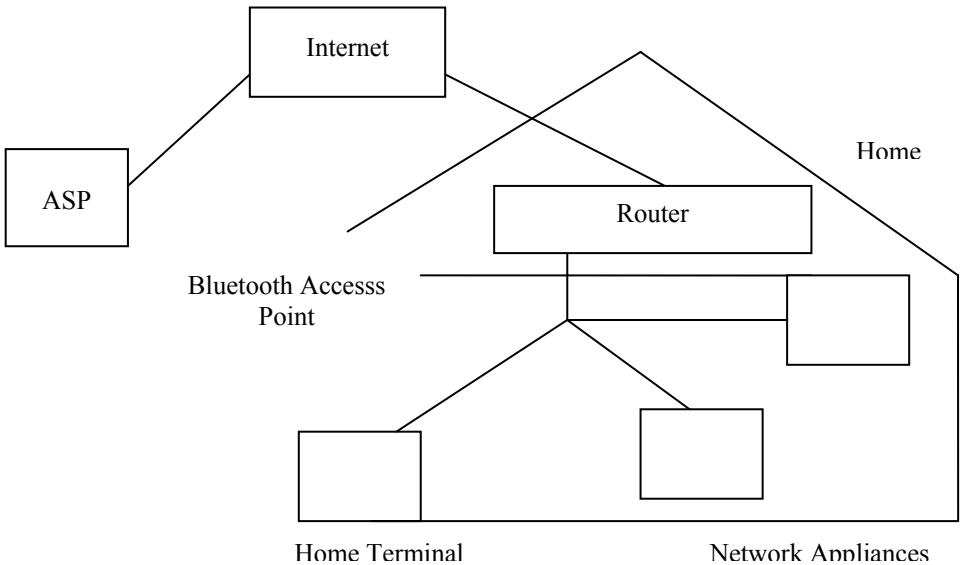

Figure 4: Overview of the Network

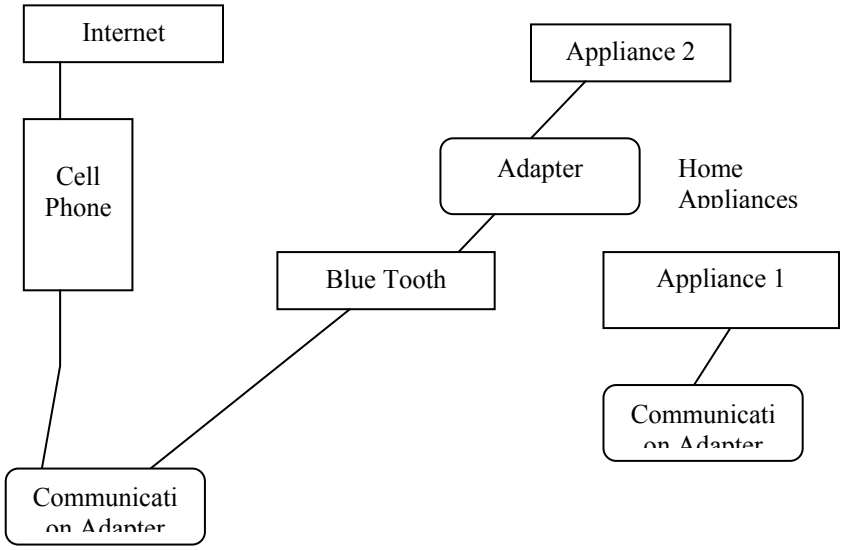

Figure 5: System Overview

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Digital Tampering Detection Techniques: A Review

Kusam[1], Pawanesh Abrol[2] and **Devanand[3]**

Abstract - ***In this era of digital computing, the interest and necessity of representing information in visual forms has become very important. Due to considerable improvement in computing and network technologies, and the availability of better bandwidths, the past few years have seen a considerable rise in the accessibility, sophistication, and transmission of digital images using imaging technologies like digital cameras, scanners, photo-editing, and software-packages. However, this technology is also being used for manipulating digital images and creating forgeries that are difficult to distinguish from authentic photographs. Tampering of images involves pasting one part of an image onto another one, skillfully manipulated to avoid any suspicion. Any image manipulation can become a forgery, based upon the context in which it is used. The sophisticated and low-cost tools of the digital age enable the creation and manipulation of digital images without leaving any perceptible traces. As a result, the authenticity of images can't be taken for granted, especially when it comes to legal photographic evidence. Manipulations on an image encompass processing operations such as scaling, rotation, brightness adjustment, blurring, contrast enhancement, etc. or any cascade combinations of them. Thus the problem of establishing image authenticity has become more complex with easy availability of digital images and free downloadable image editing softwares leading to diminishing trust in digital photographs. Detecting forgery in the digital images is one of the challenges of this exciting digital age. A lot of research is underway to detect and prevent forgery in digital images. One of the problems in web based image applications is non-availability of original image for evaluation. Further, digital imagery authentication techniques based on cryptographic principles and digital signatures offer no modification protection following image transmission. In this paper, we study the major approaches to detect forgery in digital images. Initially, the process of digital image tampering is explained. Subsequently, we analyze some of recent algorithms for detecting digital forgery including copy-move, chromatic aberration, PCA for detecting duplicated image, lighting inconsistencies. Preliminary investigations show that different algorithms have different domains of tampering detection and have different merits and demerits. The decision about the content authenticity is complex and can b better established by interpreting the results obtained by applying a set of these methods.***

Index Terms - Digital Image, Digital Forgery, Digital Tampering.

1. INTRODUCTION

An image is a two-dimensional function, f(x,y), where x and y are spatial (plane) coordinates and the value of f(x,y) at any pair of coordinates (x,y) is called the intensity or gray level of the image at that point. An image contains a lot of information and can be monochromatic or colored. When the digital technology is used to capture, store, modify, or view images, they must be first converted into numbers: 1s and 0s called bits. A combination of eight bits is called a byte. A digital image is composed of a finite number of elements which are referred to as pixels. A pixel is a basic unit of a colored or monochromatic image on a computer display or in a computer generated image. A common color image file of size 1024 X 1024 pixels and 256 colors (or 8 bits per pixel) occupies 3MB of disk or RAM space. Since a colored image contains more information (coloring details), so its file size is comparatively much larger than that of monochrome. Digital images are typically stored in either 24-bit or 8-bit files. Color variations for the pixels are derived from three primary colors: red, green, and blue. Each primary color is represented by 1 byte; 24-bit images use 3 bytes per pixel to represent a color value. These 3 bytes can be represented as hexadecimal, decimal, and binary values [3].

In contrast to analog signal processing in which the image signal is treated as a continuous signal, digital image processing has many advantages. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Digital image formation, the foremost step in any digital image processing application, consists basically of an optical system, a sensor and a digitizer. The optical signal is usually transformed to an electrical signal by using a sensing device (e.g. a Charge Coupled Device sensor). The analog signal is transformed to a digital one by using a video digitizer (frame grabber). Thus, the optical image is transformed to a digital one. Due to inherent limitations of the processing systems, each digital image formation subsystem may introduce a deformation or degradation to the digital image (e.g. geometrical distortion, noise, non-linear transformation etc.). The mathematical modeling of the digital image formation system is very important in order to have precise knowledge of the degradations introduced. After conversion of the image to binary data stream, it is put back together in a grid of small squares. These tiny squares also called sample space are the pixels, and are the building blocks of all the computer graphics and images. The values in the pixels indicate the intensity level associated with that pixel.

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There has been wide availability of the different powerful image processing and editing software with help of which the digital images can be easily manipulated. Many of these software are freely available and often do not require any special skills to operate. A digital image can be enlarged, enhanced, backgrounds, color contrasts and color schemes can be altered, even facial features can be changed to some other person's appearance. Images can be converted from one image format to another and any part of image can be altered pixel by pixel. Before the digital age, it was fairly easy to detect the altered photographs. But now with the advent in the commercial softwares, the tampering of the photographs have become very easy, can be carried out without any obvious signs of tampering and it is becoming harder to uncover and spot the authentic ones. With the increased reliance on digital images for information, the need to ensure their authenticity increases as well. Research in the field of image authenticity is still in its infancy state. +Recently, research on digital image forensics has gained attention by addressing forgery detection and image source identification. Both static images as well as video can be manipulated. However, in the current paper, we have discussed the digital forgeries related to static digital images only.

Any image manipulation can become a forgery, based upon the context in which it is used. An image altered for fun or someone who has taken a bad photo, but has been altered to improve its appearance cannot be considered a forgery even though it has been altered from its original capture. On the other side, some people creates a forgery for gain and prestige and to make the recipient believe that the image is real and not the fake one. Three types of forgeries can be identified:

a) Using Graphical Software is one method in which a forged image can be created. It especially needs a skilful creator who can ensure that the image he is creating is realistic, e.g. that the fall of light on objects in an image is consistent right across the image, that shading is consistent, the absorption of light by an object etc. An image created using this method takes some time to develop.
b) Creating an image by altering its Content is another method. In this, the recipient is duped to believe that the objects in an image are something else from what they really are. The image itself is not altered, and if examined will be proven as so.

Creating an image by altering its Context is the third method. In this, objects are removed or added from an image resulting in copy-move forgeries. E.g. a person can be added or removed. The easiest way is to cut an object from one image and insert it into another image. Various image / photo editing softwares like Adobe Photoshop, XnView, ProShow Gold etc. make this a simple task [6].

An example of a digital forgery is shown in Figure 1. As the newspaper cutout shows, three different photographs were used in creating the composite image: Image of the White House, Bill Clinton, and Saddam Hussein. The White House was rescaled and blurred to create an illusion of an out-of-focus background. Then, Bill Clinton and Saddam were cut off from two different images and pasted on the White House image. Care was taken to bring in the speaker stands with microphones while preserving the correct shadows and lighting. Figure 1 is, in fact, an example of a very realistic looking forgery [7].


INTERNET

Spies turn to high-tech info ops

PCs, Internet used for manipulating images, public opinion

BY DANIEL VERTON

ALTERED IMAGE

Federal intelligence agencies are studying ways to use computers and the Internet, rather than just leaflets and radio broadcasts, to shape and disseminate information designed to sway public opinion in the world's hot spots.

As part of its so-called "perception management" program, the intelligence community has for decades created misinformation to trigger political change without direct political or military involvement in countries where the United States has vested interests, such as Iraq and North Korea.

Acting on congressional recommendations to bolster research and development in information technology, intelligence agencies are turning to PCs to develop more sophisticated means of manipulating and delivering digital photos, video clips and recorded sound to portray fictitious events in hopes of provoking desirable outcomes.

1 2 3

Altered Egos

The top photo, of a fictitious meeting between President Clinton and Saddam Hussein, was generated by digitally altering and combining elements from three photos, shown below the altered image. Intelligence agencies plan to use similar techniques to create images and then disseminate them via the Internet in their efforts to influence events in foreign countries, such as Iraq.

Figure 1:Example of a Digital Image Forgery

With this increased reliance on digital images for information, the need to ensure their authenticity increases as well. The manipulation of images through forgery influences the perception an observer has of the depicted scene, potentially resulting in ill consequences if created with malicious intentions. This poses a need to verify the authenticity of images originating from unknown sources in absence of any prior digital watermarking or authentication technique. Authentication of digital images plays an important role in forensic investigation, criminal investigation, insurance processing, surveillance systems, intelligence services and journalism.

There have been quite a few techniques proposed in combating the tampering of digital images. The digital camera computes a cryptographic hash of the image, and encrypts the hash using the private component of the key, which is built into the camera. The encrypted hash is then stored along with the digital image. Another complementary approach is to use digital time-stamping / digital signatures. These schemes effectively protect the data from modification during transmission, but they offer no protection following transmission. Since the information needed for these schemes to perform the authentication is separate from the data. An attacker can simply modify the data, recalculate the new message digest or digital signature, and attach them together.

Without knowledge of the original data or of the original authentication information, it is impossible to contest the authenticity of the modified digital image. Since the value of digital images is based on its content, the image bits can be modified to embed codes without changing the meaning of its content. Once the codes are embedded in the data content and the data is manipulated, these codes will also be modified so the authenticator can examine them to verify the integrity of the data. [8]

The widely used approach to verify an image's authenticity is to embed checksums into the least significant bits (LSB) of the image. A secret numeric key known by both the sender and the recipient protects these checksums. Another cost effective way to authenticate picture is through the use of metadata, although the information gathered from Metadata cannot stand on its own, as metadata is not strictly bound to a file, but it can provide useful information if it is used in the proper context.

The process of detecting image tampering is supposed to be carried out in six stages. The first five stages correspond to major theoretical goals of the process, the last one is related to real-life applications, a) blind method for resampling detection, b) blind method for duplicated regions detection, c) detection of discrepancies in lighting conditions and brightness levels, d) automatic method for detection of double JPEG compression, e) detection of inconsistent noise patterns, f) system integration and testing. Overall, these methods proved encouraging in detecting image forgeries with an observed accuracy of 60%.

Also, Digital watermarks have been proposed as a means for fragile authentication, content authentication, detection of tampering, localization of changes and recovery of original content. While digital watermarks can provide useful image before the tampering occurs. This limits their application to controlled environments that include military systems or surveillance cameras. Unless all digital acquisition devices are equipped with a watermarking chip, it will be unlikely that a forgery-in the-wild will be detectable using a watermark. It might be possible, but very difficult, to use unintentional camera "fingerprints" related to sensor noise, its colour gamut, and / or its dynamic range to discover tampered areas in images. Another possibility for blind forgery detection is to classify textures that occur in natural images using statistical measures and find discrepancies in those statistics between different portions of the image. At this point, however, it appears that such approaches will produce a large number of missed detection as well as false positives.

In this research work we have studied the techniques and methods of Digital Image Forgery Prevention and Detection Mechanisms. Also, we have reviewed the forgery detection method using Block Matching techniques of Copy-move algorithm [7, 11]. In the next section, we discuss some of the algorithms which have been presented by different researchers for detection of digital image tampering. Under Results & Discussion, we investigate and comparatively analyze some of the algorithms on the basis of the merits, demerits, input, output and space & time complexity. We present the conclusion and the future directions in which we are working.

2. LITERATURE REVIEW

The sophisticated and low-cost tools of the digital age enable the creation and manipulation of digital images without leaving any perceptible traces. As a result, the authenticity of images can't be taken for granted, especially when it comes to legal photographic evidence. Manipulations on an image encompass processing operations such as scaling, rotation, brightness adjustment, blurring, contrast enhancement, etc. or any cascade combinations of them. Doctoring images also involves the pasting one part of an image onto another one, skillfully manipulated so to avoid any suspicion. One effective tool for providing image authenticity and source information is digital watermarking.

These digital watermarks also offer forgery detection. Several watermarking techniques have been proposed. One uses a checksum on the image data which is embedded in the least significant bits of certain pixels. Others add a maximal length linear shift register sequence to the pixel data and identify the watermark by computing the spatial cross-correlation function of the sequence and the watermarked image. Watermarks can be image dependent, using independent visual channels, or generated by modulating JPEG coefficients. These watermarks are designed to be invisible, or to blend in with natural camera or scanner noise. Visible watermarks also exist. In addition to these, a visually undetectable, robust watermarking scheme has come into existence which can detect the change of a single pixel and can locate where the changes occur. The algorithms work for color images and can accommodate JPEG compression [9].

The embedding of a watermark during the creation of the digital object limits it to applications where the digital object generation mechanisms have built-in watermarking capabilities. Therefore, in the absence of widespread adoption of digital watermarking technology, it is necessary to resort to image forensic techniques. Image forensics can reconstitute the set of processing operations to which the image has been subjected. In turn, these techniques not only enable us to make statements about the origin and authenticity of digital images, but also may give clues as to the nature of the manipulations that have been performed.

One such image forensic scheme is based on the interplay between feature fusion and decision fusion in which three categories of features are considered, namely, the binary similarity measures between the bit planes, the image quality metrics applied to denoised image residuals, and the statistical features obtained from the wavelet decomposition of an image. These forensic features were tested against the background of single manipulations and multiple manipulations, as would actually occur in doctoring images [10].

The availability of powerful digital image processing softwares, such as PhotoShop, XnView, ProShow Gold, makes it relatively easy to create digital forgeries from one or multiple images. Over the past few years the field of digital forensics has emerged to detect various forms of tampering. A common manipulation in tampering with an image is to copy and paste portions of the image to conceal a person or object in the scene.

Another possibility for blind forgery detection is to classify textures that occur in natural images using statistical measures and find discrepancies in those statistics between different portions of the image. At this point, however, it appears that such approaches will produce a large number of missed detections as well as false positives [7].

Another efficient technique which can automatically detect and localize duplicated regions in an image, works by first applying a Principal Component Analysis (PCA) on small fixed-size image blocks to yield a reduced dimension representation. This representation is robust to minor variations in the image due to additive noise or lossy compression. Duplicated regions are then detected by lexicographically sorting all of the image blocks [11]. This technique is effective on plausible forgeries, and has quantified its sensitivity to JPEG lossy compression and additive noise. The detection is possible even in the presence of significant amounts of corrupting noise.

Building specifically on this work, and more broadly on all of these forensic tools, a new lighting-based digital forensic technique came into existence. While creating a digital composite of two or more people, it is often difficult to match the lighting conditions under which each person was originally photographed and the lighting effects due to directional lighting (e.g., the sun on a clear day). At least one reason for this is that such a manipulation may require the creation or removal of shadows and lighting gradients. To the extent that the direction of the light source can be estimated for different objects / people in an image, lighting inconsistencies can therefore be a useful tool for revealing traces of digital tampering [12].

Also, a newly developed forensic tool came into existence that exploits imperfections in a camera's optical system. When creating a digital forgery, it is sometimes necessary to conceal a part of an image with another part of the image or to move an object from one part of an image to another part of an image. These types of manipulations will lead to inconsistencies in the lateral chromatic aberrations, which can therefore be used as evidence of tampering [13]. This current approach only considers lateral chromatic aberrations. The efficacy of this approach is seen in detecting tampering in synthetic and real images.

As usual, all of these techniques will be vulnerable (weak / defenseless) to countermeasures that can hide traces of tampering. This technique, in conjunction with a growing body of other forensic tools, is effective in exposing digital forgeries.

3. BRIEF MATHEMATICAL REVIEW

The pre-requisite of forgery detection using copy-move algorithm includes – completion of the match process in finite and reasonable time and allowing an approximate match of small image segments. Since any digital image can be considered as an array M x N of pixels with certain associated intensities, any tampering of type copy-move can introduce a correlation between the original image and the pasted one. This correlation can be used to detect the tampering. Primarily there are two approaches used to find the approximate block matching:

1. Exhaustive Search
2. Autocorrelation

Exhaustive Search: In this method, the image and its circularly shifted version are overlaid looking for closely matching image segments. Let us assume that x_{ij} is the pixel value of a grayscale image of size M x N at the position i,j. In the exhaustive search, the following differences are examined:

$| x_{ij} - x_{i+k} \bmod(M)\ j+l \bmod(N) |$, k = 0, 1, …, N-1 for all i and j.

It is easy to see that comparing x_{ij} with its cyclical shift [k, l] is the same as comparing x_{ij} with its cyclical shift [k', l'], where k'=M-k and l'=N-l. Thus, it suffices to inspect only those shifts [k, l] with $l \leq k \leq M/2$, $1 \leq l \leq N/2$, thus cutting the computational complexity by a factor of 4.

Finding the correct threshold value 't' is challenging because even in natural images there may be a large amount of pixel pairs that may produce the differences below the threshold. However, this threshold difference Δx_{ij} can be considered to set the proper threshold value based on the requirements, complexity and results.

The comparison and image processing require the order of MN operations for one shift. Thus, the total computational requirements are proportional to $(MN)^2$.

Autocorrelation: This technique is based on the fact that the original and copied segments will introduce peaks in autocorrelation corresponding to the segments which have been copied and moved. However, the computation of autocorrelation factor after passing the given through High-Pass filter provides better results.

The autocorrelation of the image x of the size M x N is defined by the formula:

$$r_{k,l} = \sum_{i=1}^{M} \sum_{j=1}^{N} x_{i,j}\, x_{i+k,\, j+1},\ i, k = 0, \ldots, M-1,\ j, l = 0, \ldots, N-1.$$

The autocorrelation can be efficiently implemented using the Fourier transform utilizing the fact that $r = x * x'$, where $x_{ij}' = x_{M+1-i,\, N+1-j}$, i = 0… M-1, j = 0… N-1. Thus we have

$r = F^{-1}\{F(x)\, F(x')\}$, where F denotes the Fourier transform.

The working of autocorrelation copy-move forgery detection method is explained in the flowchart below:

that matches exactly two types of methods can be done using following matching techniques.

In case of Block-matching, a minimum segment size is specified this is then considered for the match. To identify the identical rows of the given matrix 'A' are lexicographically ordered. The matching rows are then searched by going through all m x n rows of ordered matrix 'A' and looking for two consecutive rows that are identical.

The blocks form an irregular pattern that closely matches the copied-and-moved foliage. This method also indicates the use of retouch tool on the pasted segment to cover the traces of the forgery.In the Robust match technique, the quantized DCT coefficients are calculated and 'Q' factor is computed that determines the quantization steps for DCT transform coefficients. Since, quantized values of DCT coefficients for each block are compared; the algorithm might find too many matching block pairs.

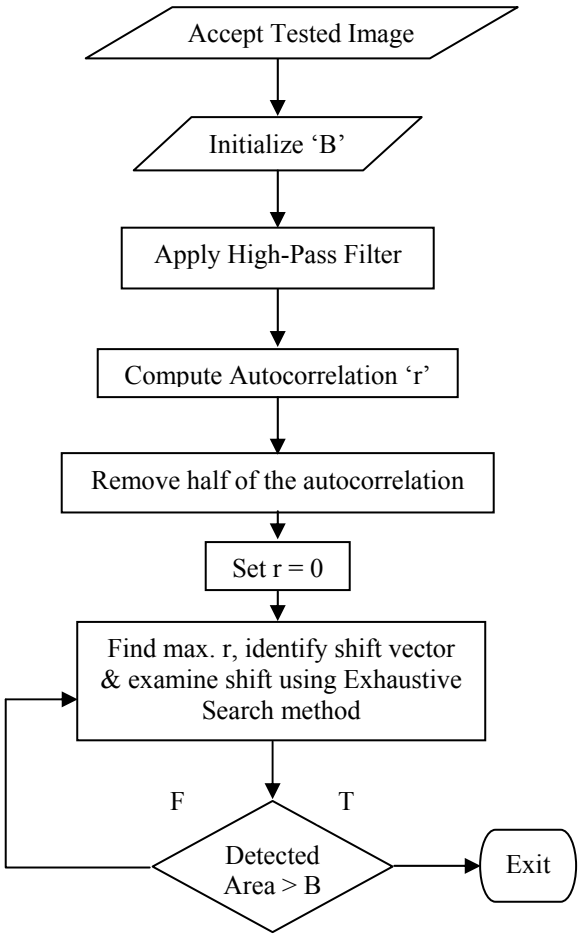

Figure. 2. Flowchart depicting the working of autocorrelation copy-move forgery detection method.

Note: B – Minimal size of a copied-moved segment.
r – Autocorrelation.

This matching can be reduced by computing shift vector 's' between two matching blocks as given below:
$s = (s_1, s_2) = (i_1\text{-}j_1, i_2\text{-}j_2)$.
Because the shift vectors –s and s correspond to the same shift, the shift vectors s are normalized, if necessary, by multiplying by -1 so that $s_1 \geq 0$.
The Exhaustive search is quite simple and effective and is a most obvious approach whereas the Exact match approach works significantly much better and faster than other approaches. Also, Exhaustive search technique used in detecting copy-move forgery is quite computationally expensive. Moreover, the computational complexity of the exhaustive search makes it impractical for practical use even for medium-sized images.

4. RESULTS AND DISCUSSION

The practice of forging photographs is probably as old as the art of photography itself. Digital photography and powerful image editing softwares like Adobe Photoshop, Xnview, ProShow Gold, made it very easy today to create believable forgeries of digital pictures even for a non-specialist. As digital photography continues to replace its analog counterpart, the need for reliable detection of digitally doctored images is quickly increasing. Recently, several different methods for detecting digital forgeries were proposed. Jessica Fridrich, David Soukal and Jan Lukáš proposed a method based on detection of Copy-Move Forgery in digital images. Also, Alin C Popescu and Hany Farid established a method for exposing digital forgeries by detecting Duplicated Image Regions. Micah K. Johnson and Hany Farid proposed several methods for exposing digital forgeries such as Detecting Inconsistencies in Lighting and detecting inconsistencies through Chromatic Aberration. For each of these methods, there are circumstances when they will fail to detect a forgery. The copy-move detection method is an efficient and reliable detection method which focuses on a special type of digital forgery – the copy-move attacks in which a part of the image is copied and pasted somewhere else in the image with the intent to cover an important image feature. The method may successfully detect the forged part even when the copied area is enhanced / retouched to merge it with the background and when the forged image is saved in a lossy format, such as JPEG. This method supports two algorithms for detecting Copy-Move forgery, one that uses an exact match for detection and other that is based on an approximate match. The two approaches introduced by the approximate match algorithm are Exhaustive Search and Autocorrelation whereas two other approaches introduced are Exact match algorithm and Robust match algorithm. The Exhaustive search is quite simple and effective and is a most obvious approach whereas the Exact match approach works significantly much better and faster than other approaches. This method of detection is limited to one particular case of forgeries, when a certain part of the image was copied and pasted somewhere else in the same image (e.g., to cover an object). It is very difficult to use unintentional cameras "fingerprints" related to sensor noise, its color gamut, and / or its dynamic range to discover tampered areas in images. Also, Exhaustive search technique used in detecting copy-move forgery is quite computationally expensive. Moreover, the computational complexity of the exhaustive search makes it impractical for practical use even for medium-sized images. The next method for detecting duplicated regions in an image works by first applying a Principal Component Analysis (PCA) on small fixed-size image blocks to yield a reduced dimension representation that is robust to minor variations in the image due to additive noise or lossy compression. Duplicated regions are then detected by lexicographically sorting all of the image blocks. This technique is efficient on plausible / credible digital forgeries and quantifies its robustness and sensitivity to additive noise and lossy JPEG compression. It is such an

efficient technique that automatically detects duplicated regions in a digital image. The detection of duplicated image regions are still possible even in the presence of significant amounts of corrupting noise. This technique works in the complete absence of digital watermarks or signatures offering a complementary approach for image authentication. This representation is robust to minor variations in the image due to additive noise or lossy compression. But still, little doubt is there that counter-measures will be created to foil this technique. The method for exposing digital forgeries by Detecting Inconsistencies in Lighting, for instance, can be a useful / wonderful tool for revealing traces of digital tampering while creating a digital composite of two or more people standing side by side. It is often difficult to exactly match the lighting conditions / effects from the individual photographs due to directional lighting (e.g. the sun on a clear day, floor lamp, single directional light source with controlled lab settings).

This method is efficient in estimating the direction of a point light source from only a single image using various forensic tools adopted from computer vision (field / world). The standard approaches used here for estimating the light source direction / illuminant's direction includes: Infinite Light Source (3-D), Infinite light Source (2-D), Local Light Source (2-D) and Multiple Light Sources. Also, it can be extended to accommodate a local directional light source e.g. a desk lamp, floor lamp. Moreover, it is applicable and effective on both synthetically generated images and natural photographs.

The various loop holes / flaws of this method includes that this solution requires the knowledge of 3-D and 2-D surface normals from at least four and three distinct points respectively on a surface with the same reflectance. With only a single image and no objects of known geometry in the scene, it is unlikely that this will be possible. Manipulations in images in this technique may require the creation or removal of shadows and lighting gradients. Also, this method assumes nearly Lambertian surface for both the forged and original areas and might not work when the object does not have a compatible surface, when pictures of both the original and forged objects were taken under approximately similar lighting conditions. This system also may not work during a cloudy day when no directional light source was present. The Chromatic aberration method is used for automatically estimating lateral chromatic aberration and shows its efficacy in detecting digital tampering. Lateral Chromatic aberration manifests itself, to a first order approximation, as an expansion / contraction of color channels with respect to one another. When tampering with an image, this aberration is often disturbed and fails to be consistent across the image. This approach is effective when the manipulated region is relatively small, allowing for a reliable global estimate. It is efficient for detecting digital tampering in synthetic and real images and can be used to detect tampering in visually plausible forgeries.

This model fails to estimate Longitudinal Chromatic aberrations and other forms of optical distortions. It also fails when the manipulated region is relatively very large. For synthetic images, the average error is 3.4 degrees with 93% of the errors less than 10 degrees. For calibrated / real images, the average error is 20.3 degrees with 96.6% of the errors less than 60 degrees. Thus, the average errors for real images are approximately six times larger than the synthetically generated images. Much of these errors are due to longitudinal chromatic aberrations. Obviously, the problem of detection of digital forgeries is a complex one with no universally applicable solution. Thus, a set of different tools can be all applied to the image at hand. The decision about the content authenticity is then reached by interpreting the results obtained from different approaches. This accumulative evidence may provide a convincing enough argument that each individual method cannot. So in future, all these techniques in conjunction with a growing body of other forensic tools, is effective in exposing digital forgeries. The Comparative analysis of the selected above mentioned algorithms on the basis of the various merits-demerits, domain, types of input-output etc. has been presented in the form of table, Table 1.

5. CONCLUSION

Techniques and methodologies for validating the authenticity of digital images and testing for the presence of tampering and manipulation operations on them have recently attracted attention. Detecting forgery in the digital images is one of the challenges of this exciting digital age. The sophisticated and low-cost tools of the digital age enable the creation and manipulation of digital images without leaving any perceptible traces. As a result, the authenticity of images can't be taken for granted, especially when it comes to legal photographic evidence. Thus, the problem of establishing image authenticity has become more complex with easy availability of digital images and free downloadable image editing softwares leading to diminishing trust in digital photographs. Another common manipulation in tampering with portions of the image is "copy-move". Spotting digital fakes by detecting inconsistencies in lighting is another method. Primarily, in this paper we have reviewed two approaches the Exhaustive Search and the Autocorrelation which are used to find the approximate block matching. Robust search method reduces the number of searches where as exact match search is exhaustive and requires more memory and time. Therefore, robust technique is better in case of time dependent interactive searches.

FUTURE SCOPE

We have been further working on the field of Digital Image Tampering in the following areas:

1. Analyzing other recent algorithms related to forgery detection methods like Digital Watermarking, Inconsistencies in the Complex Lighting Environments, Color Filter Array Interpolation, Re-sampling etc.
2. Video Forgery Detection Methods.

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Table 1: Comparison of different Digital Image Forgery Detection Tools / Techniques / Algorithms				
Digital Image Forensic Tools / Techniques / Algorithms	**Works for**	**Domain**	**Merits**	**Demerits**
1. Detecting Lighting Inconsistencies	Effective on both synthetically generated images and natural photographs. Manipulations in images in this technique may require the creation or removal of shadows and lighting gradients.	Efficiently work for Infinite Light Source (3-D), Infinite light Source (2-D), Local Light Source (2-D) and Multiple Light Sources.	This method assumes nearly Lambertian surface for both the forged and original areas and might not work when the object does not have a compatible surface, when pictures of both the original and forged objects were taken under approximately similar lighting conditions.	This system also may not work during a cloudy day when no directional light source is present.
2. Detecting Inconsistencies through Lateral Chromatic Aberrations	Efficient on detecting tampering in visually plausible forgeries.	This approach for detecting tampering is effective when the manipulated region is relatively small.	This approach is efficient for detecting digital tampering in synthetic and real images.	This model fails to estimate Longitudinal Chromatic aberrations and other forms of optical distortions. This approach also fails when the manipulated region is relatively very large.
3. Detection by Classification of Textures in Copy-Move Forgery	Effective on both synthetic and real images.	This method is limited to one particular case of forgeries, when a certain part of the image was copied and pasted somewhere else in the same image (e.g. to cover an object).	Efficient for detecting forgery in small copy areas.	It is very difficult to discover tampered areas in images. Also, Exhaustive search technique used in detecting copy-move forgery is quite computationally expensive.
4. Principal Component Analysis (PCA) in Duplicated Image Regions	Efficient on plausible / credible digital forgeries	An efficient technique that automatically detects duplicated regions in a digital image.	Good for minor variations due to additive noise and lossy compression.	May fail to detect considerable large changes. Little doubt is there that counter-measures will be created to foil this technique

Resource Optimization Using XML

Gaurav Kumar[1] and **Anu Suneja**[2]

Abstract - Extensible Markup Language [XML] database is one of the hot areas of research now days. Number of developers and research organizations are working on the capabilities and efficiency of using Extensible Markup Language [XML] database because of its unique structure and processing speed. In any web based database search, there is need of a server side script as well as back-end RDBMS [Relational Database Management System]. Generally SQL [Structured Query Language] is used for querying the database. Moreover, the web hosting cost is also very high in various plans using these technologies. XML has an exceptional feature to be used as a database as well as a document. XML document is generally formatted using CSS [Cascading Style Sheets] or XSL [Extensible Stylesheet Language.

In this research work, we have compared the capability and efficiency of XML as a database rather than a simple web document. This work is dedicated to the competence of PHP [Hypertext Preprocessor] and XML over PHP and MYSQL. In our results, we have proved that XML is giving good results rather than MYSQL.

Index Terms – Optimization, XML, Web Development, Database.

1. INTRODUCTION

In any web based database search, there is need of a server side script as well as back-end RDBMS [Relational Database Management System]. Generally SQL [Structured Query Language] is used for querying the database. Moreover, the web hosting cost is also very high in various plans using these technologies**.** XML has an exceptional feature to be used as a database as well as a document [1]. XML document is generally formatted using CSS [Cascading Style Sheets or XSL [Extensible Stylesheet Language] [2].

2. EXISTING THEORY

The problem in the existing architecture is the platform dependence of various scripts and languages. The hosting of Windows Platform support Microsoft products and obviously costlier than the other hosting plans [3]. Servers which host the website require operating systems and licenses. Windows 2003 and other related applications like SQL Server each cost a significant amount of money; on the other hand, Linux is a free operating system to download, install and operate.

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The basic ideas underlying XML are very simple: tags on data elements identify the meaning of the data, rather than, e.g., specifying how the data should be formatted [as in HTML], and relationships between data elements are provided via simple nesting and references [4].

To host the website on Windows Server platform, there is restriction that we can use ASP [Active Server Pages] for database maintenance. At the back-end, there is restriction to use MS-ACCESS or SQL SERVER as RDBMS.

On other side, Linux hosting uses PHP or CGI [Common Gateway Interface]/PERL [Project Extraction and Report Language] with MYSQL as back-end database. ColdFusion and JSP do not fit in these categories of hosting. Java Server Pages [JSP] is a Java technology that allows the software developers to create dynamically web applications, with HTML, XML, or other document types. JSP needs the web server compatible with Java Technology and the commonly used Web Servers are JRun and Apache Tomcat. On the other hand, ColdFusion is a software language that is also used for Internet application development such as for dynamically-generated web sites. ColdFusion is a similar Active Server Pages, JavaServer Pages or PHP but it is platform independent.

More specifically, Microsoft based technologies require additional tools including Antivirus utilities for security which is more costly to host in international web hosting servers [5].

Table 1 depicts the platform dependence of various scripts and respective back-end databases.

Server Side Script [HTTP Web Server required]	**Back End Database**
ASP [PWS, IIS]	MS Access, SQL Server
JSP [JRun, WebSphere, WebLogic, Apache Tomcat, JBoss, JWS]	MS Access, SQL Server, Oracle
PHP [Abyss, Apache http server]	MS Access, MySQL, SQL Server, Oracle
CGI with PERL [Abyss, Apache http server]	MS Access, MySQL, SQL Server, Oracle
JavaScript[No Need Of Web Server]	Data File [Not Secured]
XML **[No Need Of Web Server]**	It may be used as Database itself

Table 1: Different Server Side Scripts with their back-end databases

Note –The above specified table has been prepared after hands-on experience with all these technologies.

3. RESEARCH METHODOLOGY

We have taken two databases XML and MYSQL for storing records. The values from database are fetched using PHP. Entire exercise was performed to calculate the execution time of getting results from database. The script was executed and

tested on all prominent web browsers so that the actual performance can be obtained.

To prove the efficiency related to XML database, we have used LAMP [LINUX APACHE MYSQL PHP] stack on one side and LAXP [Linux, Apache, XML, PHP] on other side. These two different frameworks are used to get the same type of results in optimized manner.

First of all, I have used XML as back-end database and retrieved the records using PHP. Time of Execution of the query is recorded so that it can be compared with other stack LAXP.

At second attempt, I have used LAMP [Linux Apache MYSQL PHP], in which the same database structure and records are used. These records are retrieved using PHP from MYSQL database.

In this attempt, the time of execution of the script and query execution time is recorded. Finally, the execution time of the queries is compared. After comparing the conclusion is found that XML is obviously the better option as a back-end database rather than other RDBMS packages.

Here is the source code in PHP to fetch the records –

PHP SCRIPT FOR CONNECTION AND QUERIES EXECUTION

```
<?php
list($usec, $sec) = explode(' ',microtime());
 $querytime_before = ((float)$usec + (float)$sec);
$q=$_GET["q"];
$xmlDoc = new DOMDocument();
$xmlDoc->load("EmployeeDatabase.xml");
$x=$xmlDoc->getElementsByTagName('NAME');
for ($i=0; $i<=$x->length-1; $i++)
{
//Process only element nodes
if ($x->item($i)->nodeType==1)
  {
  if ($x->item($i)->childNodes->item(0)->nodeValue == $q)
    {
    $y=($x->item($i)->parentNode);
    }
  }
}

$Employee=($y->childNodes);
for ($i=0;$i<$Employee->length;$i++)
{
//Process only element nodes
if ($Employee->item($i)->nodeType==1)
  {
  echo($Employee->item($i)->nodeName);
  echo(": ");
  echo($Employee->item($i)->childNodes->item(0)-
>nodeValue);
  echo("<br />");
  }
}
list($usec, $sec) = explode(' ',microtime());
 $querytime_after = ((float)$usec + (float)$sec);
 $querytime = $querytime_after - $querytime_before;
 $strQueryTime = 'Query took %01.4f sec';
 echo sprintf($strQueryTime, $querytime);
?>
```

3.1 OPTMIZATION ISSUES

1. Using XML as back-end database entirely rather than a costly RDBMS package hosting
2. Execution time of the queries
3. Optimization of Back-end Database
4. Optimization of processing load on the Server

3.2 DEVELOPMENT TOOLS TO BE USED:

XML with its various standards with PHP as server side script

1. XML-DOM [Document Object Model]
2. XQuery
3. XForm

3.3 TESTING TOOLS

To test the web scripts/code written in XML will be tested in the various prominent HTTP Clients [Web Browsers]

1. Internet Explorer 7
2. Firefox 1.0.2
3. Mozilla 1.7.8
4. Opera 8
5. Netscape 6

4. SIMULATION AND EXPERIMENT RESULTS FOUND

4.1 XML Database Structure Used

An XML document has a logical and a physical structure. More specifically, XML the document is composed of units called entities. An entity may refer the other entities which cause their inclusion in the document. An XML document begins with a root or document entity. The document comprises various declarations, elements, comments, character references, and processing instructions, all of which are indicated in the document by explicit markup. A software component called an XML processor is used to read XML documents and provides access to their content and structure. An XML processor is doing its work on behalf of another module which is called the application. This specification tells the required behavior of an XML processor in terms of how it should read the XML data and the information it must provide to the application [6].

Here is the XML Database which is used at back-end named as EmployeeDatabase.xml -

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<EMPLOYEES>
      <EMP>
            <ID>1</ID>
            <NAME>BOB DYLAN</NAME>
            <SALARY>9000</SALARY>
            <DEPARTMENT>RESEARCH</DEPARTMENT>
                  </EMP>
```

```
    <EMP>
        <ID>2</ID>
        <NAME>BONNIE TYLER</NAME>
        <SALARY>10000</SALARY>
        <DEPARTMENT>TESTING</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>3</ID>
        <NAME>DR. SMITH</NAME>
        <SALARY>19000</SALARY>
        <DEPARTMENT>TESTING</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>4</ID>
        <NAME>GARY MOORE</NAME>
        <SALARY>23000</SALARY>

<DEPARTMENT>DEVELOPMENT</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>5</ID>
        <NAME>EROS RAMAZZOTTI</NAME>
        <SALARY>30000</SALARY>

<DEPARTMENT>DEVELOPMENT</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>6</ID>
        <NAME>BEE GEES</NAME>
        <SALARY>13000</SALARY>
        <DEPARTMENT>RESEARCH</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>7</ID>
        <NAME>DR.HOOK</NAME>
        <SALARY>UK</SALARY>
        <DEPARTMENT>TESTING</DEPARTMENT>
            </EMP>
    <EMP>
        <ID>8</ID>
        <NAME>ROD STEWART</NAME>
        <SALARY>12000</SALARY>

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```

4.2 Experiment Results on Execution of PHP Script

ATTEMPTS OF RETRIEVAL OF RECORDS FROM DATABASE	XML/PHPv	PHP/MYSQL
ATTEMPT 1	Query took 0.0435 sec	Query took 0.0885 sec
ATTEMPT 2	Query took 0.0430 sec	Query took 0.0825 sec
ATTEMPT 3	Query took 0.0235 sec	Query took 0.0715 sec
ATTEMPT 4	Query took 0.0245 sec	Query took 0.0825 sec
ATTEMPT 5	Query took 0.0435 sec	Query took 0.0845 sec
ATTEMPT 6	Query took 0.0425 sec	Query took 0.0755 sec
ATTEMPT 7	Query took 0.0435 sec	Query took 0.0765 sec
ATTEMPT 8	Query took 0.0425 sec	Query took 0.0875 sec
ATTEMPT 9	Query took 0.0335 sec	Query took 0.0685 sec
ATTEMPT 10	Query took 0.0435 sec	Query took 0.0885 sec
ATTEMPT 11	Query took 0.0535 sec	Query took 0.0885 sec
ATTEMPT 12	Query took 0.0630 sec	Query took 0.0825 sec
ATTEMPT 13	Query took 0.0435 sec	Query took 0.0755 sec
ATTEMPT 14	Query took 0.0645 sec	Query took 0.0865 sec
ATTEMPT 15	Query took 0.0435 sec	Query took 0.0875 sec
ATTEMPT 16	Query took 0.0325 sec	Query took 0.0785 sec

ATTEMPTS OF RETRIEVAL OF RECORDS FROM DATABASE	XML/PHPv	PHP/MYSQL
ATTEMPT 17	Query took 0.0535 sec	Query took 0.0755 sec
ATTEMPT 18	Query took 0.0625 sec	Query took 0.0835 sec
ATTEMPT 19	Query took 0.0735 sec	Query took 0.0625 sec
ATTEMPT 20	Query took 0.0235 sec	Query took 0.0815 sec

4.3 Input Output:

Input

Select the Department: DEVELOPMENT

Output

ID: 9
NAME: Andrea Bocelli
SALARY: 17000
DEPARTMENT: Development
Query took 0.0435 sec

5. CONCLUSION

Generally, to implement the web based database maintenance or standalone, there must be a Web Server [known as HTTP Server], which cater the requests from Web Browser [known as HTTP Client]. The addition resources [Back-End Database] for web based database searching will be avoided using the plan; rather we can use XML as database and retrieval, search. I have achieved the goal of optimization of resources using XML code with PHP.

The existing structure of the web based database maintenance includes the ADO which builds connection between the various web applications. A range of server side scripts are available for structuring the ADO connection. The well-known server side scripts are ASP [Active Server Pages], PHP [Personal Home Pages], CGI [Common Gateway Interface], PERL [Project Extraction and Report Language], JSP [Java Server Pages], Macromedia ColdFusion. The web administrator is required to use ADO connection for creation, updations and maintenance of the back-end database. XML overcomes all these complications by its use as a database structure.

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Web Document Clustering for Finding Expertise in Research Area

Anil Kumar Pandey[1] and T. Jaya Lakshmi[2]

Abstract - ***Researchers often need to find expertise in their chosen area of research. Finding expertise is very useful as relevant research papers can be studied and the experts could be identified. Therefore finding expertise in the chosen area of research has always attracted interest among academic community. These days research institutions and individual researchers make their publications and research findings available on web. With the exclusive growth of World Wide Web search engine users are overwhelmed by the huge volume of results returned in response to a simple query, which is far too large to get the desired knowledge. Therefore one of the methods of finding the expertise is by way of efficiently and accurately clustering the web documents, which enhances the integrity of web search engine. Data mining techniques matured making it possible to automate the web document clustering. In this paper, we present mutually exclusive Maximal Frequent Item set discovery based K- Means clustering approach. It has been implemented in JAVA. The common text processing approach is to convert the downloaded web documents into vectors. It is being done by extracting document features and it generates the document-feature data set. For a set of documents, the feature set is composed of all terms appearing in any one of the documents. We call this a document-feature data set. If document m contains feature n, then the corresponding value, in row n and column m of the table, is set to one. Otherwise, it is zero. Then, Apriori algorithm is applied to these document feature data set. The mutually exclusive frequent sets generated by Apriori algorithm are taken as initial points of K-Means algorithm. The output of the K-Means clustering algorithm will be the sets of highly related documents appearing together with same features. This approach enables the clustering of the web documents. It enables researchers to find the documents related to their desired area clustered and displayed together during the web search. It will significantly help them in terms of saving the time and getting all the relevant papers together in a cluster..***

Index Terms - Web Document Clustering, Vector space model, Term frequency, Invert Document frequency, Apriori algorithm, maximal frequent set, k-means clustering.

1. INTRODUCTION

The growth of the Internet has seen an explosion in the amount of information available; Document clustering plays an important role for helping people organize this vast amount of data. It attempts to organize documents into groups such that documents within a group are more similar to each other than documents belonging to different groups Researchers often need to find expertise in their chosen area of research. This is very useful as relevant research papers can be studied and the experts could be identified. Therefore finding expertise in the chosen area of research has always attracted interest among academic community. These days research institutions and individual researchers make their publications and research findings available on web. The first stage in any document clustering technique is document representation model.

The rest of this paper is organized as follows: in section 2, Vector Space Model that is used in literature for document clustering will be briefly introduced. Section 3 presents k-means clustering algorithm and method used to calculate initial centroids in detail. Section 4 describes Web Document Clustering algorithm for finding expertise in Research Area in detail. The experimental results are given in section 5. Finally, conclusion and some future research directions are presented in Sections 6 and 7 respectively.

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2. DATA MODEL

Most clustering algorithms expect the data set to be available in the form of a set of vectors

$$X = \{x_1, x_2, \ldots, x_m\}$$

Where the vector x_i, i = 1… m corresponds to a single object in the data set and is called the *feature vector*. Extracting the proper features to represent through the feature vector is highly dependent on the problem domain.

2.1 Document Data Model

Vector Space model is selected to represent document objects. Each document is represented by a vector d, in the term space such that

$$d = \{w_{i1}, w_{i2}, \ldots, w_{in}\} \quad (1)$$

where i= 1,…, n is weight calculated as explained in following paragraph.

Term weighting scheme is employed here to measure the significance of each term [2]. In this scheme, tf_i represents term frequency (TF) and idf_i represents inverse document frequency (IDF). The assumptions behind TF*IDF are based on two empirical observations: First, the more times a term occurs in a document, the more relevant it is to the topic. Second, the more times a term appears throughout all documents in the whole collection, the more poorly it discriminates between documents. Therefore, term frequency is the number of times one term t_k appears in a document *i* and *t f (k, i)* is used to denote it. Inverse document frequency is inversely proportional to df_k, which is the document frequency for term t_k. Given M documents and N terms, the computation of idf *(k)* is as follows [2]:

$$idf(k) = \log\left(\frac{M}{df_k}\right) \quad (2)$$

Therefore, the weight is given as

$$w_{ik} = tf(k, i) * idf(k) \quad (3)$$

After the above transformation, the complicated, hard-to-understand documents are converted into machine acceptable, mathematical representations. The problem of measuring the similarity between documents is now converted to the problem of calculating the distance between document vectors. The standard cosine similarity, which defines the angle or cosine of the angle between two vectors, is utilized in our application. It is computed as follows:

$$\cos(d_i, d_j) = \frac{d_i^t d_j}{\|d_i\| \|d_j\|} \quad (4)$$

For a group of vectors A, in K-means, they need to be represented by their "central" vector. This central vector(C_A) is generated by taking the average value of all the points included in this group. It is calculated as follows:

$$C_A = \frac{\sum_{d \in A} d}{|A|} \quad (5)$$

3. CLUSTERING ALGORITHMS

The process of grouping a set of physical or abstract objects into classes of similar objects is called clustering. A cluster is a collection of data objects that are similar to one another within the same cluster and are dissimilar to the objects in other clusters. A cluster of data objects can be treated collectively as one group and so may be considered as a form of data compression.

3.1. K-Means Clustering Algorithm

K-means is one of the simplest unsupervised learning algorithm that solves the well known clustering problem [6]. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priori. The main idea is to define k centroids, one for each cluster. These centroids should be placed in an efficient way because different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early groupage is done. At this point we need to re-calculate k new centroids as barycenters of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop we may notice that the k centroids change their location step by step until no more changes are done. In other words centroids do not move any more.

Finally, this algorithm aims at minimizing an objective function, in this case it is cosine distance specified in the previous section.

The algorithm is composed of the following steps:

1. Place K points into the space represented by the objects that are being clustered. These points represent initial group centroids.
2. Assign each object to the group that has the closest centroid.
3. When all objects have been assigned, recalculate the positions of the K centroids.
4. Repeat Steps 2 and 3 until the centroids no longer move. This produces a separation of the objects into groups from which the metric to be minimized can be calculated.

3.2. Calculating Initial Cluster Centroids

The Apriori algorithm[5] is the most well known association rule mining algorithm. It uses the following property, which we call the *large item set property*: Any subset of a large item set must be large. The large item sets are also said to be downward closed because if an item set satisfies the minimum support requirements, so do all of its subsets.

The basic idea of the Apriori algorithm is to generate candidate itemsets of a particular size and then scan the database to count these to see if they are large. During scan i, candidates of size i, C_i are counted. Only those candidates that are large are used to generate candidates for next pass. That is, L_i is used to generate C_{i+1}.An itemset is considered as large, if all of its subsets are also large.

We can use this algorithm to generate the initial points of k-means algorithm for document clustering.

4. ALGORITHM DESCRIPTION

Assume that each document in the document-feature data set corresponds to an item in the transactional database; each feature corresponds to a transaction. The aim is to search for highly related documents appearing together with same features. Similarly, the frequent item set discovery in the transaction database serves the purpose of finding items appearing together in many transactions. Therefore, if we apply frequent item set discovery to our document feature data set, "frequent" document set will be discovered.

Here frequent document sets are documents appearing together with the same feature, i.e., document sets which have large amount of feature in common. These documents are considered to be related to a certain extent. Minimum support is the minimum similarity among documents in our application.

The advantage of using frequent item set discovery is that it can capture the relation among more than two documents while the normal similarity measurement, such as cosine similarity mentioned above, can only calculate the proximity between two documents. Moreover, frequent item set discovery is capable of detecting the most related document sets in the whole collection. These document sets can be viewed as having the highest density if we imagine all these document vectors are in a n-dimensional space. The density inside a correctly

defined cluster is normally higher than its outside area. Therefore, these document sets are regarded as the initial clusters and their centroids are the initial points for K-means algorithm.

A maximal frequent item set mining algorithm is employed in this experiment. Suppose that the required cluster number is k. Then we get the maximal frequent item sets with the largest support. The centers of those frequent item sets are the initial points of K-means algorithm.

The clustering process can be summarized as follows:

ALGORITHM

Input: Text files containing abstracts of various research papers, Stop word list and Minimum support.

Step1: Read terms in text files containing abstracts of research papers.

Step2: Remove terms in Stop word list and remove stemming using Porter Stemming Algorithm [8].

Step3: Prepare document feature matrix

Step4: The matrix generated in Step 3 and the minimum support will be given as input to Apriori Algorithm and get the Minimum Frequent Item sets (MFI)as output.

MFI=$\{I_1,I_2 \ldots I_k\}$

Where I=$\{d_a,d_b,\ldots d_c\}$.

Step5: For each document, generate the document vector.

d=$(tf(t_1,d) * idf_{t1}, tf(t_2,d) * idf_{t2}, \ldots tf(t_n,d) * idf_{tn})$

Step6: Calculate the initial centers as follows:

Calculate the center of each item set in MFI

Then IP is:

P_1=Center $_{I1}$

P_2=Center $_{I2}$

Pk=Center Ik

Where $$Center_I = \frac{\sum_{d \in I} d}{|I|}$$

Set the initial points of k-means algorithm as IP

Step7: Set the initial points of K-means algorithm as IP.

Get clustering result.

Output: The sets of highly related documents appearing together with same features.

The algorithm is depicted in Figure 1.

5. EXPERIMENTAL RESULTS

The process is implemented in JAVA.

A simple example is given here to illustrate the whole process of the approach. The data tested consists of twelve abstracts whose names were given as in table 1. The feature set includes six terms: document, cluster, vector, space, model, term. Table 2 shows the details of this document-feature data set. Given the minimum support 50%, two maximal frequent document sets were discovered. This maximal frequent document sets discovery procedure is depicted in Figure 2. Document vectors calculated by using equation 1 and equation 3 are shown in Table 2. They consist of six terms. The discovered maximal frequent document sets are considered to be the highest related documents and they construct the initial clusters. Therefore, their cluster centroids are computed according to equation 5. We set these generated vectors as the initial points in K-means algorithm. Then the algorithm starts to assign each document vector to its nearest cluster centroid and re-compute the new cluster center. This iteration continues until all the clusters do not change any more. Figure 3 illustrates the process and shows the final results. These twelve documents are divided into two groups.

6. CONCLUSION

In this paper, an approach for clustering web documents has been proposed. The experimental results of testing on web documents show that the proposed web document clustering method is clustering the relevant documents is more reliably and simply as compared to other document clustering methods. The proposed web document clustering method clusters the documents and presents to the researcher only those documents, which they intend.

FUTURE SCOPE

Study can be undertaken to assess the possibility of combining this method with clustering algorithms using wavelet analysis. As an extension, similar clustering techniques can be used to find the current trend of a particular research area, and to find the leading journals in a research area and the details about the researchers who are working in the same area.

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Doc	docu ment	clu ster	vec tor	spa ce	mod el	term
Abs1	0	1	0	0	0	0
Abs2	1	1	1	0	0	0
Abs3	2	0	1	0	0	0
Abs4	2	1	2	0	3	0
Abs5	2	0	3	0	0	0
Abs6	1	0	2	0	0	0
Abs7	0	0	0	8	1	2
Abs8	0	1	0	4	3	1
Abs9	0	0	0	3	0	2
Abs10	0	0	0	6	3	3
Abs11	0	1	0	4	0	0
Abs12	0	0	0	9	1	1

Table 1: An Example of Document-feature Data

Document	Vector
Abs1	(0, 0.380, 0, 0, 0, 0)
Abs2	(0.380, 0.380, 0.380, 0, 0, 0)
Abs3	(0.760, 0, 0.380, 0, 0, 0)
Abs4	(0.760, 0.380, 0.760, 0, 1.14, 0)
Abs5	(0.760, 0, 1.14, 0, 0, 0)
Abs6	(0.380, 0, 0.760, 0, 0, 0)
Abs7	(0, 0, 0, 2.408, 0.380, 0.760)
Abs8	(0, 0.380, 0, 1.204, 1.14, 0.380)
Abs9	(0, 0, 0, 0.903, 0, 0.760)
Abs10	(0, 0, 0, 1.806, 1.14, 1.14)
Abs11	(0, 0.380, 0, 1.204, 0, 0)
Abs12	(0, 0, 0, 2.709, 0.380, 0.380)

Table 2: Document Vectors

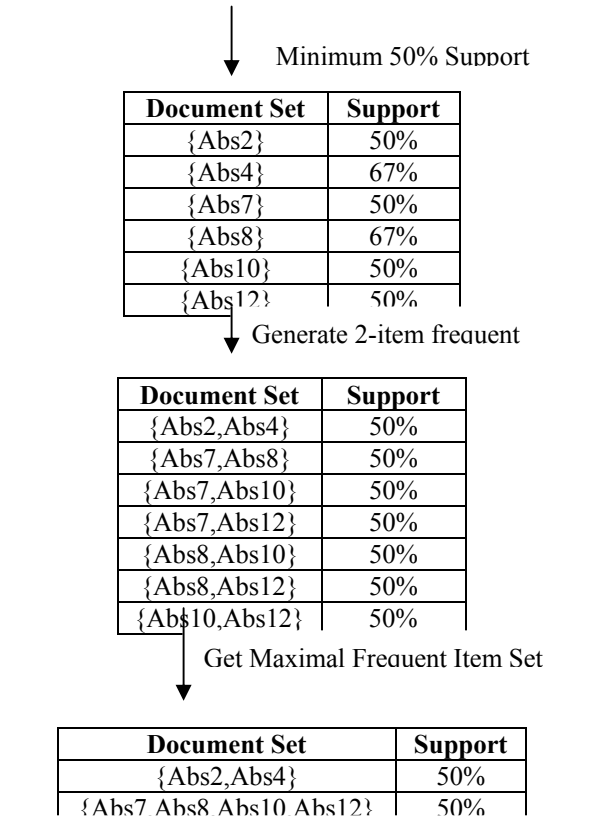

Figure 1: Discovering Initial Points Using

Maximal Frequent Document Set	Vectors
Abs2	(0.380,0.380,0.380,0,0,0)
Abs4	(0.760,0.380,0.760,0,1.14,0)
Abs7	(0,0,0,2.408,0.380,0.760)
Abs8	(0,0.380,0,1.204,1.14,0.380)
Abs10	(0,0,0,1.806,1.14,1.14)
Abs12	(0,0,0,2.709,0.380,0.380)

Calculate Cluster Centroids

Cluster	Centroid
1	(0.57,0.38,0.57,0,0.57,0)
2	(0,0.095,0,2.032,0.76,0.665)

Final Clustering of relevant Documents

	Relevant Documents
1	Abs1,Abs2,Abs3,Abs4,Abs5,Abs6
2	Abs7,Abs8,Abs9,Abs10,Abs11,Abs12

Figure 2: Process of K-Means Clustering

Continued on Page No. 146

Performance Analysis of High Speed Data Networks Using Priority Discipline

K. Bhatia[1], A. K. Pal[2] and **Anu Chaudhary[3]**

Abstract - Recent advancements in network technology allow integration of different services on the same networking infrastructure. Thus, voice, data and video or multimedia traffic share the same transmission, switching and storage resources over a single network. This integration offers the user a single access facility to all communication services through a unified interface. Since Asynchronous Transmission Mode (ATM) networks support diverse services such as voice, data, video etc., therefore, ATM has been chosen for the use in the Broadband Integrated Service Digital Networks (B-ISDN). In this paper, we have developed a queuing model for the ATM networks in which three types of traffic e.g. voice, data, and video are considered. We analyze a discrete time single-server (GI/1/1) queuing system with three priority queues of infinite capacity. The waiting time distribution for the packets in each class is derived explicitly. We have also derived expressions for probability generating function of the system contents along with the packet delay of these classes considered in the study.

Index Terms - B-ISDN, Priority Scheduling, ATM Networks, Probability Generating Function, packet delay.

1. INTRODUCTION

With the increased demand for communication service of all kinds (voice, data and video etc.), Broadband Integrated Service Digital Networks (B-ISDN) has received increased attention in the past few years. The key to the success of B-ISDN system is the ability to support a wide variety of traffic and diverse service and performance requirements. The B-ISDN is an appropriate choice to support traffic requiring bandwidth ranging from a few kilobits per second (e.g. a slow terminal) to several hundred megabits per second (e.g. moving image data). Some traffic, such as interactive data and video, is high bursts; while some traffic, such as large files, is continuous. The B-ISDN is also required to meet diverse service and performance requirements of multimedia traffic. Some services such as real-time video communication require error- free transmission as well as rapid transfer [1]. The B-ISDN has received increased attention as communication architecture capable of supporting multimedia applications. The B-ISDN networks are being designed to carry the traffic generated by wide range of services. These services will have diverse traffic flow characteristics and performance requirements. Among the techniques proposed to implement B-ISDN, Asynchronous Transfer Mode (ATM) is considered to be the most promising technique because of its efficiency and flexibility [2], [3]. An ATM is a fixed length transport scheme, which can carry heterogeneous mix of traffic in an integrated and efficient way by statically multiplexing bursty traffic flows. An ATM can be considered as the switching technology that supports two fundamental approaches of switching: circuit switching and packet switching [4],[5]. A B-ISDN should be able to facilitate expected (as well as unexpected) future service in a practical and easily expanded fashion. A few examples of expected future services include high-definition TV (HDTV), broadband videotext, and video/document retrieval services [6], [7]. The ATM is now becoming promising technology for transport of high-bandwidth applications. Different types of traffic need different QoS standards. For real-time applications mean delay and delay jitter are not too large, while for non-real-time applications, the cell loss ratio (CLR) is the restrictive quantity. Two priority categories can be distinguished, which will be referred to as delay priority and loss priority. Delay priority scheduling tries to reduce the delay of delay-sensitive traffic (such as voice). This is done by using a more sophisticated type of scheduling than the simple FIFO scheduling. Priority is given to delay-sensitive traffic over delay-insensitive traffic. Several types of delay priority (or cell scheduling) schemes such as weighted-round-robin (WRR), weighted-fair-queuing (WFQ) have been proposed and analyzed for ATM applications, each with their own specific algorithmic and computational complexity [8]. On the other hand, loss-priority schemes attempt to reduce the cell loss of loss-sensitive traffic (such as data). Again, various types of loss-priority (or cell discarding) strategies for ATM such as push out buffer (POB), partial buffer sharing (PBS) have been presented in the literature [9]. An overview of both types of priority schemes has been given by Bae and Suda [10]. In ATM networks, one of the most important problems is to meet the QoS for all traffic, e.g. the delay and loss requirement for real-time and non-real-time traffic. One method of solving this problem is the use of priority control [11], [12], [13]. J.Walraevens et.al.[14] proposed a discrete time queueing system with HOL (Head Of Line) priority and also developed generating functions for assessing the performance of ATM buffers. There have been a number of contributors with respect to switches with output queueing, in the case of a single traffic type and a FIFO scheduling discipline [15], [16], [17].

In this paper, we have proposed a new queueing model for integrated high speed data networks in which three types of traffic are considered. We have employed priority queueing discipline to analyze mean delay of the system, high priority is given to highly sensitive data (which cannot be stored for the longer period of time) and low priority is given to normal data. We have analyzed a discrete time single-server (GI/1/1) queueing system with three priority queues of infinite capacity. The waiting time distribution for the packets in class is derived

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explicitly and expressions for the probability generating function of the system contents are also derived along with the packet delay of these classes considered in the study.

2. MATHEMATICAL MODEL

We investigate a discrete-time queueing system with one server and three priority classes with infinite capacity. The time is assumed to be slotted and the transmission time of a packet is one slot. We have considered three types of traffic arriving in the system, namely packets of class1 (video), packets of class2 (voice) and packets of class3 (data) which arrive in the first, second and third queue respectively. In multiply (integrated service) systems various types of data can be transmitted through single channel. In the current communication systems we can access broadband (Internet), telephone and cable TV networks through single channel. In such type of integrated communication system priority discipline plays an important role because sensitive data (high priority data like video data) needs to be transmitted without delay whereas the insensitive data (like low priority data) can be stored for later transmission. Therefore in this model, we assign the highest priority to video data, then comes in priority order the voice data and finally to the simple data. The number of arrivals of class j during slot k is denoted by $a_{j,k}\,(j=1,2,3)$ and the $a_{j,k}$'s are independent and identically distributed (i.i.d) from slot-to-slot. However, in one slot, the number of arrivals of one class can be correlated with the number of arrivals of the other classes. The total number of arriving packets during slot k is denoted by:

$$a_{T,k} \cong a_{1,k} + a_{2,k} + a_{3,k}$$

and its Probability generating function (pgf) is defined as $A_T(z) = E[z^{a_{T,k}}] = A(z, z)$.

Further, we define the marginal pgf's of the number of arrivals from all classes

$$A_j(z) \cong E[z^{a_{j,k}}] = A(j, z) \quad \text{where , } j = 1, 2, 3$$

From these pgf's we can calculate the arrival rate of class j:

$$\lambda_j \cong E[a_{j,k}] = A'_j .$$

The total arrival rate is the sum of the arrival rates of all classes:

$$\lambda_T = A'_T(1) = A'_1(1) + A'_2(1) + A'_3(1)$$

The system has one server that provides the transmission of packets, at a rate of one packet per slot. Newly arriving packets can enter in the service at the beginning of the slot following their arrival slot at the earliest. Packets in queue1 have a higher priority than those in queue2 and queue3. Packets in queque2 have higher priority than those in queue3.

3. SYSTEM CONTENTS

In this section, we derive the steady-state joint pgf of the system contents of all three queues. We assume that the packet in service (if any) is part of the queue that is serviced in the slot. We denote the system contents of queue j at the beginning of slot k by $u_{j,k}$ and the total system contents at the beginning of slot k by $u_{T,k}$.

As there are three distinct classes of messages, we find it necessary to distinguish among the imbedded points as to which class completes service. This is indicated by the term j class epoch, where j =1, 2, or 3. Let $u_{j,k}$ be the number of class j messages in the system at the k^{th} departure epoch. We can express $u_{j,k}$ as the sum of the number of the system contents at the previous epoch and the number of new arrivals. If the $(k+1)^{th}$ departure epoch is in class1, then the impact of this is that a class1 message is in the process of departing from the system and that new messages of all three classes are arriving while the message of class1 is being transmitted. We have for $u_{1,k} > 0$ as:

$$u_{1,k+1} = u_{1,k} - 1 + a_{11} \tag{1a}$$

$$u_{2,k+1} = u_{2,k} + a_{12} \tag{1b}$$

$$u_{3,k+1} = u_{3,k} + a_{13} \tag{1c}$$

where, $a_{1,k}$ (k = 1, 2, 3) is the number of class k massages arriving during the transmission of a class1 massage. For simplicity of discussion we have dispensed with any reference to the departure time in the transmission of class1 massage.

Similarly, if $(k+1)^{th}$ departure epoch is in class 2, we have for $u_{2,k} > 0$ as:

$$u_{1,k+1} = a_{21} \tag{2a}$$

$$u_{2,k+1} = u_{2k} - 1 + a_{22} \tag{2b}$$

$$u_{3,k+1} = u_{3k} + a_{23} \tag{2c}$$

Because of the priority discipline, there could not have been any class1 message in the system at the k^{th} departure. In considering a class3 epoch we recognize that the k^{th} departure must have left the system devoid of class1 and 2 messages. We have for $u_{3,k} > 0$

$$u_{1,k+1} = a_{31} \tag{3a}$$

$$u_{2,k+1} = a_{32} \tag{3b}$$

$$u_{3,k+1} = u_{3k} - 1 + a_{33} \tag{3c}$$

Joint pgf of the system contents of all queues at the beginning of slot (k+1) yields

$$\begin{aligned}
U_{k+1}(z_1, z_2) &= E[z_1^{u_{1,k+1}}, z_2^{u_{2,k+1}} \\
&= E[z_1^{u_{1,,k}-1+a_{11}} z_2^{u_{2,k}+a_{12}} : u_{1,k} > 0] + E[z_1^{a_{2,1}} {}_2^{u_{2,k}-1+a_{2,2}} : u_{1,k} = 0 \\
&\quad u_{2,k} > 0] + E[z_1^{a_{3,1}} z_2^{a_{3,2}} : u_{1,k} = u_{2,k} = 0, u_{3,k} > 0 \\
&= z_1^{-1} E[z_1^{u_{1,k}} z_2^{u_{2,k}}] E[z_1^{a_{1,1}} z_2^{a_{1,2}}] + z_2^{-1} E[z_1^{a_{2,1}} z_2^{a_{2,2}}] E[z_2^{u_{2,k}}] + \\
&\quad E[z_1^{a_{3,1}} z_2^{a_{3,2}}] \\
&= z_1^{-1} A(z_1 z_2)[U_k(z_1 z_2) - U_k(0, z_2)] \\
&+ z_2^{-1} A(z_2 z_2)[(z_2 - 1) U_k(0,0) + U_k(0, z_2)] \\
&+ A(z_1 z_2)
\end{aligned} \tag{4}$$

For steady-state distribution of the system contents, $U(z_1, z_2)$ we define as :

$$U(z_1, z_2) \cong \lim_{k\to\infty} U_k(z_1, z_2)$$

Applying this limit in equation (4), we get the following :

$$U(z_1z_2) =$$
$$z_1^{-1}A(z_1z_2)[U(z_1z_2) - U(0, z_2)] +$$
$$z_2^{-1}A(z_2z_2)[(z_2 - 1)U(0,0) + U(0, z_2)] + A(z_1z_2)$$
$$U(z_1z_2) = \frac{z_1A(z_1z_2)}{(z_1 - A(z_1z_2))}$$
$$+ \frac{z_1A(z_2z_2)(z_2 - 1)U(0,0)}{z_2(z_1 - A(z_1z_2))} \quad (5)$$
$$+ \frac{(z_1A(z_2z_2) - z_2A(z_1z_2))U(0, z_2)}{z_2(z_1 - A(z_1z_2))}$$

The right hand side of the equation (5), contains two quantities which need to be determined namely the function $U(0, z_2)$ and constant $U(0, 0)$.

To compute the function $U(0, z_2)$, we apply Rouche's theorem, provided that for a given value of z_2 in the unit circle ($|z_2| \le 1$), the equation $z_1 = A(z_1z_2)$ has one solution in the unit circle for z_1, which will be denoted by $\gamma(z_2)$ in the remainder and is implicitly defined by $\gamma(z) = A(\gamma(z), z)$.

Since $\gamma(z_2)$ is an approximation to the zero (i.e. root) of the denominator of the right hand side of equation (5) and a generating function remains finite in the unit circle, therefore, $\gamma(z_2)$ must also be a zero of the numerator. Hence, we have

$$z_1A(z_1z_2) + \frac{z_1A(z_2z_2)(z_2 - 1)U(0,0)}{z_2} + \frac{z_1A(z_2z_2)}{z_2} - \frac{z_2A(z_1z_2)U(0, z_2)}{z_2} = 0$$

By solving the above eqaution we get ,

$$U(0, z_2) = \gamma(z_2) + \frac{A(z_2z_2)}{z_2} + \frac{A(z_2z_2)(z_2 - 1)U(0,0)}{z_2} \quad (6)$$

After substituting the values of $U(0, z_2)$ in equation (5)

$$U(z_1z_2) = \frac{z_1A(z_1z_2)}{[z_1 - A(z_1z_2)]} + \frac{z_1A(z_2z_2)(z_2 - 1)U(0,0)}{z_2[z_1 - A(z_1z_2)]}$$
$$+ \frac{z_1A(z_2z_2) - z_2A(z_1z_2)}{z_2[z_1 - A(z_1z_2)]} \quad (7)$$
$$\times\left[\gamma(z_2) + \frac{A(z_2z_2)}{z_2} + \frac{A(z_2z_2)(z_2 - 1)U(0,0)}{z_2}\right]$$

Next we determine the constant U(0,0) from the equation (7) by substituting z_1 by 1, by appliying the normalization candition U(1,1) =1 and by using l'Hospitals rule. The result is the probability of having an empty system

: $U(0, 0) = 1 - \lambda_T$.

Notice that the stability condition equals $\lambda_T < 1$.

$$U(z_1z_2) = \frac{z_1A(z_1z_2)}{z_1 - A(z_1z_2)} + \frac{z_1A(z_2z_2)(z_2 - 1)(1 - \lambda_T)}{z_2(z_1 - A(z_1z_2))} + \frac{z_1A(z_2z_2) - z_2A(z_1z_2)}{z_2(z_1 - A(z_1z_2))} \quad (8)$$
$$\times\left[\gamma(z_2) + \frac{A(z_2z_2)}{z_2} + \frac{A(z_2z_2)(z_2 - 1)(1 - \lambda_T)}{z_2}\right]$$

From this pgf, we can calculate the marginal pgf values $U_j(z)$ (j = 1, 2, 3) of the system contents of class j :

$$U_1(z) = \lim_{k\to\infty} E[z^{u_{1,k}}] = U(z, 1)$$

By putting $z_1 = z$ and $z_2 = 1$ in equation (8), we get the following:

$$U_1(z) = \frac{zA_1(z)}{z - A_1(z)} + \frac{zA_2(z) - A_1(z)}{z - A_1(z)} \times [\gamma(1) + A_2(z)] \quad (9)$$

For, $U_2(z) = \lim_{k\to\infty} E[z^{u_{2,k}}] = U(1, z)$

By putting $z_1 = 1$ and $z_2 = z$ in equation (8), we get the following:

$$U_2(z) = \frac{A_1(z)}{1 - A_1(z)} + \frac{A_2(z)(z - 1)}{z(1 - A_1(z))}(1 - \lambda_T)$$
$$+ \frac{A_2(z) - zA_1(z)}{z(1 - A_1(z))} \times \left[\gamma(z) + \frac{A_2(z)}{z}[z - \lambda_T(1 - z)]\right]$$

(10) $$U_3(z) = \lim_{k\to\infty} E[z^{u_{3,k}}] = U(z, z)$$

By putting $z_1 = z$ and $z_2 = z$ in equation (8), we get the following:

$$U_3(z) = \frac{zA_T(z)}{z - A_T(z)} + \frac{A_T(z)(z - 1)}{(z - A_T(z))}(1 - \lambda_T) \quad (11)$$

4. PACKET DELAY

The packet delay is defined as the total amount of time that a packet spends in the system, i.e., the number of slots between the end of the packets arrival slot and the end of its departure slot. In this section, we shall derive expressions for the pgf values of the packet's delay of three classes.

The amount of time a tagged class1 packet spends in the system i.e. packet delay for class 1 is given by:

$$d_1 = [u_{1,k} - 1]^+ + f_{1,k} + 1 \quad (12)$$

Here, $[...]^+$ denotes the maximum of the argument and zero. slot k is assumed to be the arrival slot of the tagged packet, $u_{1,k}$ is the system contents of queue1 at the beginning of this slot, and $f_{1,k}$ is defined as the total number of class 1 packets that arrive during slot k, and which have to be served before the tagged packet. Similarly, for class2 and class3 packets:

$$d_2 = [u_{2,k} - 1]^+ + f_{1,k} + f_{2,k} + 1 \quad (13)$$

$$d_3 = [u_{3,k} - 1]^+ + f_{1,k} + f_{2,k} + f_{3,k} + 1 \quad (14)$$

For class1 the pgf $F_1(z) = E[z^{f_{1,k}}]$ can be calculated for queue1.

$$F_1(z) = E\left[z^{f_{1,k}}\right] = \frac{A_1(z) - 1}{\lambda_1(z - 1)} \quad (15)$$

$$E(z^{d_1}) = F_1(z)[U_1(z) + (z - 1)U_1(0)] \quad (16)$$

Using equation (9) and (15) in (16), we get:

$$d_1 = \frac{A_1(z)-1}{\lambda_1(z-1)} \times \begin{bmatrix} \frac{zA_1(z)}{z-A_1(z)} \\ +\frac{zA_2(z)-A_1(z)}{z-A_1(z)} \\ \times[\gamma(1)+A_2(z)] \\ +(z-1)\times[A_2(0)] \end{bmatrix} \quad (17)$$

Similarly, for class2 and class3 are given by.

$$F_2(z) = \frac{A_2(z)-1}{\lambda_2(z-1)}$$

$$E(z^{d_2}) = F_1(z)F_2(z)[U_2(z)+(z-1)U_2(0)]$$

$$d_2 = \frac{A_1(z)-1}{\lambda_1(z-1)} \times \frac{A_2(z)-1}{\lambda_2(z-1)} \times \begin{bmatrix} \frac{A_1(z)}{1-A_1(z)} + \frac{A_2(z)(z-1)}{z(1-A_1(z))}(1-\lambda_T) \\ +\frac{A_2(z)-zA_1(z)}{z(1-A_1(z))} \\ \times\left[\gamma(z)+\frac{A_2(z)}{z}[z-\lambda_T(1-z)]\right] \\ +(z-1)\frac{A_1(0)}{1-A_1(0)} \end{bmatrix} \quad (18)$$

$$F_3(z) = \frac{A_3(z)-1}{\lambda_3(z-1)}$$

$$E(z^{d_3}) = F_1(z)F_2(z)F_3(z)[U_3(z)+(z-1)U_3(0)]$$

$$d_3 = \frac{A_1(z)-1}{\lambda_1(z-1)} \times \frac{A_2(z)-1}{\lambda_2(z-1)} \times \frac{A_3(z)-1}{\lambda_3(z-1)} \times \left[\frac{zA_T(z)}{z-A_T(z)} + \frac{A_T(z)(z-1)}{z-A_T(z)}(1-\lambda_T) + (z-1)\times(1-\lambda_T)\right] \quad (19)$$

5. CALCULATION OF MEAN OF PACKET DELAY

In this section, we give expressions for the mean values of the studied stochastic variables. To make the expressions more readable, we define λ_{11} and λ_{TT} as follows:

$$\lambda_{11} \cong \left.\frac{\partial^2 A(z_1,z_2)}{\partial^2 z_1}\right|_{z_1=z_2=1} \text{ and } \lambda_{TT} \cong \left.\frac{\partial^2 A_T(z)}{\partial z^2}\right|_{z=1}.$$

Equations for mean of packet delays are as follows :

$$\begin{aligned} E(d_1) = {} & \frac{(1-\lambda_1/3)^2(\lambda_2-\lambda_{11})(1-\lambda_1/3-\lambda_3/3)^3}{\lambda_1} \\ & -\frac{((1-\lambda_1/3)^3-1)(1-\lambda_1/3-\lambda_3/3)^2(\lambda_{11}+\lambda_{31})}{\lambda_1} \\ & -\frac{((1-\lambda_1/3)^2-1)(1-\lambda_1/3)^3\times\lambda_{11}}{\lambda_1^2} \\ & +\begin{bmatrix}(1-\lambda_1/3)^3+(1-\lambda_1/3)(\lambda_2-\lambda_{11}) \\ -(1-\lambda_1/3)^2(\lambda_2-\lambda_{11})\end{bmatrix} \\ & \times\left(\frac{\lambda_2}{1-\lambda_1}\right)+(1-\lambda_1/3-\lambda_3/3)^2(\lambda_{12}+\lambda_{31}) \end{aligned} \quad (20)$$

$$\begin{aligned} E(d_2) = {} & \frac{(1-\lambda_T)(\lambda_{12}-\lambda_2)(1-\lambda_1/3)^4}{\lambda_1\lambda_2} \\ & +\frac{(1-\lambda_T)(1-\lambda_1/3)^2(\lambda_2-\lambda_{12})}{\lambda_1\lambda_2} \\ & \times(1-(1-\lambda_1/3)^3) \\ & +\frac{\lambda_{TT}(1-\lambda_1/3)^3(1-(1-\lambda_1/3)^3)}{\lambda_1\lambda_2} \end{aligned} \quad (21)$$

$$\begin{aligned} E(d_3) = {} & 1-\lambda_T \\ & +\frac{(1-\lambda_1/3)^3+(\lambda_2+\lambda_3-\lambda_{13})(1-\lambda_1/3)^2}{1-[(\lambda_2+\lambda_3-\lambda_{13}(1-\lambda_1/3)^2]} \\ & +\frac{(1-\lambda_T)(1-\lambda_1/3)^3}{1-[(\lambda_2+\lambda_3-\lambda_{13}(1-\lambda_1/3)^2]} \end{aligned} \quad (22)$$

6. NUMERICAL EXAMPLE

We assume three types of traffic. Traffic of class-1 is delay sensitive (for video) and in this order traffic of class-3 is assumed to be delay insensitive (for instance data). The packet arrivals on each epoch are assumed to be i.i.d. with arrival rate λ_T. An arriving packet is assumed to be class-j with probability λ_j / λ_T (j =1, 2 , 3) ($\lambda_T = \lambda_1 + \lambda_2 + \lambda_3$). We define α as the fraction of class-1 arrivals in the overall traffic mix (i.e. α = λ_1 / λ_T). In Fig.1, mean Packet delays and total arrival rates of classes are shown for α = 0.25. Values of λ_{11}, λ_{12} and λ_{21} can be calculated using $\lambda_{ij} = \frac{\partial^2 A(z_1,z_2)}{\partial^2 z_i z_j}$,

where $A(z_1z_2) = \left(1-\frac{\lambda_1}{N}-\frac{\lambda_2}{N}(1-z_1)-\frac{\lambda_3}{N}(1-z_2)\right)^N$

for N = 3 (Total Inlets).

7. CONCLUSION

In this paper we analyzed an integrated network system with priority scheduling discipline, We have obtained generating functions and performance measures such as system contents and mean packet delays. In this model high sensitive data is defined with high priority class and normal data has been given to low priority class. The results and graphs show that the mean delay of normal data (low sensitive data) is greater than high sensitive data. In the past communication system, generally there were two types of data transmissions through the single channel, like normal data and voice data (or normal data and multimedia data). Whereas in the present scenario of communication it is based on multiply system where normal data, voice data, multimedia data, broadband internet, cable TV, internet TV are transmitted through a single communication channel which creates the complexity of networks (i.e. high sensitive data may have more delays). In this model we have considered three types of data (normal data, voice data, and video or multimedia data). As result shows high sensitive data (i.e. video or multimedia data) has minimum delays comparative to other categories of the data. Thus model can be very helpful in the implementation of integrated high-speed data networks.

FUTURE SCOPE

By implementing the above mentioned networks we will be able to improve the performance of integrated high speed networks where time delay is the most important issue for the networks. Such type of network is also useful for the multiply systems.

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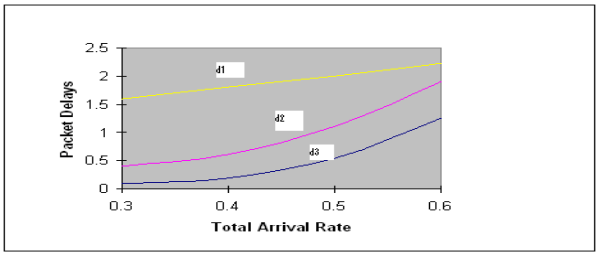

Figure 1: Mean Value of Packet Delays versus the Total Arrival Rate (At $\alpha = 0.25$)

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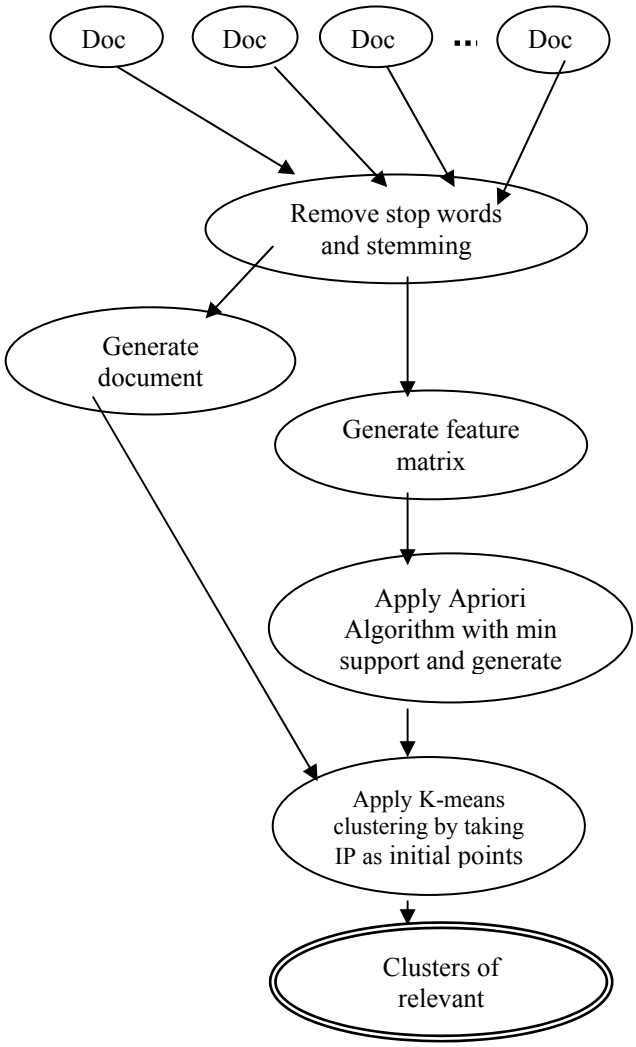

Figure 1: Algorithm Description

Optimized Image Representation in Memory using Linear Arrays

Anu Suneja

Abstract - ***Various Image representation methods consume very large amounts of memory and takes large transmission time over the network. In this paper, we have tried to reduce memory requirements for storing images which can get transmitted in small time period. Initially, the preamble of a digital image as well as matrix representation of a digital image is discussed. The paper proposes an algorithm to optimize the image representation including the performance evaluation of this technique compared with the traditional techniques.***

1. INTRODUCTION

Digital images are the basis for the visualization and digital representation of designs on computers and paper [1]. These are defined in memory by a finite valued function over a finite domain. Let us assume that a digital image is a rectangular array of size M X N having domain D

D = {(r,c) | r = 0,1-------, M-1 and c=0,1,------N-1}[1]

is represented in memory by a matrix of order M X N having some integer elements g (i, j) for $0 \leq i \leq M-1$, $0 \leq j \leq N-1$

where each element g (i, j) of matrix is considered as a pixel element. It represent gray level (in monochrome image) or color (in colored image) associated with pixel position (i, j). [2], [3]

There is some problem with matrix representation of an image. The problem is that it takes very large amount of memory to store any image. Since here color or gray level of each pixel is stored as individual element. Even if color of some continuous pixels is same, still it has to be stored as individual element. This problem gets worst as resolution of image get increased. Larger the memory required for an image, larger will be the time to transfer that image over network [4].

A number of compression methods have been designed to reduce transmission time for image transfer. There are two major methods to achieve it. Either use dedicated channel for image transfer or compress the image before transmitting it [5]. In this paper, we have used second method i.e. to compress the image before transmitting it. Here rather than using matrix representation, image has been represented using two 1- D arrays. This method will be more efficient if large number of continuous pixels have same color or gray level value.

2. TRADITIONAL MATRIX REPRESENTATION OF AN IMAGE

Digital Image is graphical representation of an object which is, in fact, a regular matrix that is a collection of pixel wise grey levels or intensity values [6].

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According to traditional image representation method, image is stored in main memory in matrix form having dimensions R x C, where R is no. of rows and C is no. of columns or we can say resolution of screen is R x C. Value of A [i, j] = color code of pixel (i, j) [7].Matrix representation of image results in large consumption of memory. Like if resolution of screen is R x C, range of colors provided is K and word length of system to store K color values is w bytes. This implies memory required to store an image will be=R x C x w bytes. In this image representation method, if color of some adjacent pixels is same still that same value for each pixel has to be repeated for its corresponding position in the matrix.

Resolution	Colors used	Memory utilized in Traditional method(in bytes)
8 × 8	8	128
16 × 16	16	512
64 × 64	64	8192
64 × 64	4	8192
64 × 64	8	8192
64 × 64	32	8192
64 × 64	64	8192
128 × 128	8	32768
128 × 128	16	32768
128 × 128	32	32768
128 × 128	64	32768
128 × 128	128	32768

Table 1: Memory requirement in Matrix based image representation method (assumed word length w=2 bytes)

3. PROPOSED METHOD

In proposed method, we can reduce memory requirement by taking advantage of adjacent pixels having same color. In this method, instead of using traditional 2-D array for storing pixel wise color value, we use two 1-D arrays. First 1-D array stores colors used in adjacent pixels and second array stores count of continuous pixels having same color.

If

Color[i] =n, Count[i] =m …… (1)

implies from current to next 'm' pixels have same color value 'n'.

In proposed method memory size required is calculated as:

$m_r = (c + d) * w$ ……(2)

Where m_r = memory required

c = size of array color

d = size of array count

w = word length

Resolution	colors used	Memory utilized in proposed method (in bytes)
8 × 8	8	32
16 × 16	16	64
64 × 64	64	256
64 × 64	4	2056
64 × 64	8	1040
64 × 64	32	320
64 × 64	64	256
128 × 128	8	4112
128 × 128	16	2080
128 × 128	32	1088
128 × 128	64	640
128 × 128	128	512

Table 2: Memory requirement in proposed image representation method

If resolution of screen is M × N and number of colors used in image is p then memory required to store a symmetric image according to proposed method will be:

$[(M \times N)/p + p] \times w$ ……..(3)

Where w is word length.

In this method, image is not represented pixel wise, so pixel position is calculated using formula:

a) x=x+1 if cnt mod r =0 ……(4)
   x=x otherwise

b) y=0 if y=r-1 ……(5)
   y=y+1 otherwise

In proposed method, unlike matrix representation of image co ordinates (x, y) of pixel are not known rather color c_i and number of adjacent pixel cnt_i having same color c_i is given. Therefore, some algorithm is required to find pixel position from the given array C and count.

ALGORITHM:

Step 1) Set x: = -1, y: = -1, cnt: = 0
Step 2) Repeat Step 3 for i = 0 to nc -1
Step 3) Repeat Step 4 for k = 0 to count[i]-1
Step 4 if (cnt mod r==0) then
x=x+1
[End of step 4 If statement]
Step 5) if (y==r-1) then
y = 0
Else
y=y+1
[End of step 5 if statement]
Step 6) Drawpixel(x, y, color [I])
Step 7) cnt = cnt+1
[End of step 3 for loop]
[End of step 2 for loop]
Step 8) Exit

4. COMAPRISON OF PROPOSED METHOD WITH TRADITIONAL MATRIX REPRESENTATION:

Where in traditional method we have to store color value for each pixel according to resolution of screen, in proposed method, we just store the number of pixels that have color value color[i], color [i+1] and so on.

Proposed representation of an 8 X 8 sized image with 8 colors:

```
color[8]={0,1,2,3,4,5,6,7};
count[8]={8,8,8,8,8,8,8,8};
```

Traditional representation of an 8 X 8 sized image with 8 colors:

```
color [8][8]=  {{0, 0, 0, 0, 0, 0, 0, 0},
                {1, 1, 1, 1, 1, 1, 1, 1},
                ……….
                {7, 7, 7, 7, 7, 7, 7, 7}};
```

Representation of an image acc. to proposed method will consume less memory than traditional method .This is because here image is stored color wise and not pixel wise.

To draw an image of resolution 8 X 8 where 8 colors are used in symmetric way, Memory required to store such image in matrix form will be 128 bytes. Whereas, if we store same image acc. to proposed method we need only 32 bytes. It will not only save memory but also save execution time. Time taken to draw above image represented in traditional method is noted to be 9844429.978022 ns where as in proposed method time is noted to be 9844442970.615385 ns.

As resolution get increased more and more memory is saved. Also less the frequency with which color get changed more the memory will be saved in proposed method as compare to traditional method as shown below:

frequency of change in color	2	4	8	16
Memory Saved (in %)	0	50	75	87.45

Table 3: Memory saved with change in color

Proposed method not only saves memory, but it also save execution time as shown:

Resolution	colors used	Execution Time	
		Traditional	Traditional
8 X 8	8	954442686.2	954442625.7
16 X 16	16	954442774	954442729.6
64 X 64	64	954442861	954442823.2
128 X 128	128	954442975.3	954442899.7
64 X 64	16	954443059.5	954443029.2
64 X 64	32	954443126.5	954443098.2
64 X 64	64	954442861	954442823.2
128 X 128	16	954443200.3	954443167.2
128 X 128	32	954443273	954443227.7
128 X 128	64	954443334.5	954443307.1
128 X 128	128	954443388.3	954443357.1

Table 4: Comparison of execution time taken for Traditional and proposed method

5. CONCLUSION

In this paper digital images are represented using color codes of continuous pixels, which is different from matrix based representation that was traditionally used. It leads to reduction in memory requirement for storing an image. Also it saves

image transmission time over the network. Comparison of memory utilized in traditional and proposed method has been made using charts.

6. REFERENCES

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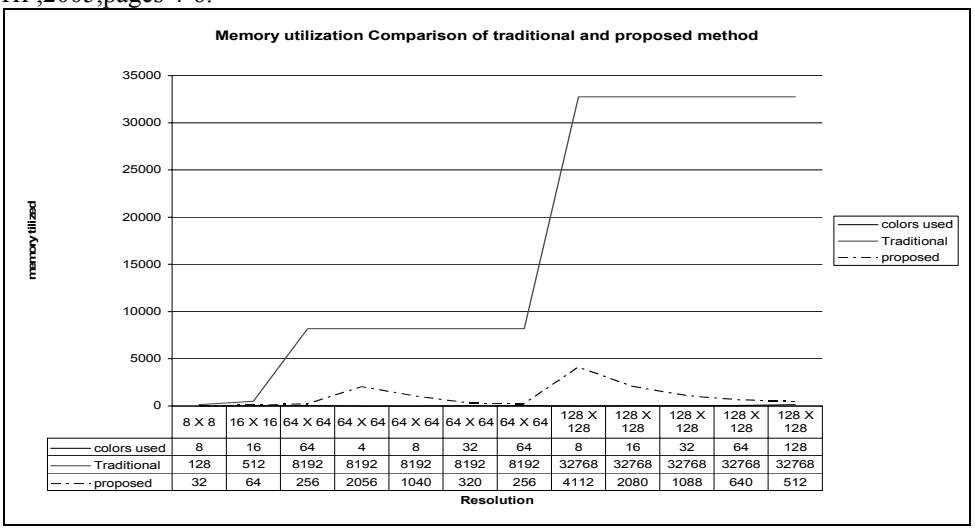
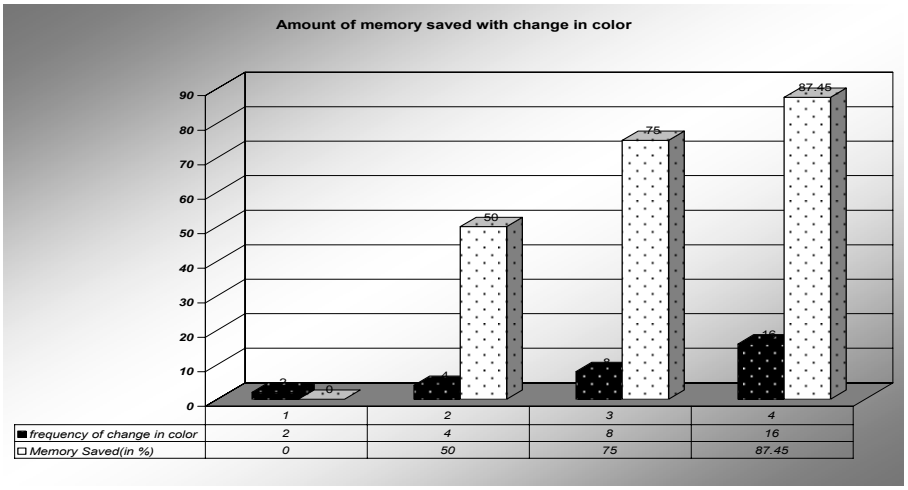


	8 X 8	16 X 16	64 X 64	64 X 64	64 X 64	64 X 64	64 X 64	128 X 128	128 X 128	128 X 128	128 X 128	128 X 128
colors used	8	16	64	4	8	32	64	8	16	32	64	128
Traditional	128	512	8192	8192	8192	8192	8192	32768	32768	32768	32768	32768
proposed	32	64	256	2056	1040	320	256	4112	2080	1088	640	512

Figure 1: Comparison of memory utilized Traditional and proposed image representation method



	1	2	3	4
frequency of change in color	2	4	8	16
Memory Saved(in %)	0	50	75	87.45

Figure 2: Comparison of memory saved with change in color for Traditional and proposed method

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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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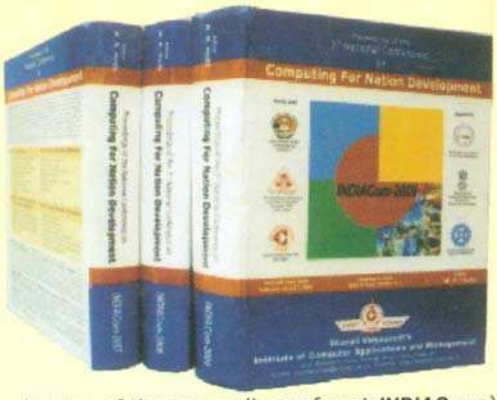

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