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The Performance of Soft Chekpointing Approach in Mobile Computing Systems

By Ruchi Tuli, Parveen Kumar
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Abstract- Mobile computing raises many new issues such as lack of stable storage, low bandwidth of wireless channel, high mobility, and limited battery life. These new issues make traditional checkpointing algorithms unsuitable. Coordinated checkpointing is an attractive approach for transparently adding fault tolerance to distributed applications since it avoids domino effects and minimizes the stable storage requirement. However, it suffers from high overhead associated with the checkpointing process in mobile computing systems. In literature mostly, two approaches have been used to reduce the overhead: First is to minimize the number of synchronization messages and the number of checkpoints; the other is to make the checkpointing process nonblocking. Since MHs are prone to failure, so they have to transfer a large amount of checkpoint data and control information to its local MSS which increases bandwidth overhead. In this paper, we introduce the concept of “Soft checkpoint” which is neither a tentative checkpoint nor a permanent checkpoint, to design efficient checkpointing algorithms for mobile computing systems. Soft checkpoints can be saved anywhere, e.g., the main memory or local disk of MHs. Before disconnecting from the MSS, these soft checkpoints are converted to hard checkpoints and are sent to MSSs stable storage. In this way, taking a soft checkpoint avoids the overhead of transferring large amounts of data to the stable storage at MSSs over the wireless network. We have also shown that our soft checkpointing scheme also adapts its behaviour to the characteristics of network.

Keywords: *Mobile distributed system, coordinated checkpointing, fault tolerance, Mobile Host.*

GJCST Classification: *C.1.3, C.2.1*

THE PERFORMANCE OF SOFT CHEKPOINTING APPROACH IN MOBILE COMPUTING SYSTEMS

Strictly as per the compliance and regulations of:

The Performance of Soft Chekpointing Approach in Mobile Computing Systems

Ruchi Tuli[α], Parveen Kumar[Ω]

Abstract- Mobile computing raises many new issues such as lack of stable storage, low bandwidth of wireless channel, high mobility, and limited battery life. These new issues make traditional checkpointing algorithms unsuitable. Coordinated checkpointing is an attractive approach for transparently adding fault tolerance to distributed applications since it avoids domino effects and minimizes the stable storage requirement. However, it suffers from high overhead associated with the checkpointing process in mobile computing systems. In literature mostly, two approaches have been used to reduce the overhead: First is to minimize the number of synchronization messages and the number of checkpoints; the other is to make the checkpointing process nonblocking. Since MHs are prone to failure, so they have to transfer a large amount of checkpoint data and control information to its local MSS which increases bandwidth overhead. In this paper, we introduce the concept of "Soft checkpoint" which is neither a tentative checkpoint nor a permanent checkpoint, to design efficient checkpointing algorithms for mobile computing systems. Soft checkpoints can be saved anywhere, e.g., the main memory or local disk of MHs. Before disconnecting from the MSS, these soft checkpoints are converted to hard checkpoints and are sent to MSSs stable storage. In this way, taking a soft checkpoint avoids the overhead of transferring large amounts of data to the stable storage at MSSs over the wireless network. We have also shown that our soft checkpointing scheme also adapts its behaviour to the characteristics of network.

Keywords- Mobile distributed system, coordinated checkpointing, fault tolerance, Mobile Host

I. Introduction

A mobile distributed system consists of both Mobile Hosts (MH) and static Mobile Service Stations (MSS). A set of dynamic and wireless communication links can be established between an MH and an MSS, and a set of high-speed communication link is assumed between the MSSs. An MSS may communicate with a number of MHs but an MH at a time communicates with only one MSS. An MH communicates with the rest of the system via the MSS it is connected to. Message transmission through wireless links takes an unpredictable but finite amount of time. Reliable message delivery is assumed during normal operation. The system does not have any shared memory or global clock [1]. Distributed computation in such mobile computing environment is performed by a set of processes executing concurrently on MHs and MSSs in the network. The processes communicate asynchronously with each other. A process experiences a sequence of state transitions during its execution and the atomic action which causes the state transition is called an *event*. The event having no interaction with another process is called an *internal event*; the message sending and receipt are *external events*. *Computation* is a sequence of state transitions within a process.

The diversity and flexibility introduced by mobile computing brings new challenges to the area of fault tolerance. Types of failures that were rare in the fixed environments are common with mobile hosts. Physical damage becomes much more probable, because mobile hosts are carried with the users while they move between sites. Mobile hosts can also be lost or stolen. Transient failures due to power or connectivity problems can be frequent events.

In this paper, we focus on checkpoint based recovery technique for mobile computing systems. A checkpoint protocol typically functions as follows : the protocol periodically saves the state of the application on stable storage. When a failure occurs, the application rolls back to the last saved state and then restarts its execution. Checkpoint protocols proposed in the literature are not suitable for mobile environments because of disconnections. Another problem is that these previously proposed protocols do not adapt their behaviour to the characteristics of the current network connection. If the network has a poor Quality of Service like small bandwidth and a high failure rate, the protocol should be able to trade off recovery time with operational costs.

II. Related Work and Problem Formulation

a) *Related Work*

The most commonly used technique to prevent complete loss of computation upon failure is Coordinated checkpointing [2], [3], [4], [5], [13]. In this approach, the state of each process in the system is periodically saved on the stable storage, which is called a checkpoint of the process. To recover from a failure,

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the system restarts its execution from a previous consistent global checkpoint saved on the stable storage. In order to record a consistent global checkpoint, processes must synchronize their checkpointing activities. In other words, when a process takes a checkpoint, it asks to all relevant processes by sending checkpoint requests to take checkpoints. Therefore, coordinated checkpointing suffers from high overhead. The protocol presented in this paper shows performance improvement over the work reported in [3], [4], [6], [7] & [8]. The protocol designed by Acharya and Badrinath [6] requires to create a new checkpoint whenever they receive a message after sending a message. Processes also have to create a checkpoint prior to disconnection. Pardhan et al. [7] proposed two uncoordinated protocols. The first protocol creates a checkpoint everytime when a process receives a message. The second protocol creates checkpoints periodically and logs all messages received. P. Kumar and R. Garg [11] proposed a hybrid scheme, wherein an all process checkpoint is enforced after executing minimum-process algorithm for a fixed number of times. In the first phase, the MHs in the minimum set are required to take soft checkpoint only. Soft Checkpoint proposed by them is stored on the disk of the MH and is similar to mutable checkpoint [8]. In the minimum process algorithm, a process takes its forced checkpoint only if it is having a good probability of getting the checkpoint request; otherwise, it buffers the received messages.

S. Kumar, R.K. Chauhan and P.Kumar [12] proposed a soft checkpoint approach in which a process in minset [ ] takes a soft checkpoint first and then soft checkpoint will be discarded, if it receives aborted message from the initiator. These soft checkpoints are saved on main memory of the mobile hosts [MHs], and then the soft checkpoint will be saved on the stable storage of MSS at a later time only if they receive the hard checkpoint request from the initiator. Their scheme requires low battery power of MHs, low checkpoint latency, low transmission cost, and low recovery time due to reduced disk accessed of MSS by the MHs. As soft checkpoint approach is less reliable, to make it reliable they transfer the soft checkpoint on stable storage

The protocols proposed in [3], [4] & [8] follow two-phase commit distributed structure. In the first phase processes take temporary checkpoints when they receive the checkpoint request. These tentative checkpoints are stored in stable storage of MSS. In the second phase, if an MSS learns that all the processes have taken the temporary checkpoints successfully, initiator MSS sends commit message to all the participating nodes. In these checkpoints an MH has to transfer a large amount of data to its local MSS over its wireless network which results in higher checkpoint latency and recovery time as transferring such temporary checkpoints on stable storage may waste a large amount of computation power, bandwidth, energy and time.

The protocol proposed by us creates a checkpoint whenever the local timer expires, and it only logs the unacknowledged messages at checkpoint time. Our protocol uses two types of checkpoints to recover from failure. The two previous protocols proposed in [6] and [7] always assume hard failures.

b) *Problem formulation*

In mobile distributed system multiple MHs are connected with their local MSS through wireless links. During checkpointing, an MH has to transfer a large of amount of data like control variables, register values, environment variable to its local MSS over the wireless network. So, it consumes resources like bandwidth, energy, time and computation power.

Mobile host failures can be separated into two different categories. The first one includes all failures that cannot be repaired; for example, the mobile host falls and breaks, or is lost or stolen. The second category contains the failures that do not permanently damage the mobile host; for example, the battery is discharged and the memory contents are lost, or the operating system crashes. The first type of failure will be referred to as hard failures, and the second type as soft failures. The protocol should provide different mechanisms to tolerate the two types of failures. The objective of the present work is to design a checkpointing approach which is suitable for mobile computing environment.

c) *Basic idea*

The basic idea of the proposed protocol is to use time to coordinate the creation of global states. Whenever, the local timer expires, the processes save their states periodically. Two distinct types of checkpoints are created by processes. The first checkpoint called the *soft checkpoint* saved locally in the mobile hosts to tolerate soft failures. The second type of checkpoints is *hard checkpoints* which is stored on stable storage of MSS and is used to recover from hard failures. Soft checkpoints are less reliable than hard checkpoints as the same can be lost with hard failures. But soft checkpoints cost much less than hard checkpoints. For different network configurations, the protocol saves distinct number of soft checkpoints per hard checkpoint. For a slow network, many soft checkpoints can be crated to avoid network transmissions

For a given network configuration, the protocol can exchange hard failure recovery time with performance costs. Hard failures are recovered with global states containing only hard checkpoints. The amount of rollback due to hard failures is small on average if the protocol creates hard checkpoints frequently, which causes the protocol to perform poor.

However, Soft checkpoints keep the system in running mode correctly while the mobile host is disconnected. In other words, a disconnected mobile host can be viewed as a host connected to a network with no bandwidth. In this case, the number of soft checkpoints per hard checkpoint is set to infinity, which means that all processes' states are stored locally. The local checkpoints are used to recover the mobile host from soft failures.

III. The Proposed Checkpointing Algorithm

a) *System Model*

The mobile environment model used in this protocol contains both fixed and mobile hosts interconnected by a backbone network. The fixed hosts are called MSS and mobile hosts are connected to MSS by wireless links. A MSS is connected to another MSS by wired network. The static network provides reliable and sequenced delivery of messages between any two MSSs. Similary wireless link between MSS and MH ensures FIFO delivery of messages. An MH can directly communicate with MSS only if the MH is physically located in that MSS. A cell is a geographical area around MSS which can have many MH. An MH can freely move from one cell to another and change its geographical position. At any instant of time, an MH can belong to only one cell. If an MH does not leave its cell, then every message sent to it from local MSS would be received in sequence in which it is sent.

b) *Algorithm Concept*

We assume that the protocol maintains a unique checkpoint number counter, *CkpNum*, at each process to guarantee that the independently saved checkpoints verify the consistency property. Whenever the process creates a new checkpoint, the value of *CkpNum* is incremented and is piggybacked with every message. The consistency property is ensured if no process receives a message with a $CkpNum_i$ larger than the current local *CkpNum*. If $CkpNum_i$ is larger than the local *CkpNum*, the process creates a new checkpoint before delievering the message to the application. The recoverability property is guaranteed by logging at the sender all messages that might become in-transit. These are the messages that have not been acknowledged by the receivers at checkpoint time. The sender process also logs the send and receive sequence number counters. During normal operation, these counters are used by the communication layer to detect lost messages and duplicate messages due to retransmissions. After a failure, each process resends the logged messages. Duplicate messages are detected as they are during the normal operation.

c) *Creation of a global state*

Whenever a mobile host moves out of the range of the cell or user turns off the network interface, it becomes disconnected. In a disconnected mode, the mobile host cannot access any information that is stored on a stable storage. Due to this reason, the protocol must be able to perform its duties correctly using local information. The protocol continues to save soft checkpoints to recover from soft failures. Two types of disconnections are considered. A *Temporary disconnection* allows the protocol to exchange few messages with stable storage just before the mobile host becomes isolated. Examples include the situations where communication layer informs the protocol when mobile host moves outside the range of cell or the boundary areas where signal strength becomes weaker. A *permanent disconnection* implies the case in which protocol is not able to exchange any messages with stable storage. Example includes when use unplugs the cable without turning off the application.

The creation of a new global state before disconnection is necessary for both the mobile host and the other hosts. This new global state is important because it prevents the rollback of work that was done while the mobile host was disconnected. If the new global state is not saved and another host fails after the disconnection, the application rolls back to the last global state that was stored (without warning the mobile host). The mobile host cooperates with the stable storage to create a new global state before disconnection. Just before the mobile host becomes isolated, the protocol sends to stable storage a request for checkpoint, and saves a new checkpoint of the process (hard or soft, depending on the network). Then the stable storage broadcasts the request to the other processes. Processes save their state as they receive the request. New global states can only be created before the mobile host detaches from the network if disconnections are orderly.

When the mobile host reconnects, the protocol sends a request to stable storage, asking for the current checkpoint number and the CN of the last hard global state. When the answer arrives, the protocol updates the local CN using the current checkpoint number. The protocol also creates a hard checkpoint if the mobile host has been isolated for a long time.

d) *Working of the Algorithm*

We illustrate the execution of the protocol with the help of following figure. This figure (Figure 1) represents the execution of three processes. Processes create their checkpoints at different instants, because timers are not synchronized. After saving its CkpNum checkpoint, process P1 sends message m1. When m1 arrives, process P3 is still in its CkpNum-1 checkpoint interval. To avoid a consistency problem, P3 first creates its CkpNum checkpoint, and then delivers m1. P3 also

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resets the timer for the next checkpoint. Message m2 is an in-transit message that has not been acknowledged when process P2 saves its CkpNum checkpoint. This message is logged in the checkpoint of P2. Message m3 is a normal message that indirectly resynchronizes the timer of process P2. It is possible to observe in the figure the effectiveness of the resynchronization mechanism.

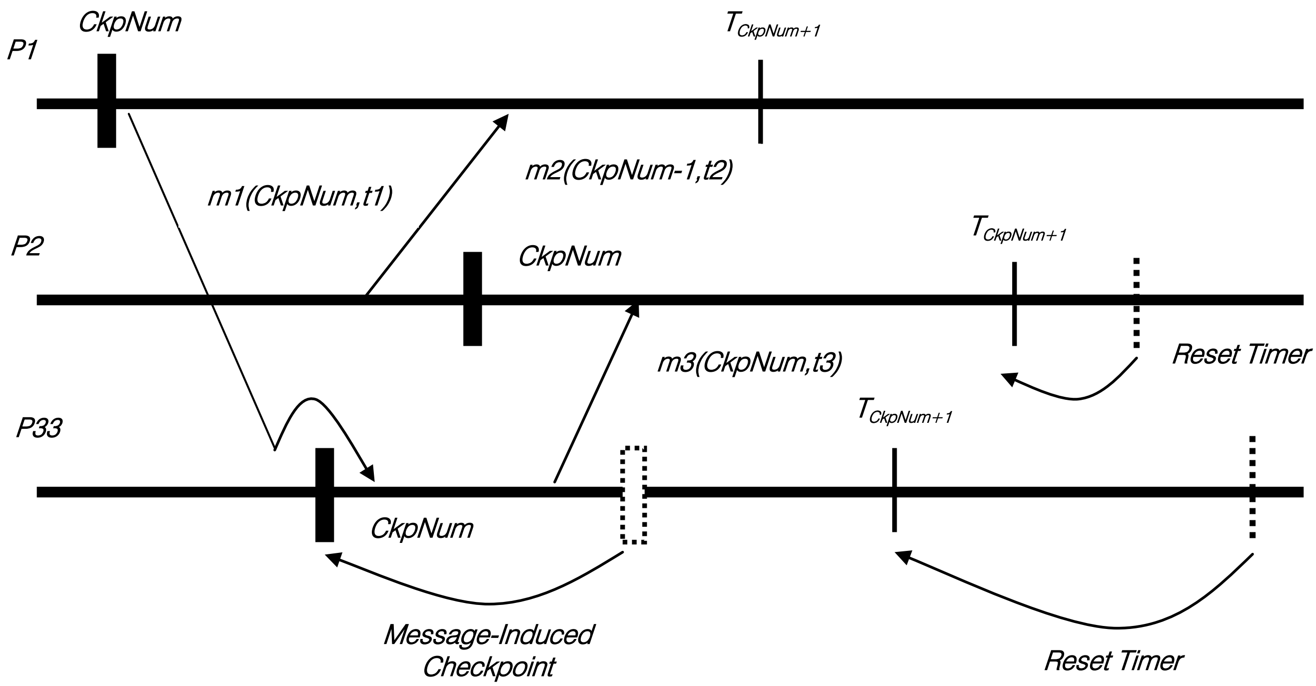

Figure 1:- Time-based soft checkpointing

e) *The Algorithm*

Following is the pseudocode of the algorithm. The algorithm uses the following local variables –

// S_i - Sender's Identifier

// $CkpNum_i$ – Current checkpoint number of the sender

// $timeToCkp_i$ – Time interval until next checkpoint

// msg_i – Message contents

i. *Message Receiving*

receiveMsg (S_i, $CkpNum_i$, $timeTockp_i$, msg_i)
if (($CkpNum$=$CkpNum_i$) and $getTimeToCkp$( ) > $timeToCkp_i$))
    resetTimer ($timeToCkp_i$);
else if ($CkpNum$<$CkpNum_i$) {
    CreateCkp ( );
    resetTimer($timeToCkp_i$);
}
delieverMsgToApplication (msg_i);

ii. *Application Process (At MH)*

createCkp ( ) :
    $CkpNum$: = $CkpNum$ +1;
    resetTimer (T);
    if (($CkpNum$ mod $maxsoft$) = 0) sendCkpST (getState ( ));
    else saveState (getState ( ), CkpNum);

C. Stable Storage (At MSS)

// The function arguments are same as in message receiving

receiveCkp (S_i, $CkpNum_i$, $timeTockp_i$, $state_i$)
    saveState ($state_i$, $CkpNum_i$);
    $CkpNum$: = max ($CkpNum$, $CkpNum_i$);
    setFlag ($CkpNum_i$, S_i);
    if (row ($CkpNum_i$) = 1) {
        $CkpHard$: = $CkpNum_i$;
        garbageCollect ($CkpHard$);
    }

The functions given above are used to create a new checkpoint. Function *createCkp* is called to save a new process state. It starts by incrementing the *CkpNum*, and then it resets the timer with the checkpoint period. Next, the function determines if the checkpoint should be saved locally or sent to stable storage. The function *saveState* stores the process state locally, and the function *sendCkp* sends the process state to stable storage. The function *receiveCkp* is called by the stable storage to store newly arrived checkpoints. It first writes the received state to the disk, and then updates the local checkpoint counter. Then, it determines if a new hard global state has been stored using a checkpoint table. The checkpoint table contains one row per *CkpNum*, and one column per process. The table entries are initialized to zero. An entry is set to one whenever the corresponding checkpoint is written to disk. The table only needs to keep one bit per entry, which means that it can be stored compactly. A new hard global state has been saved when all entries of a row are equal to one. The variable *CkpHard* keeps the checkpoint number of the new hard global state. The function garbageCollect removes all checkpoints with checkpoint numbers smaller than *CkpHard*.

IV. Adaptivity to Different Network Types

The protocol adapts its behavior to the characteristics of the network. If the network has a poor quality of service, the protocol saves many soft checkpoints before it sends a hard checkpoint to stable storage. The number of soft checkpoints stored per hard checkpoint is called *maxVal,* and it depends on the quality of service of the current network. The assignment of *maxVal* values to the different networks is made statically, and saved in a table. Table 1 gives two examples of possible assignments. The minimal quality of service corresponds to a disconnected mobile host. In this case, *maxVal* value is set to infinity, which means that only soft checkpoints are created. The minima *maxVal* column represents an assignment where hard checkpoints are created frequently, which guarantees a small re-execution time after a hard failure.

The maxima *maxVal* column corresponds to the opposite case. Application processes run on hosts that might be connected to different networks, each corresponding to a distinct *maxVal* value. This means that a global state can include both soft and hard checkpoints. To ensure that recovery is always possible, the protocol has to keep at each moment a global state containing only hard checkpoints. This global state is used to recover the application from hard failures. Otherwise, the domino effect [9] can occur, and recovery might not be possible. The protocol guarantees that new hard global states are saved by correctly initializing the *maxVal* table. The process that creates hard checkpoints less frequently is the one running in the host connected to the network with the worst quality of service. The protocol guarantees that a new hard global state is stored every time this process creates a hard checkpoint, by initializing the table in such a way that *maxVal* values are multiples of each other.

For example, if we have two processes P1 and P2 and the processes have *maxVal* value 2 and 4. This means that a new hard global state is created after every 2 and 4 soft checkpoints. Process P1 creates hard checkpoints whenever *CkpNum* is equal to 2, 4, 6, 8…. and process P2 creates whenever *CkpNum* is equal to 4, 8, 12, 16,….The protocol also keeps the last global state that was stored (which can include soft checkpoints) to recover from soft failures.

Table 1:- Creation of Hard Checkpoints

Quality Of Service	MaxVal	
	Minima	Maxima
Excellent	1	2
Good	2	8
Average	4	32
Poor	8	128
Disconnected	∞	∞

V. Comparison With the Related Work

In this section we compare our work with Acharya and Badrinath [6] and Pardhan et al. [7] since our work is very closely related to their work. The protocol designed by Acharya and Badrinath [6] requires to create a new checkpoint whenever they receive a message after sending a message. Processes also have to create a checkpoint prior to disconnection. Pardhan et al. [7] proposed two uncoordinated protocols. The first protocol creates a checkpoint every time when a process receives a message. The second protocol creates checkpoints periodically and logs all messages received. Also, the two protocols proposed in [6] and [7] always assume hard failures. These two algorithms have the following good features:

1. Only those processes that have received some message after sending a message, take checkpoints during checkpointing [6] or when process receives a message [7] thereby reducing the number of checkpoints to be taken.
2. Reductions in the number of checkpoints help in the efficient use of the limited resources of mobile computing environment.
3. Uses minimum interaction (only once) between the initiator process and the system of n processes and there is no synchronization delay.

However, the algorithms have a limitation too. Consider a system of n process distributed system. Let, the cost of sending a checkpoint request message from initiator to a single process be C_i. Hence, the checkpoint request cost, incurred by a single execution of the checkpointing algorithm, would be (n-1)C_i. Thus, the checkpoint request cost, incurred by k executions of the checkpointing algorithm, would amount to k(n-1)C_i. Therefore, the checkpoint request overhead, for applications involving large number of processes and running for longer durations, increases exponentially.

In the present work, we have attempted to eliminate above problem by using timer. It is a well-known fact that the use of timer eliminates extra

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coordination messages [10]. A process takes checkpoint whenever its local timer expires. Moreover, only those processes take checkpoint, after expiry of their local timer, who have sent at least one message in the current checkpoint interval. Therefore, the number of processes taking checkpoint and, subsequently, the total number of checkpoints is significantly reduced. In addition, the use of timer removes need of the initiator process for sending the checkpointing request messages.

Our protocol creates a checkpoint whenever the local timer expires, and it only logs the unacknowledged messages at checkpoint time. Our protocol uses two types of checkpoints to recover from failure - *soft checkpoints* created and stored in MH to recover from soft failures and *hard checkpoints* created and stored at MSS to recover from permanent failures. Table 2 gives a comparison of our work on different parameters with the protocols proposed in [6] and [7].

Table 2 : Comparison with the related work

Parameters	Acharya and Badrinath [6]	Pardhan et al. [7]	Our Protocol
Creation of checkpoint	When a new message is received after sending a message	When process receives message	When local timer expires
No. of checkpoint phases	1	1	2
Failure assumed	Hard	Hard	Hard and Soft
Adaptable	No	Depend on wireless bandwidth	Vary with QoS of network
Coordination Method	Message based	Message based	Timer Based
Checkpoint Latency	High	High	Low
Transmission Cost	High	High	Low
Recovery Time	High	High	Less
CPU Overhead	High	High	High
Additional Hardware	Not Required	Not Required	Additional processor is required on MH
Main Memory requirement	Low	Low	High
Reliability	Low	Low	High
Efficiency	Low	Low	High
Suitability	For Large Systems	For Large Systems	For Large and small systems

VI. Conclusion

In our proposed approach, a have described a protocol that is able to save consistent recoverable global states. The process creates a new checkpoint whenever the local timer expires. The protocol stakes a soft checkpoint and saves it on the mobile host and later on before disconnection converts it to the hard checkpoint that is stored on MSS as soft checkpoint is less reliable. The protocol adapts its behavior to different types of networks by changing the number of soft checkpoints to be taken per hard checkpoint. When the mobile host is disconnected, the protocol creates soft checkpoints to recover from soft failures. The main features of our algorithm are: (1) it is non-blocking; (2) it is adaptive because it takes checkpointing decision on the basis of checkpoint sequence number; (3) it doesn't require tracking and computation of dependency information; (4) it doesn't require any control message because it uses timer to indirectly coordinate the creation of consistent global checkpoints and the local timers are not synchronized through control messages but by piggybacking control information on application messages.

References Références Referencias

1. C. Chowdhury, S. Neogy, "A Consistent Checkpointing- Recovery Protocol for Minimal number of Nodes in Mobile Computing System", *in International Conference on High Performance Computing*, pp-599-611, 2007.
2. Koo, R. and Toueg, S. (1987) 'Checkpointing and roll-back recovery for distributed systems', IEEE Trans. on Software Engineering, Vol. 13, No. I, January, pp.23–31.
3. G. Cao and M. Singhal, "On Coordinated Checkpointing in Distributed Systems," IEEE Trans. Parallel and Distributed System pp. 1213-1225, Dec. 1998.
4. E.N. Elnozahy, D.B. Johnson, and W. Zwaenepoel, ªThe Performance of Consistent Checkpointing,º Proc. 11th Symp. Reliable Distributed Systems, pp. 86-95, Oct. 1992.
5. R. Prakash and M. Singhal, "Low-Cost Checkpointing and Failure Recovery in Mobile Computing Systems," IEEE Trans. Parallel and Distributed Systems, pp. 1035-1048, Oct. 1996.
6. Acharya, A. and Badrinath, B.R. Checkpointing distributed applications on mobile computers. In Proceedings of the Third International Conference on Parallel and Distributed Information Systems (Austin, Texas, Sep, 1994), pp 73-80.

7. Pradhan, D.K., Krishna, P., and Vaidya, N.H. Recovery in mobile environments: Design and trade-off analysis. In Proceedings of the 26th International Symposium on Fault-Tolerant Computing, (Sendai, Japan, June 1996), IEEE, pp. 16–25.
8. G. Cao and M. Singhal., "Mutable Checkpoints : A New checkpointing Approach for Mobile Computing Systems", In Proceedings of the IEEE Trans. Vol. 12, No. 2, pp-157-172, Feb. 2001
9. Randell, B. System structure for software fault tolerance. IEEE Trans. Softw. Eng. SE-1, 2 (June 1975), 220–232.
10. N. Neves, "Time-based coordinated checkpointing," Ph.D. dissertation, UIUCDCS-R-98-2054, University of Illinois at Urbana-Champaign, 1998.
11. P. Kumar and R. Garg, "Soft checkpointing based coordinated checkpointing protocol for Mobile Distributed Systems", International Journal of Computer Science Issues, Vol. 7, Issue 3, No. 5, May, 2010
12. S. Kumar, R.K. Chauhan and P. Kumar, "Reliable Soft-Checkpoint Based Fault Tolerance Approach for Mobile Distributed Systems", International Journal of Computer and Network Security", Vol. 2, No., June, 2010
13. Parveen Kumar, R K Chauhan, "A Coordinated Checkpointing Protocol for Mobile Computing Systems", International Journal of Information and Computing Science, Vol. 9, No. 1, pp. 18-27, 2006.

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Robust Image Watermarking in contourlet Domain Using Genetic Algorithm

By A.Arulmurugan, N.Arul, P.Santhosh kumar
Anna University

Abstract- In this paper objective is to develop a robust image watermarking method in contourlet domain using GA(Genetic Algorithm) to improve the quality and robustness of the watermarked image, by reducing the (BER)Bit Error Rate to with stand against common image processing attacks. Selecting more Co-efficient in more directions is achieved by means of combining Laplacian Pyramid with Directional filter bank structure which captures directional information efficiently.

Keywords: Image Watermarking Genetic Algorithm(GA) Bit Error Rate(BER) Extraction Algorithm; Embedded Algorithm Watermarking Techniue phrase peak signal-to-noise ratio (PSNR);

GJCST Classification: I.4.m

ROBUST IMAGE WATERMARKING IN CONTOURLET DOMAIN USING GENETIC ALGORITHM

Robust Image Watermarking in contourlet Domain Using Genetic Algorithm

A.Arulmurugan[α], N.Arul[Ω], P.Santhosh kumar[β]

Abstract- **In this paper objective is to develop a robust image watermarking method in contourlet domain using GA(Genetic Algorithm) to improve the quality and robustness of the watermarked image, by reducing the (BER)Bit Error Rate to with stand against common image processing attacks. Selecting more Co-efficient in more directions is achieved by means of combining Laplacian Pyramid with Directional filter bank structure which captures directional information efficiently.**

Keywords: Image Watermarking; Genetic Algorithm(GA);Bit Error Rate(BER); Extraction Algorithm;Embedded Algorithm; Watermarking Technique; phrase peak signal-to-noise ratio(PSNR);

I. Introduction

Digital Watermarking is the process of possibly irreversibly embedding information into a digital signal. The signal may be audio, video, or pictures for example. If the signal is copied then the information is also carried in the copy.

In visible watermarking, the information is visible in the picture or video. Typically, the information is text or a logo which identifies the owner of the media. The image on the right has a visible watermark. When a television broadcaster adds its logo to the corner of transmitted video, this is also a visible watermark.

In invisible watermarking, information is added as digital data to audio, picture or video, but it cannot be perceived as such (although it may be possible to detect that some amount of information is hidden). The watermark may be intended for widespread use and is thus made easy to retrieve or it may be a form of Steganography, where a party communicates a secret message embedded in the digital signal. In either case, as in visible watermarking, the objective is to attach ownership or other descriptive information to the signal in a way that is difficult to remove. It is also possible to use hidden embedded information as a means of covert communication between individuals.

One application of watermarking is in copyright protection systems, which are intended to prevent or deter unauthorized copying of digital media. In this use a copy device retrieves the watermark from the signal before making a copy; the device makes a decision to copy or not depending on the contents of the watermark. Another application is in source tracing. A watermark is embedded into a digital signal at each point of distribution. If a copy of the work is found later, then the watermark can be retrieved from the copy and the source of the distribution is known. This technique has been reportedly used to detect the source of illegally copied movies.

While some file formats for digital media can contain additional information called metadata, digital watermarking is distinct in that the data is carried in the signal itself.

The use of the word of watermarking is derived from the much older notion of placing a visible watermark on paper.

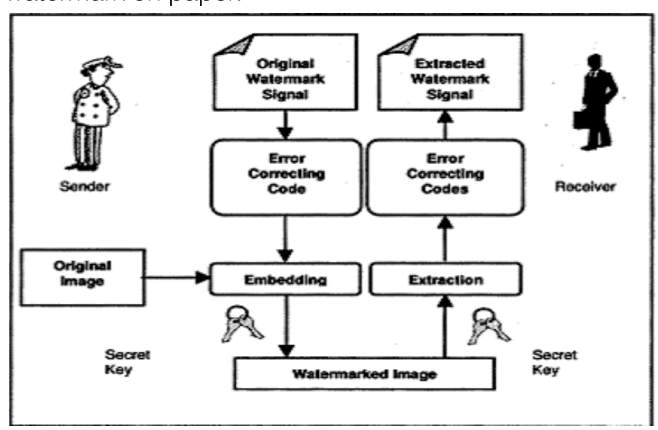

Figure 1: Watermarking Technique

II. Proposed Work

a) *Contourlet Domain*

Main aim of the proposed work is to select more co-efficient in more directions in order to increase the quality and robustness when compared with the existing work.

b) *Advantages Of Contourlet Domain*

- Contourlet possesses the important properties of directionality and anisotropy which wavelets do not possess and so it outperforms wavelets in many image processing applications.
- Contourlet provides a much richer set of directions and shapes than wavelets and thus is more efficient in capturing smooth contours.
- Contourlet is a multidirectional and multi-scale transform and is obtained by combining both Laplacian Pyramid (LP) and Directional Filter Bank (DFB). After Laplacian Pyramid, each band pass image is passed through a series of

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directional filter banks. The required number of directions can be specified by the user.

- Contourlet gives more edges, it is more suitable for data hiding applications and more data can be hidden in the high frequency regions without perceptually distorting the original image.

c) *Image Processing with MatLab*

Image processing is a very important and widely used process in which images are processed to retrieve information that is not visible to the naked eye, as well as it is used in a large number of other applications where the standard picture is not enough.

The first step is to download all the 'jpg' and 'tif' files that are to be used in this lab. Locate them as a link on the webpage.

The second step is to set the directory of MatLab to the directory which contains your\ image files. Be sure that you create this directory on your U-drive. We can do this by first typing cd on the MatLab prompt. Usually the default setting is:
c:\MatlabR12\work

If this is so, change the directory by simply typing cd.. which changes the directory to c:\Matlab. We can repeat the step to go to C:\ drive and then type cd d:\. This will change the MatLab directory to our'd' drive. In order to read the image use the following command in MatLab imread('filename'); This command will save the image in the Image detail module.

Format	Variants
BMP	1-bit, 4-bit, 8-bit, 16-bit, 24-bit, and 32-bit uncompressed images; 4-bit and 8-bit run-length encoded (RLE) images
CUR	1-bit, 4-bit, and 8-bit uncompressed images
HDF	8-bit raster image datasets, with or without an associated colormap; 24-bit raster image datasets
ICO	1-bit, 4-bit, and 8-bit uncompressed images
JPEG	Any baseline JPEG image; JPEG images with some commonly used extensions
PBM	Any 1-bit PBM image; raw (binary) or ASCII (plain) encoded
PCX	1-bit, 8-bit, and 24-bit images
PGM	Any standard PGM image; ASCII (plain) encoded with arbitrary color depth; raw (binary) encoded with up to 16 bits per gray value
PNG	Any PNG image, including 1-bit, 2-bit, 4-bit, 8-bit, and 16-bit grayscale images; 8-bit and 16-bit indexed images; 24-bit and 48-bit RGB images
PPM	Any PPM image; ASCII (plain) encoded with arbitrary color depth; raw (binary) encoded with up to 16 bits per color component
RAS	Any RAS image, including 1-bit bitmap, 8-bit indexed, 24-bit truecolor and 32-bit truecolor with alpha
TIFF	Any baseline TIFF image, including 1-bit, 8-bit, and 24-bit uncompressed images; 1-bit, 8-bit, and 24-bit images with packbits compression; 1-bit images with CCITT compression; also 16-bit grayscale, 16-bit indexed, and 48-bit RGB images
XWD	1-bit and 8-bit ZPixmaps; XYBitmaps; 1-bit XYPixmaps

Figure 2: Different Image Formats

Since bitmap images are fairly large, they take a long time to convert into matrices. Hence we stick to jpeg and tiff image formats in this lab.

III. Embedding Phase

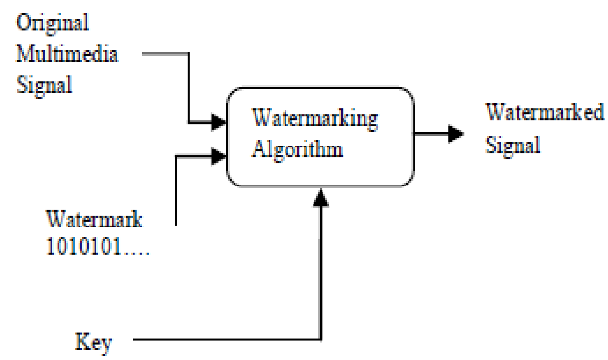

Figure 3: Embedding watermarks

d) *Implementation Of Genetic Algorithm*

i. *Initialization*

The Chromosomes are initialized by using the population size, no. of Objective functions, no. of decision variables, minimum and maximum range of decision variables.

Function f = initialize variables (N, M, V, min_tange, max_range)

Where,

N - Population size M - Number of objective functions V - Number of decision variables. min_range - A vector of decimal values which indicate the minimum value for each decision variable.

max_range - Vector of maximum possible values for decision variables.

ii. *Evaluation function*

The Evaluation function evaluates one chromosome at a time and returns the value for the objective function. The decision variables are used to form the objective function.

Function f = evaluate objective(x, M, V)

Function to evaluate the objective functions for the given input vector x. x is an array of decision variables and f(1), f(2), etc are the objective functions. The algorithm always minimizes the objective function hence if you would like to maximize the function then multiply the function by negative one.

Where,

M is the number of objective functions.

V is the number of decision variables.

Exp (-4*x (1))*(sin(6*pi*x(1))) ^6

1 - exp(-4*x(1))*(sin(6*pi*x(1))) ^6.

©. Genetic Operator

This function is used to produce offsprings from parent chromosomes by the set of selected chromosomes.

Function f = genetic operator (parent chromosome, M, V, mu, mum, l_limit, u_limit)

Where,

M - Number of objective functions.

V - Number of decision varaiables.

Mu - distribution index for crossover.

Mum - distribution index for mutation.

l_limit - a vector of lower limit for the Corresponding decision variables.

u_limit - a vector of upper limit for the corresponding decision variables.

iii. Selection

The individuals are selected by using their rank that is obtained through their fitness value and it is continued till the cross-over area gets filled. Before that checking of every individuals contains the same number of elements is performed.

Function tournament_selection (chromosome, pool_size, tour_size)

Tournament selection process

In a tournament selection process n individuals are selected at random, where n is equal to tour_size. From these individuals only one is selected and is added to the mating pool, where size of the mating pool is pool_size. Selection is performed based on two criteria. First and foremost is the rank or the front in which the solutions reside. Individuals with lower rank are selected. Secondly if the rank of two individuals is the same then, the crowding distance is compared. Individuals with greater crowding distance are selcted.The size of chromosome is taken. The number of chromosome is not important while the number of elements in chromosome is important.

S. No.	G4	G3	G2	G1	Fitness	Rank
C1	0	1	0	0	4	1
C2	1	0	0	0	8	2
C3	1	1	0	0	12	4
C4	1	0	1	0	10	3

Table 1: Rank Calculation

iv. Cross over and Mutation

Cross over operation is performed by using the probability with 90%. Two individuals are selected and it is checked that the selected two individuals for cross over operation not the same. The information of the two selected parent chromosomes is collected and the cross over operation is performed for each decision variable in the parent chromosome.

Function f= replace_chromosome (intermediate_chromosome,pro,pop)

This function replaces the chromosomes based on rank and crowding distance. Initially until the population size is reached each front is added one by one until addition of a complete front which results in exceeding the population size. At this point the chromosomes in that front are added subsequently to the population based on crowding distance.

- $C_{i,k}$ = Child.
- $p_{i,k}$ = Selected parent.
- β_k = Random number.

$$c_{1,k} = \frac{1}{2}\left[(1-\beta_k)p_{1,k} + (1+\beta_k)p_{2,k}\right]$$

$$p(\beta) = \frac{1}{2}(n_c+1)\beta^{n_c}, \text{if } 0 \leq \beta \leq 1$$

Operations of Cross over

Selected Individuals

S. No.	G4	G3	G2	G1	Fitness
C3	**1**	**1**	0	0	12
C4	1	0	**1**	**0**	10

Table 2: Selected Individuals subjected under Cross over Operation

After Cross over

S.No.	G4	G3	G2	G1	Fitness
C34	1	1	1	0	14

Table 3: After Cross over

Mutation is performed with a probability of 10% and it is based on polynomial mutation. Mutation is performed on the selected element of the chromosome and the selected element is inverted or reversed to obtain a new child as a resulting chromosome.

$$C_k = p_{ike} + (p_k^u - p_k^{t})\delta_k.$$

Where,

S.No	G4	G3	G2	G1	Fitness
M34	1	1	1	1	15

Ck is the child.

Pk is the parent.

P_k^u is the upper bound on the parent component.

P_k^t is the lower bound on the parent component.

δ_k is small variation which is calculated from a polynomial distribution.

$$\delta_k = 1-[2(1-r_k)]^{\frac{1}{n_m+1}} \quad \text{if rk} < 0.5$$

$$\delta_k = (2r_k)^{\frac{1}{n_m+1}} -1 \quad \text{if rk} > 0.5$$

Where,

rk is an uniformly sampled random number between (0,1).

η_m is mutation distribution index.

After Mutation

Table 4: After Mutation

v. Embedding Algorithm

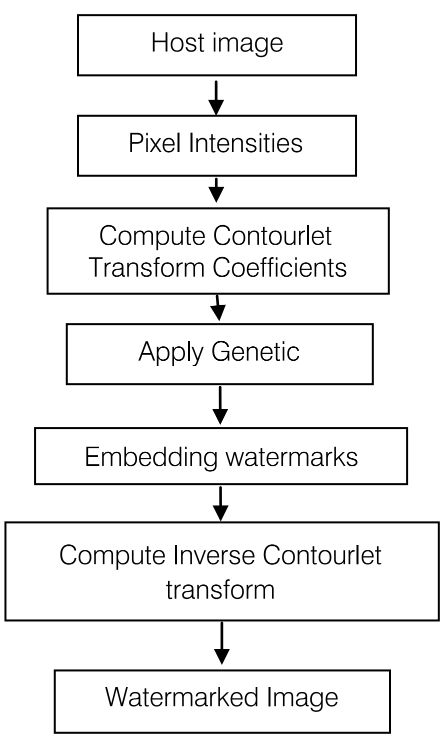

Figure 4: Embedding process

In Embedding phase, an image that is transformed into binary format is inserted in the original image as the watermark.

The Embedding Algorithm is as following:

1. The original image is decomposed into its sub bands using contourlet transform.

In Contourlet, the number of directional subbands at each level is set to 2n where n is a positive integer number. Forexample, if we choose to decompose an image into four levels using n= (1, 2, 3, 4) then we get 2, 4, 8, and 16 subbands

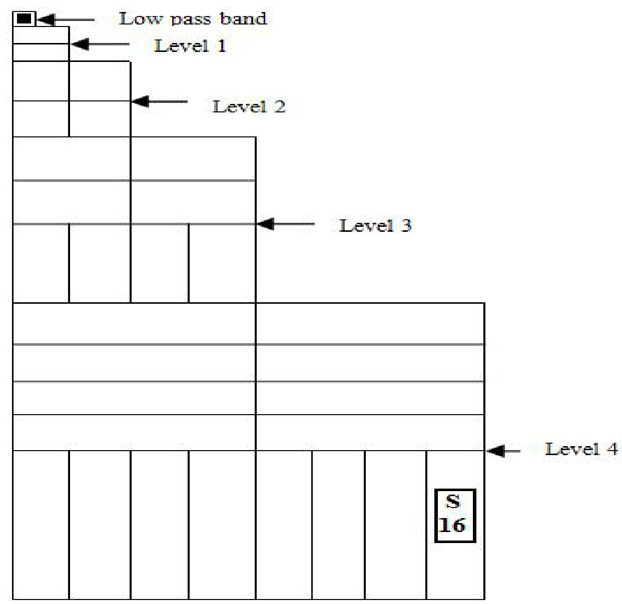

Figure 5: Contourlet decomposition

y = dfbdec(x, fname, n).

Where,

X: input image.

Fname: filter name.

n: number of decomposition tree levels.

Filters

[h0, h1] = dfilters (fname, type).

Where,

h0, h1: filter pair (low pass and high pass).

Fname:Filter name.

Type:'d' or 'r' for decomposition or reconstruction filters.

2. An image is taken and it is converted into binary format using decimal to binary format and it must be embedded with sub band Coefficients.

- Output Binary image=dec2bin(Input image , No. of frames);

For eg:

X=dec2bin(s,8);

3. The Sub band Co- efficients is selected by using a threshold value.
4. Genetic algorithm is applied to the Co efficient to increase the robustness and quality simultaneously.
5. Then the watermarks are embedded in the selected Co-efficients.

   In order to embed a zero bit in a Contourlet sub band, the standard deviation of its coefficients magnitude is set to zero. A one bit, is inserted with an increase in this standard deviation.

   The following rules are used for embedding:

   a. If watermark bit is zero,

$$\bar{c} = \frac{|c_1| + |c_2| + |c_3|}{3}$$

$$c_i' = sign(c_i) \times \bar{c} \quad i = 1,2,3$$

b.To insert one bit, the sub band coefficients will be changed as equation

$$c_i' = c_i + sign(c_i) \times \lambda_i \;\; i = 1,2,3$$

Where,

sign is the sign function.

λ_i is a positive constant.

6. Then perform inverse contour let transform to obtain the watermarked image.

   x = dfbrec(y, fname).

   Where,

   y: sub band images.

   fname: filter name

   x: reconstructed image

VII. Extraction Phase

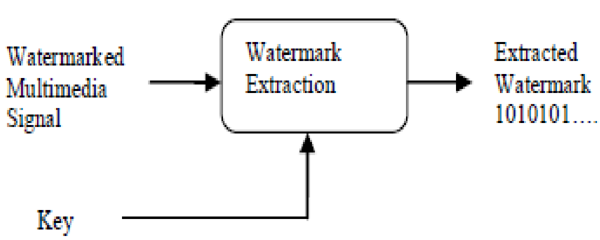

Figure 6: Extractions of Watermarks

a) *Extraction Algorithm*

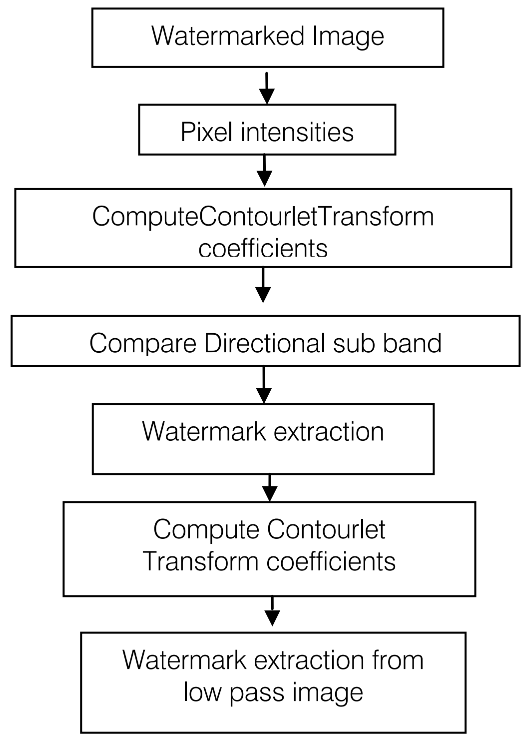

Figure 7: Extraction Process

Steps

1. The watermarked image is decomposed to sub bands LL3, HL3, LH3 and HH3 using three-level Contour let transform.
2. The significant Co efficients are extracted using the positions which are used in the step 3 of embedding algorithm.
3. For each Contour let sub band, the standard deviation of its coefficients is calculated and then is compared to a given constant threshold. The watermark bit is considered 1 (0) if the standard deviation is higher (less) than the threshold.
4. The extracted watermarks sequence is compared with the embedded watermarks sequence. The similarity of two sequences, is calculated as,

$$BER = \frac{\sum_{i=1}^{m} |msg(i) - \overline{msg}(i)|}{m}$$

Where,

m is the number of watermark bits.

BER represent bit error rate.

Embedded watermark is extracted completely, if BER is equal to zero.

IV. Experimental Results

a) *Input image*

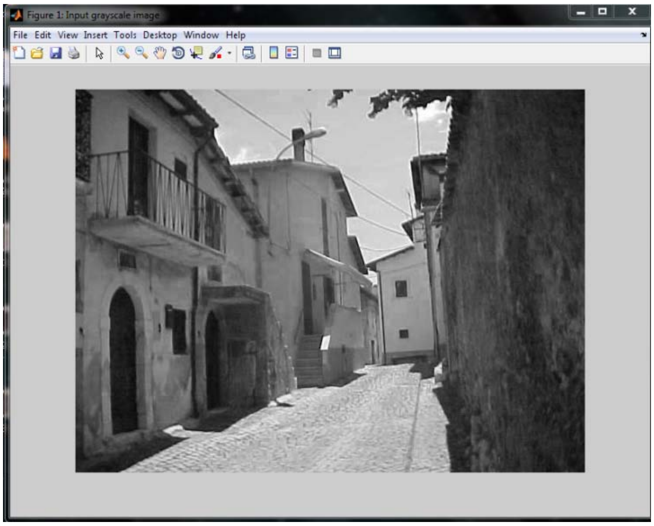

Figure 8: Input Image

b) *Image to be Merged*

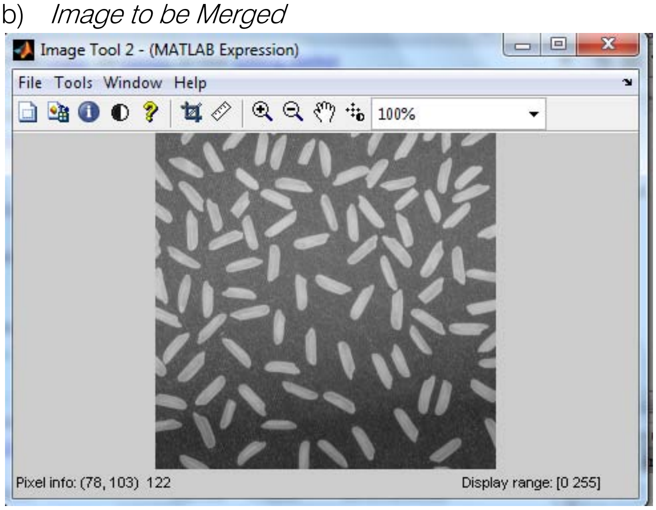

Figure 9: Image to be merged

c) *Image values*

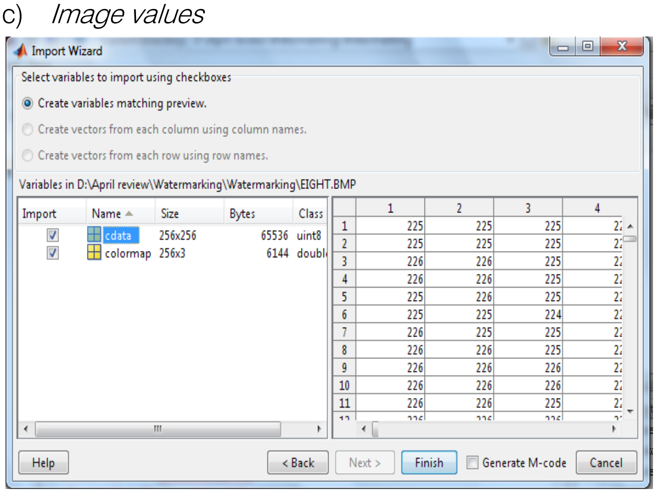

Figure 10: Unsigned integer values of the image

d) *Image values*

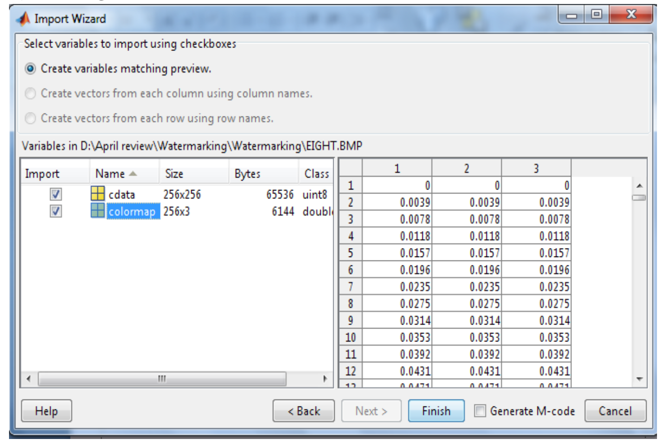

Figure 11: Double values of the image

e) *Watermarked*

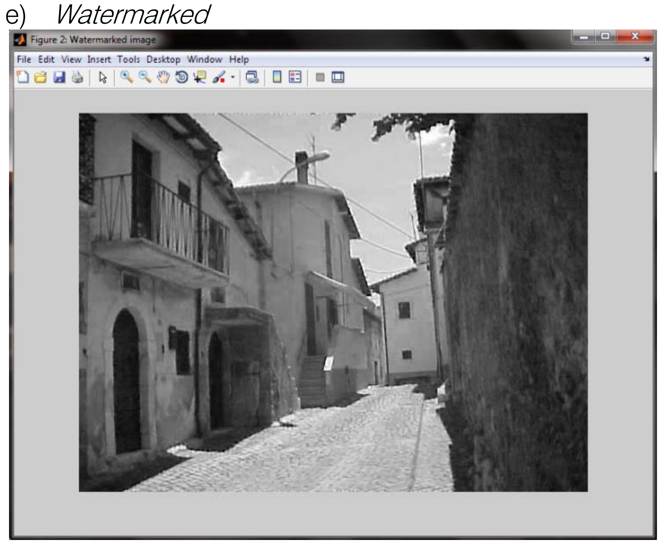

Figure 12: Watermarked image

f) *Different Pixels*

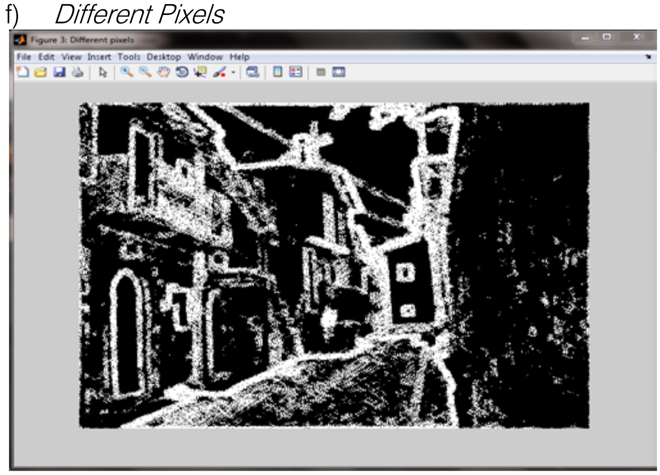

Figure 13: Different pixels of the image

g) *Binary Image '0'*

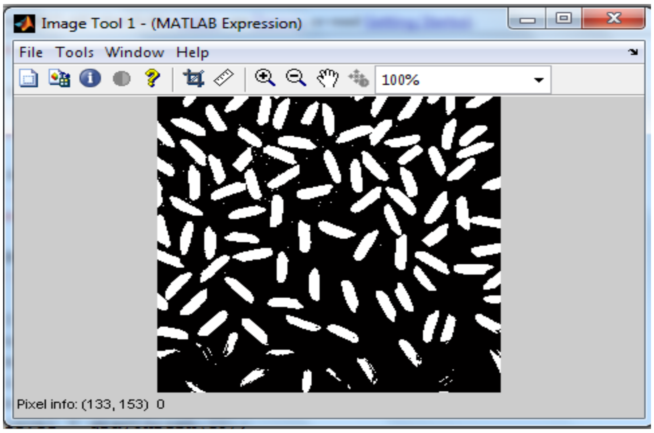

Figure 14: Binary values '0' of the image

h) *Binary image "1"*

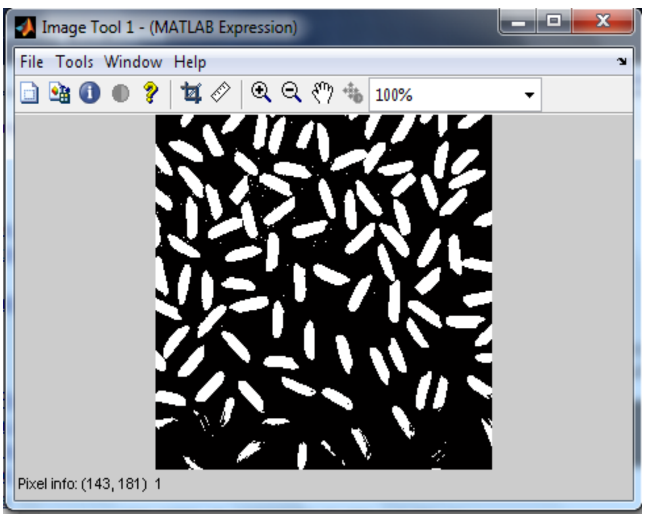

Figure 15: Binary values '1' of the image

i) *Detection of watermarks*

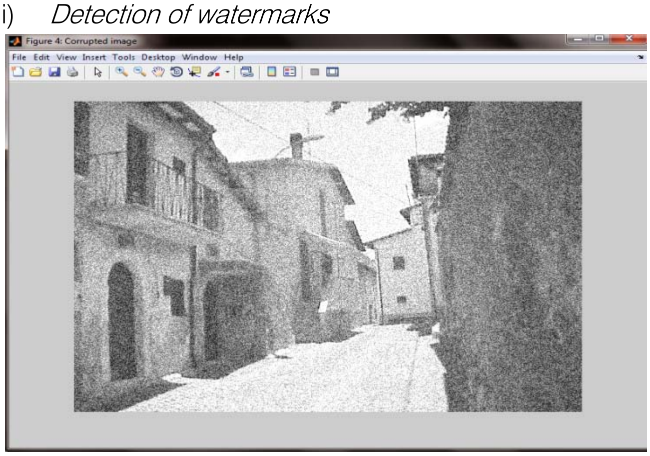

Figure 16: Detection of watermarks

V. Performance Evaluation

a) *PSNR*

The phrase peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale.

The PSNR is most commonly used as a measure of quality of reconstruction of lossy compression codecs (e.g., for image compression). The signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codecs it is used as an approximation to human perception of reconstruction quality, therefore in some cases one reconstruction may appear to be closer to the original than another, even though it has a lower PSNR (a higher PSNR would normally indicate that the reconstruction is of higher quality). One has to be extremely careful with the range of validity of this metric; it is only conclusively valid when it is used to compare results from the same codec (or codec type) and same content.

It is most easily defined via the mean squared error (MSE) which for two m×n monochrome images I and K where one of the images is considered a noisy approximation of the other is defined as:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The **PSNR** is defined as:

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

Where,

m is the number of watermark bits and BER represent bit error rate.

Embedded watermark is extracted completely, if BER is equal to zero.

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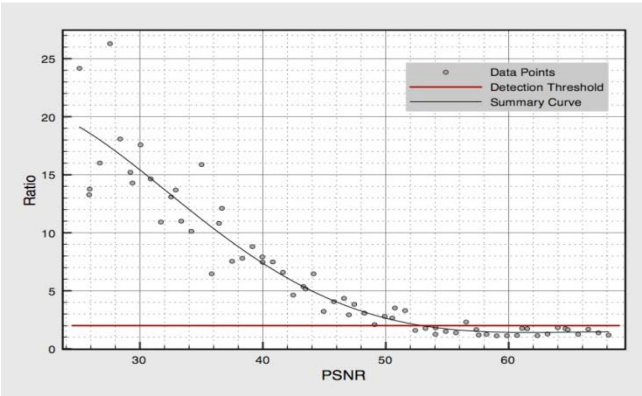

Figure 17: Calculating PSNR with Pixel ratio

PSNR of Watermarked image (45.74db), Wavelet (38.24db)

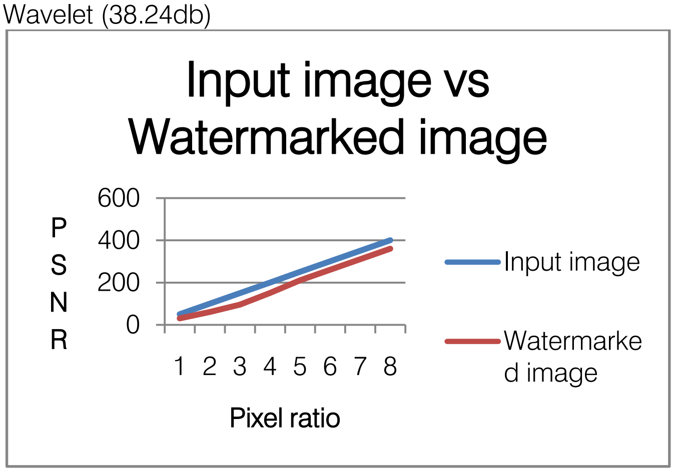

Figure 18: Input image Vs Watermarked image

b) *Bit Error Rate*

In digital transmission, the bit error rate or bit error ratio (BER) is the number of received bits that have been altered due to noise, interference and distortion. It is find out by the difference in the no. of bits that are embedded in the original image and the watermarks that are extracted from the watermarked image.

Sl. No.	Attacks	BER (Contourlet)	BER (Wavelet)
1.	Blurring	10/72	14/72
2.	Median filtering	13/72	17/72
3.	Histogram Equalization	2/72	4/72
4.	Sharpening	11/72	16/72

Table 5: Comparison of BER

VI. Conclusion and Future Enhancement

Robustness and fidelity are two major requirements in image watermarking that have opposite effect on watermarked images. There are a few methods that provide high robustness against other common image processing attacks, simultaneously.

The aim of this work is to improve the robustness against common image processing attacks. In this regard, the watermarking technique is improved by selecting the larger coefficients of third level Contourlet transform to ensure higher robustness and determine the variation of coefficients constants using Multi-Objective Genetic Algorithm. MOGA provides a good balance between the robustness and the fidelity requirements, but it increases the running time in embedding phase.

To show the superiority of this method, experimental results obtained by watermarking is compared with standard image using this method. As shown in experimental results section this method shows improvement in robustness against common image processing attacks (blurring, histogram equalization, sharpening, noise addition and median filter).

This algorithm can be implemented in latest transform domains such as Curvelet and D-Tree Complex Wavelet to use their potential capabilities. In curvelet selecting more coefficients in multiple directions is possible and in D-Tree complex wavelet using the coefficients in both phase and magnitude is possible. In addition, introducing new approaches for specifying the significant triplets can result to select more reliable coefficients (in term of robustness) for watermarking.

References Références Referencias

1. B.Chandra Mohan and S.Srinivas Kumar, “Robust Digital watermarking scheme using Contourlet transform”, International Journal of Computer Science and Network Security, Korea, 2008, pp.43-51.
2. Guiduo Duan, A.T.S. Ho, and Xi Zhao, "A novel non-redundant contourlet transform for robust image watermarking against non geometrical and geometrical attacks". 5th International Conference on Visual Information Engineering (VIE 2008), Xi'an, China, 29 July-1 Aug. 2008, (CP543), p. 124 -129.
3. Do, Minh N, and Vetterli M. “The contourlet Transform: An efficient directional multi resolutional image representation”, In IEEE transactions on Image Processing, Institute of Electrical and Electronics Engineers, New York, NY, 2005, pp. 2091-2106

4. D. D.-Y. Po and M. N. Do, "Directional multiscale modeling of images using the contourlet transform," IEEE Trans. On Image Processing, 2003, p 123-129.
5. P. Hong and M. J. T. Smith, "An octave-band family of non-redundant directional filter banks," in IEEE proc. ICASSP, vol. 2, pp. 1165-1168, 2002.
6. Hans-Georg Beyer and Kalyanmoy Deb. On Self-Adaptive Features in Real-Parameter Evolutionary Algorithm. IEEE Transactions on Evolutionary Computation, 5(3):250-270, June 2001.
7. Kalyanmoy Deb, Amrit Pratap, Sameer Agarwal, and T. Meyarivan. A Fast Elitist Multi-objective Genetic Algorithm: NSGA-II. IEEE Transactions on Evolutionary Computation, 6(2):182-197, April 2002.
8. M. M. Raghuwanshi and O. G. Kakde. Survey on multiobjective evolutionary and real coded genetic algorithms. In Proceedings of the 8th Asia Pacic Symposium on Intelligent and Evolutionary Systems, pages 150-161, 2004.
9. Miller, M. L., I. J. Cox, J. M. G. Linnartz, and T. Kalker, "A review of watermarking principles and practices," IEEE International Conference on Image Processing, 1997.
10. Liu, R. and T. Tan, "An SVD-based watermarking scheme for protecting rightful ownership," IEEE Trans. on Multimedia, Vol. 4, No. 1 March 2002.
11. D. Kundur, D. Hatzinakos, "A Robust Digital Image Watermarking Scheme Using the Wavelet-Based Fusion," icip, vol. 1, pp.544, 1997 International Conference on Image Processing (ICIP'97) - Volume 1, 1997.
12. M.D. Swanson, M. Kobayashi, and A.H. Tewfik, "Multimedia data embedding and watermarking technologies," Proceed. of the IEEE, vol. 86, no. 6, pp. 1064–1087, 1998.
13. Cox, J. Kilian, F. T. Leigton, and T. Shamoon. Secure spread spectrum watermarking for multimedia. IEEE Trans. on Image Processing, 6:1673–1687, Dec. 1997.
14. M. N. Do and M. Vetterli. The contourlet transform: An efficient directional multiresolution image representation. IEEE Trans. on Image Processing, 14(12):2091-2106, Dec. 2005.
15. S. P. Maity and M. K. Kundu. A blind cdma watermarking scheme in wavelet domain. IEEEInt. Conf Image Processing,pages 2633-2636, Oct. 2004.

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Vertical Handover decision schemes using SAW and WPM for Network selection in Heterogeneous Wireless Networks

By K.Savitha, Dr.C.Chandrasekar
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Abstract- Seamless continuity is the main goal and challenge in fourth generation Wireless networks (FGWNs), to achieve seamless connectivity "HANDOVER" technique is used, Handover mechanism are mainly used when a mobile terminal(MT) is in overlapping area for service continuity. In Heterogeneous wireless networks main challenge is continual connection among the different networks like WiFi, WiMax, WLAN, WPAN etc. In this paper, Vertical handover decision schemes are compared, Simple Additive Weighting method (SAW) and Weighted product model (WPM) are used to choose the best network from the available Visitor networks (VTs) for the continuous connection by the mobile terminal. In our work we mainly concentrated to the handover decision phase and to reduce the processing delay in the period of handover. In this paper both SAW and WPM methods are compared with the Qos parameters of the mobile terminal (MT) to connect with the best network.

Keywords: Handover, Vertical handover decision schemes, Simple additive weighting, Weight product method.

GJCST Classification: C.2.1

VERTICAL HANDOVER DECISION SCHEMES USING SAW AND WPM FOR NETWORK SELECTION IN HETEROGENEOUS WIRELESS NETWORKS

Strictly as per the compliance and regulations of:

Vertical Handover decision schemes using SAW and WPM for Network selection in Heterogeneous Wireless Networks

K.Savitha[α], Dr.C.Chandrasekar[Ω]

Abstract- Seamless continuity is the main goal and challenge in fourth generation Wireless networks (FGWNs), to achieve seamless connectivity "HANDOVER" technique is used, Handover mechanism are mainly used when a mobile terminal(MT) is in overlapping area for service continuity. In Heterogeneous wireless networks main challenge is continual connection among the different networks like WiFi, WiMax, WLAN, WPAN etc. In this paper, Vertical handover decision schemes are compared, Simple Additive Weighting method (SAW) and Weighted product model (WPM) are used to choose the best network from the available Visitor networks (VTs) for the continuous connection by the mobile terminal. In our work we mainly concentrated to the handover decision phase and to reduce the processing delay in the period of handover. In this paper both SAW and WPM methods are compared with the Qos parameters of the mobile terminal (MT) to connect with the best network.

Keyword- Handover, Vertical handover decision schemes, Simple additive weighting, Weight product method.

I. Introduction

In fourth generation wireless networks service continuity is a main goal ie., when a MT or mobile node (MN) moving in an overlapping area, continuous service must be need so the technique "HANDOVER" is done. The handover technique is mainly used to redirect the mobile user's service network from current network to a new network or one base station (BS) to another BS or one access point (AP) to another AP with same technology or among different technologies to reduce the processing delay in the overlapping area.

Handover technique has the two types, horizontal handover and vertical handover. The homogenous wireless network performs horizontal handover, if there are two BSs using the same access technology, in current system called horizontal handover. This type of mechanism use signal strength measurements for surrounding BSs to trigger and to perform the handover decision.

In heterogeneous wireless networks, the mobile station (MS) or BS will be equipped with multiple network interfaces to reach different wireless networks. When an emerging mix of overlapping heterogeneous wireless networks deployed, vertical handover is used among the networks using different access technologies.

Handover technique has the four phases: Handover Initiation, System discovery, Handover decision, Handoff execution.

- Handoff Initiation phase : The handover process was modified by some criteria value like signal strength, link quality etc.,
- System discovery phase: It is used to decide which mobile user discovers its neighbour network and exchanges information about Quality of Service (QOS) offered by these networks.
- Handover Decision phase: This phase compares the neighbour network QOS and the mobile users QOS with this QOS decision maker makes the decision to which network the mobile user has to direct the connection.
- Handoff Execution phase: This phase is responsible for establishing the connection and release the connections and as well as the invocation of security service.

The scope of our work is mainly in handover decision phase, as mentioned in the decision phase; decision makers must choose the best network from available networks. In this paper, the decision makers are Simple additive weighting (SAW) and Weighted product model (WPM) to take the decision and to select the best target visitor network (TVN) from several visitors networks.

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In this paper, two vertical handover decision schemes (VHDS) , Distributed handover decision scheme (DVHD) and Trusted Distributed vertical handover decision schemes (T-DVHD)are used. DVHD is advanced than the centralised vertical handover decision scheme and T-DVHD is the extended work of DVHD. Here we compare the distributed and trusted vertical handover decision schemes as distributed decision tasks among networks to decrease the processing delay caused by exchanging information messages between mobile terminal and neighbour networks. To distribute the decision task, vertical handover decision is formulated as MADM problem.

In our work, the proposed decision making method use WPM in a distributed manner and compared with SAW method. The bandwidth, delay, jitter and cost are the parameters took by the MT as the decision parameters for handover.

II. Related Work

At present many of the handoff decision algorithms are proposed in the literature. In (4) a comparison done among SAW, Technique for Order Preference by Similarity to Ideal Solution(TOPSIS), Grey Relational Analysis (GRA) and Multiplicative Exponent Weighting (MEW) for vertical handoff decision. In (3) author discuss that the vertical handoff decision algorithm for heterogeneous wireless network, here the problem is formulated as Markov decision process. In (5) the vertical handoff decision is formulated as fuzzy multiple attribute decision making (MADM).

In (8) their goal is to reduce the overload and the processing delay in the mobile terminal so they proposed novel vertical handoff decision scheme to avoid the processing delay and power consumption. In (7) a vertical handoff decision scheme DVHD uses the MADM method to avoid the processing delay. In (10) the paper is mainly used to decrease the processing delay and to make a trust handoff decision in a heterogeneous wireless environment using T-DVHD.

In (11) a novel distributed vertical handoff decision scheme using the SAW method with a distributed manner to avoid the drawbacks. In (14) the paper provides the four steps integrated strategy for MADM based network selection to solve the problem. All these proposal works are mainly focused on the handoff decision and calculate the handoff decision criteria on the mobile terminal side and the discussed scheme are used to reduce the processing delay by the calculation process using MADM in a distributed manner.

In (16) the comparison analysis shows the SAW, MEW, TOPSIS, VIKOR, GRA and WMC with the numerical simulation of vertical handoff in 4G networks.

III. Vertical Handover Decision Schemes

Centralized vertical handover decision (C-VHD), Distributed vertical handover decision (D-VHD), Trusted Distributed vertical handover decision (T-DVHD) are the schemes used to reduce the processing delay between the mobile node and neighbour network while exchanging the information during the handover. In this paper, D-VHD and T-DVHD schemes are compared. MADM have several methods in literature [16]. TOPSIS is used in distributed manner for network selection.

a) *Centralized vertical handover decision Schemes*

In C-VHD, a Mobile Node (MN) exchanging the information message to the Neighbour networks mean processing delay was increased by distributing in centralized manner. When processing delay had increased overall handover delay increases. This is one of main disadvantage in C-DHD, so Distributed Vertical handover decision (D-VHD) schemes was proposed in [7][8].

b) *Distributed vertical handover decision schemes*

D-VHD is used to decrease the processing delay than the C-VHD schemes. This scheme is mainly used for handover calculation to the Target visitor networks (TVNs). TVN is the network to which the mobile node may connect after the handover process was finished. In our work D-VHD takes into account : jitter, cost, bandwidth, delay as evaluation metrics to select a suitable VN which applied in MADM method.

c) *Network Selection Function (NSF):*

The network selection decision process has denoted as MADM problem, NSF have used to evaluate from set of network using multiple criteria. The above mentioned parameters are used to calculate NSF. These parameters measure the Network Quality Value (NQV) of each TVN. The highest NQV value of TVN will be selected as Visited Network (VN) by the mobile node. The generic NSF is defined by using SAW "Eq. (1) and WPM "Eq. (2)"

$$NQV_i = \sum_{i=1,j=1}^{N,n_p^+} W_j * P_{ij} \qquad (1)$$

Where, NQV_i represents the quality of i^{th} TVN. W_j is the weight of the P_{ij}, P_{ij} represents the j^{th} parameter of the i^{th} TVN. N is the number of TVNs. While n_p^+ is the number of parameters.

$$NQV_i = R_i = \frac{\prod_{j=1}^{n} x_{ij}^{\,w_j}}{\prod_{j=1}^{n} (x_j^*)^{w_j}} \qquad (2)$$

Where, NQV_i represents the quality of i^{th} TVN. w_j is the weigth of the attribute values , x_{ij} is the positive attributes and $x_j^*$is the negative attribute . R_i is the value ratio between network I and positive ideal .

Based on the user service profile, handover decision parameters have assigns different "Weights" to determine the level of importance of each parameter. In equation (3), the sum of these weights must be equal to one.

$$\sum_{j=1}^{n_p} W_j = 1 \tag{3}$$

The handover decision metrics calculation is performed on the VNs, each VN applies the MADM methods using "Eq. (3.1,3.2)" on the required (J_{req}, D_{req}, C_{req}, B_{req}) and offered (J_{off}, D_{off}, C_{off}, B_{req}) parameters

d) *Distributed Decision scheme:*

The D-VHD is explained in the Fig. 3

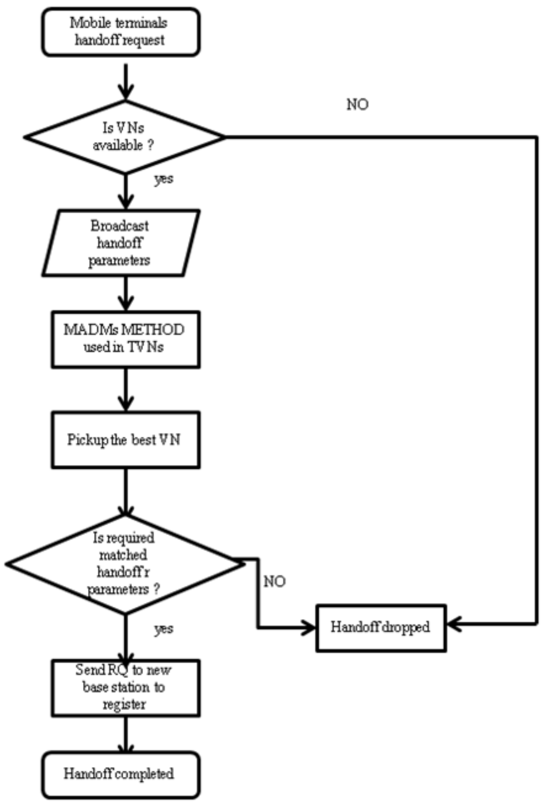

Fig. 1 D-VHD Scheme

e) *Trusted Distributed Vertical Handover Decision schemes*

Trusted handover decision and to avoid the unnecessary handover events are the important factors while exchanging the trusted information between networks and mobile node. The extension work of the DVHD scheme is T-DVHD scheme. The scheme is mainly introduced [10] for decreasing the processing delay than DVHD scheme.

The T-DVHD schemes followed by the DVHD Network selection function and Distribute Decision schemes, before sending request to connect a new base station trusted process is started

f) *Level Of Trust (LOT) test function*

LOT function is tested to execute the handover. LOT function is calculated by the following steps

If LoTi >= threshold
  Connect to the TVNi
  start Trust-test function
else if LoTi < threshold {
  if (suitable-TVN available)
    i = i + 1
    test another network
  else if (no suitable-TVN)
Handover blocked

after handover is executed by the mobile terminal with the proper TVN. Trusted Test Function is started, once the mobile terminal connects to the TVN trusted test function is calculated by the following steps to finish the T-DVHD schemes.

if Qoff < Qreq
  LOT_i = LOT – delta ;
else
  LOT_i= LOT_i+ $delta^+$;

IV. SCENARIO OF THE VERTICAL HANDOVER

In this paper, our scenario was in "Fig. 4", it explains that a cell coverage the area by WiMax technology and another cell coverage the area by WiFi and WiMax technology. A mobile terminal is overlapping with VoIP application between the cell coverage now mobile terminal intend to connect the appropriate visited network with the decision process.

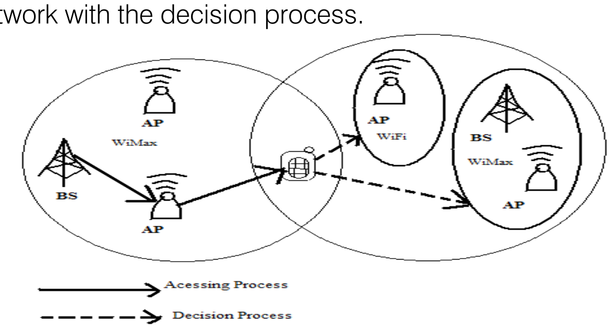

Fig. 2 Scenario of the vertical handover

V. SAW AND WPM

a) *Simple Additive Weighting (SAW) Method*

Simple Additive Weighting (SAW) which is also referred as weighted linear combination or scoring methods or weighted sum method is a simple and most often used multi attribute decision technique. The method is based on the weighted average. An evaluation score is calculated for each alternative by multiplying the scaled value has given to the alternative of that attribute with the weights of relative importance directly assigned by decision maker followed by summing of the products for all criteria.

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The application of SAW scoring requires , identification of objectives and alternatives, evaluation of alternatives, determination of sub-objective weights, additive aggregation of weighted partial preference values, sensitive analysis. It uses direct rating on the standardised scales only in purely qualitative attributes. For numerical attributes score are calculated by normalized values to match the standardised scale. The SAW is a comparable scale for all elements in the decision matrix, the comparable scale obtained by r_{ij} for benefit criteria "Eq. (4)" and worst criteria "Eq.(5)" .

$$V_{ij} = \frac{x_{ij}}{x_j^{max}} \quad (4)$$

$$V_{ij} = \frac{x_j^{min}}{x_j} \quad (5)$$

The SAW method , underlying additive values function and compute as alternatives score $V_i = V(A_i)$ by adding weighting normalized values $W_j V_{ij}$ $\forall$ j = {1,………m} before eventually ranking alternatives

$$V_i = \sum_{j=1}^{m} W_j V_{ij} \quad (6)$$

For V ε R^{n*m} with i = { 1,……,n}, j = {1,……..,m}; V_{ij} , W_j ε (0,1)

b) *Weighted Product Model (WPM) method*

The weighted product model (WPM) similar to the weighted sum model (WSM) and it is also called as Multiplicative exponent Weighting (MEW). It is another MADM scoring method. The main difference is that instead of addition usually mathematical operation now there is multiplication. As with all MADM methods, WPM is a finite set of decision alternatives described in terms of several decision criteria. The vertical handover decision problem can be expressed as a matrix form and each row i corresponds to the candidate network i and each column j corresponds to the attributes.

$$V(A_i) = \prod_{j=1}^{n} x_{ij}^{\,w_j} \quad (7)$$

Where x_{ij} denotes attribute j of candidate network i, w_i denotes the weight of attributed j .

Note that in eqn. (7), w_j is a positive power for benefit metrics $x_{ij}^{\,w_j}$, and a negative power for cost metrics $x_{ij}^{\,-w_j}$. Since the score of a network obtained by MEW does not have an upper bound , it is convenient for comparing each network with the score of the positive ideal network .This network is defined as the network with the best values in each metric. For a benefit metric, the best value is the largest. For a cost metric, the best value is the lowest.

$$R_i = \frac{V(A_i)}{V(A^*)} = \frac{\prod_{j=1}^{n} x_{ij}^{\,w_j}}{\prod_{j=1}^{n} (x_j^*)^{w_j}} \quad (8)$$

c) *Numerical Example*

The above section outlines the vertical handover decision schemes and MADM methods, SAW and TOPSIS which is used for the network selection in this paper. For instance, suppose a mobile terminal is currently connected to a WiFi cell and has to make decision among six candidate networks A1, A2, A3, A4, A5, A6, where A3, A4 are WiFi cells and others are WiMax cells. Vertical handover criteria considered here are delay, bandwidth, cost, jitter which denoted as X1, X2, X3, X4 respectively. Decision matrix D is as follows

D =

	X1	X2	X3	X4
A1	0.984	0.533	0.667	0.438
A2	1	0.1	0.75	0.812
A3	0.984	1	0.5	0.061
A4	1	0.467	1	1
A5	0.984	0.733	0.6	0.119
A6	0.968	0.667	0.667	0.263

The users running application was voice. The preference on handover criteria is modeled as weights assigned by the user on the criteria, for voice W_v which shown in the "Eq. (9)".

$$W_v = [0.3 \;\; 0.2 \;\; 0.2 \;\; 0.3] \quad (9)$$

MADM methods handle in this paper for decision problems with above data. The following section discussed the SAW and WPM are applied and the results are compared.

i. *SAW*

SAW requires a comparable scale for all elements in the decision matrix, the comparable scale is obtained by using "Eq. (4), Eq. (5)". In these x_{ij} is the performance score of alternatives A_i with respect to criteria x_j. After scaling, the normalized decision matrix is evaluated as D'

D' =

	X1	X2	X3	X4
A1	0.00062	8	9	0.411
A2	0.00063	1.5	8	0.762
A3	0.00062	15	12	0.057
A4	0.00063	7	6	0.939
A5	0.00062	11	10	0.103
A6	0.00061	1	9	0.247

Applying the weight factor from the "Eq. (9)", weighted average values for A1, A2, A3, A4, A5 and A6 are calculated for the respected to the voice application A_v

$$A_V = [0.664, 0.714, 0.563, 0.793, 0.595, 0.635]$$

The best network is A4 which is the network selected to connect the mobile terminal for service continuity with the minimum processing delay.

ii. WPM

The WPM is called dimensionless analysis because its mathematical structure eliminates any units of measure. Transformation is not necessary when we use multiplication among attribute values. The weights become exponents associated with each attribute values. From "Eq. (9)" the weight factor is applying for $V(A_i)$

$$V(A_i) = [0.054, 0.065, 0.024, 0.065, 0.035, 0.042]$$

$$V(A_i) = 0.074$$

$$R_i = [0.73, 0.89, 0.32, 0.88, 0.47, 0.57]$$

iii. *Ranking Order for Saw and WPM methods*

The ranking order using different methods of MADM are summarised in "Table 1". SAW and WPM ranks A4 and So the A4 and A2 BS have connected the mobile terminal with less processing delay to get seamless handover in between the MT and BS A4,A2 in each method.

Table 1: Ranking order comparison

SAW	A4	A2	A1	A6	A5	A3
WPM	A2	A4	A1	A6	A5	A3

After Ranking the BS for each method, we go to compare the SAW and WPM using Relative Standard Deviation (RSD).

$$RSD = \frac{S}{\bar{x}} * 100$$

The relative standard deviation is often times more convenient. It is expressed in percent and is obtained by multiplying the standard deviation s by 100 and Divide this product by the average $\bar{x}$

We calculate the relative standard deviation for SAW and MEW from ranking values. The result was WPM is better than SAW. SAW with the 12.64% and WPM with the 35.75%. Finally MT is connected to the base station with the WiMax cell A2.

VI. CONCLUSION

In this paper, we have compared the schemes of vertical handover decision in the heterogeneous wireless networks. The observation of schemes to reduce the processing delay and a trusted handover decision is done in heterogeneous wireless networks. In this paper we proposed decision makers SAW and WPM to select the best network from the visitor network for the Vertical decision schemes. The best decision maker is analyzed by the relative standard deviation and the best one is WPM. Our main goal is in the decision phase of the handover phases to take decision to which VN the mobile terminal to connect to decrease the processing delay by different decision algorithms.

REFERENCES RÉFÉRENCES REFERENCIAS

1. N.D.Tripathi, J.H.Reed and H.F.VanLandinoham, Handoff In Cellular System, *IEEE Personal Communications*, 49(2000) 2276-2285, doi: 10.1109/25.901897
2. E.Gustafsson and Annika Jonsson, Always Best Connected, *IEEE Wireless Communications*, 10(1) (2003) 49-55, doi: 10.1107/MWC.2003.1182111.
3. E.Steven-Navarro, V.W.S. Wong and Yuxia Lin, A Vertical Handoff Decision Algorithm For Heterogeneous Wireless Networks, *Wireless Communications and Networking Conference, 2007.WCNC 2007. IEEE,* Kowloon pp. 3199-3204.
4. E.steven-Navarro and V.W.S.Wong, Comparison between vertical handoff decision algorithms for heterogeneous wireless network, *Vehicular Technology Conference, 2006. VTC 2006-Spring. IEEE 63rd* ,Melbourne, Vic. , pp.947-951.
5. Wenhui Zhang, Handover Decision Using Fuzzy MADM In Heterogeneous Networks, *Wireless Communications and Networking Conference, 2004. WCNC. 2004 IEEE,* Vol.2, pp. 653-658.
6. A.Hasswa, N.Nasser and H.Hassanein, Generic Vertical Handoff Decision Function For Heterogeneous Wireless, *Second IFIP International Conference on Wireless and Optical Communications Networks, 2005. WOCN 2005*, pp. 239-243..
7. R.Tawil, G.Pujolle and O.Salazar, A Vertical Handoff Decision Schemes In Heterogeneous Wireless Systems, *Vehicular Technology Conference, 2008. VTC Spring 2008. IEEE* , Singapore , pp. 2626-2630.
8. R.Tawil, J.Demerjain, G.Pujolle And O.Salazar, Processing-Delay Reduction During The Vertical Handoff Decision In Heterogeneous Wireless System, : *International Conference on Computer Systems and Applications, 2008. AICCSA 2008. IEEE/ACS 2008.*, pp.381-385.
9. LIU yu, Ye Min-hue and ZHANG Hui-min, The Handoff Schemes in mobile IP, *Vehicular Technology Conference, 2003. VTC 2003-Spring. The 57th IEEE Semiannual* , pp. 485-489.
10. R.Tawil, J.Demerjain and G.Pujolle, A Trusted Handoff Decision Scheme For The Next Generation Wireless Networks, *IJCSNS*, Vol.8, pp.174-182, June 2008.
11. R.Tawil, G.Pujolle and O.Salazar, Vertical Handoff Decision Schemes For The Next Generation Wireless Networks, *Wireless Communications and Networking Conference, 2008. WCNC.2008*, pp. 2789-2792.

12. R.Tawil, G.Pujolle and J.Demerjain, Distributed Handoff Decision Scheme Using MIH Function For The Fourth Generation Wireless Networks, : 3rd International Conference on *Information and Communication Technologies: From Theory to Applications, 2008. ICTTA 2008.*, pp. 1-6.
13. A.Dvir, R.Giladi, I.Kitroser and M.Segal, Efficient Decision Handoff Mechanism For Heterogeneous Networks, *IJWMN,* 2(2010) 1-13.
14. Lusheng Wang and David Binet, MADM- Based Network Selection In Heterogeneous Wireless Networks: A Simulation Study, *1st International Conference on Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronic Systems Technology, 2009. Wireless VITAE 2009*, pp. 559-564.
15. N.Nasser, A.Hasswa and H.Hassanein, Handoff In Fourth Generation Heterogeneous Networks, Communications Magazine, IEEE , 44(2006), pp. 96-103, doi:10.1109/MCOM.2006.1710420
16. J.D Martinez- Morales, V.P.rico, E.Steven, Performance comparison between MADM algorithms for vertical handoff in 4G networks, *7th International Conference on Electrical Engineering Computing Science and Automatic Control (CCE), 2010* ,pp. 309-314.
17. M.Kassar, B.Kervella, G.Pujolle, An overview of vertical handover decision strategies in heterogeneous wireless networks, *Elsevier, Journal of computer communications*, 37(10) (2008), doi:10.10.16/J.COMCOM.2008.01044
18. Y.Choi, S.Choi, Energy aware WLAN scanning in integrated IEEE 802.16c/802.11 networks, *Journal Computer communications*,31(15)(2009), doi:10.1016/J.COMCOM.2009.05.017.
19. D.L.Olson, Comparison of weights in TOPSIS models, *J Mathematical and computer modelling*, 40(2000),721-727, doi:10.1016/J.MCM.2004.10.003.

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Sizing and Geometry Optimization of Pin Connected Structures Via Real Coded Genetic Algorithm (RCGA)

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Abstract- Optimization of sizing and geometry is one of the active areas of research in structural engineering. In sizing optimization of structures the goal is minimizing the weight of the structure while the cross sectional areas of the members are considered as design variables. In this kind of optimization the nodal coordinates and connectivity among different members are considered stable. In the geometry optimization the nodal coordinates are considered as design variables. Simultaneous sizing and geometry optimization are considered in most structural optimization problems. In this article, Real Coded Genetic Algorithm (RCGA) is utilized to optimize sizing and geometry of pin connected structures. Also some schemes and a kind of mutation which is called class mutation are used to increase the efficiency of RCGA (optimum RCGA). In class mutation contrary to multiple mutation, design variables with the same characteristics are classified into one group so there is more handle on the variables during the mutation pprocess. The performance characteristics of above method are investigated by two pin connected structures (18 and 25 bar pin connected structures). Examples show that the proposed method gives better results than some other schemes such as numerical methods and the classical GA.

Keywords: Sizing and geometry optimization, optimum Real Coded Genetic Algorithm, Class Mutation, pin connected structures

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SIZING AND GEOMETRY OPTIMIZATION OF PIN CONNECTED STRUCTURES VIA REAL CODED GENETIC ALGORITHM RCGA

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Sizing and Geometry Optimization of Pin Connected Structures Via Real Coded Genetic Algorithm (RCGA)

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Abstract- Optimization of sizing and geometry is one of the active areas of research in structural engineering. In sizing optimization of structures the goal is minimizing the weight of the structure while the cross sectional areas of the members are considered as design variables. In this kind of optimization the nodal coordinates and connectivity among different members are considered stable. In the geometry optimization the nodal coordinates are considered as design variables. Simultaneous sizing and geometry optimization are considered in most structural optimization problems. In this article, Real Coded Genetic Algorithm (RCGA) is utilized to optimize sizing and geometry of pin connected structures. Also some schemes and a kind of mutation which is called class mutation are used to increase the efficiency of RCGA (optimum RCGA). In class mutation contrary to multiple mutation, design variables with the same characteristics are classified into one group so there is more handle on the variables during the mutation process. The performance characteristics of above method are investigated by two pin connected structures (18 and 25 bar pin connected structures). Examples show that the proposed method gives better results than some other schemes such as numerical methods and the classical GA.

Index Terms - sizing and geometry optimization, optimum Real Coded Genetic Algorithm, Class Mutation, pin connected structures.

I. Introduction

Optimization of sizing and geometry is one of the active areas of research in structural engineering. In sizing optimization of structures the goal is minimizing the weight of the structure while the cross sectional areas of the members are considered as design variables. In this kind of optimization the nodal coordinates and connectivity among different members are considered stable. In the geometry optimization the nodal coordinates are considered as design variables. Simultaneous sizing and geometry optimization are considered in most structural optimization problems.

Structural optimization is based on two methods: Numerical methods and Evolutionary techniques. Numerical methods have been developed earlier than Evolutionary techniques which have been used by different researchers e.g., Vanderplaats and Moses [1] separated the design space into two parts and used different methods for optimization in each subspace: a fully stressed design was applied for optimization in sizing subspace, and steepest descent method was used for optimization in geometry subspace. Imai and Schmit [2] have used an advanced primal-dual method, called the multiplier method. Pederson [3] has used The SLP (sequence of linear programs) method with move limits in sizing and geometry optimization. Lipson and Gwin [4] applied the complex method to optimize the size and shape of trusses.

Genetic Algorithm (GA) is one of the evolutionary algorithms that can be used for solving the structural optimization problems [5]. GA was introduced by John Holland in 1975 and developed by one of his students, Goldberg (1989). The advantage of this method to numerical methods is its ability to find the global minimum or maximum with continuous or discrete variables without using the derivatives of cost function [6]. Genetic algorithm is used directly only for solving unconstrained optimization problems so for solving constrained problems we should transform them to unconstrained problems by penalty function method [5]. This method also has been used by different researchers e.g: Soh and Yang [7], have used fuzzy logic for handling the GA operators in size and shape optimization of structures. Kaveh and Kalatjari [8], have used force method and genetic algorithm for sizing, and geometry optimization of trusses. Zheng, Querin and Barton [9] have used genetic programming method for sizing and geometry optimization in discrete structures. Ali, Behdinan and Fawaz [10] have investigated the applicability and viability of integration a FEM software package with binary GA. Hwang and He [11] have proposed a hybrid optimization algorithm which combines genetic algorithm and simulated annealing

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algorithm. Yang and Soh [12] have proposed a new GA-based evolution approach with the tournament selection scheme.

In the present paper an optimum RCGA, with a kind of new mutation operator called class mutation is used for solving the sizing and geometry optimization of structures.Two pin connected structures with continuous sizing and geometry variables are presented to demonstrate the robustness of the method.

II. Genetic Algorithm (GA)

GA is one of the methods which may be used to solve an optimization problem. This algorithm is based on natural selection using random numbers and does not require a good initial estimate [13].

a) *Binary Genetic Algorithm*

GA in the binary form works with binary string. Each string which is called chromosome is the member of population and the GA's operators that are inspired from the natural selection guide the population to the evolution or in other words, maximize the fitness function. A simple genetic algorithm consists of three operators: Reproduction, Crossover and Mutation.

Reproduction: The reproduction operator copies each chromosome proportional to its fitness function in the mating pool so the chromosome with the best fitness function will be copied more than the rest in the new population.

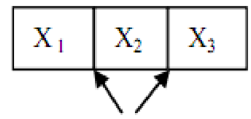
Crossover: The crossover operator works on two chromosomes and produces two new offspring that will inherit some characteristics of their parents. In this process two chromosomes in the mating pool are selected in pairs with (p_c) probability, then another random number determines the crossover point on the chromosome. Finally all bits of these two strings are exchanged between each other. Crossover point can be selected more than once on the chromosome.

Mutation: The mutation operator causes random changes in the people of population. In the process the chromosomes with probability of (p_m) are selected for mutation from the population, then a random number determines the position of mutation point and the bit in this place is complemented (Multiple Mutation) [14]-[15].

b) *Real Coded Genetic Algorithm (RCGA)*

Since in structural optimization problems with continuous variables we need to work on real numbers, we have used RCGA. In RCGA contrary to the binary method it is not required to decode the variables also, less processing memory is used [6]. In this method each chromosome is defined as an array of real numbers with the mutation and crossover operators working as shown in Fig. 1. The mutation can change the value of a real number randomly and the crossover can take place at the boundary of two real numbers [16].

$$\overline{X} = (x_1, x_2, x_3)$$



Possible crossover position

$$x_i \xrightarrow{\text{Mutation}} x_i = x_i + \text{rand}\left(-\frac{X_{imax}}{2}, \frac{X_{imax}}{2}\right)$$

X_{imax} is the maximum possible value for X_i

Fig. 1- Operation of mutation and crossover operators in RCGA

III. Penalty Function

Since GA is used only for solving unconstrained optimization problems, it is necessary to transform the constrained problem to the unconstrained optimization problem. In this article a quadratic penalty function is used as (1) [5]:

$$\min \varphi(A) = \frac{1}{L_f}\sum_{1}^{N} \rho_i l_i A_i + \beta\{\sum_{1}^{N} |(\frac{|\sigma_i|}{|\sigma_i^a|} - 1)^+|^2 + \sum_{1}^{M} |(\frac{|\delta_i|}{|\delta_i^a|} - 1)^+|^2\}$$

$$(\frac{|\sigma_i|}{|\sigma_i^a|} - 1)^+ = \max(\frac{|\sigma_i|}{|\sigma_i^a|} - 1, 0) \qquad (1)$$

$$(\frac{|\delta_i|}{|\delta_i^a|} - 1)^+ = \max(\frac{|\delta_i|}{|\delta_i^a|} - 1, 0)$$

$\sigma_i^a = \sigma_i^L$ when $\sigma i < 0$

$\sigma_i^a = \sigma_i^U$ when $\sigma i \geq 0$

$\delta_i^a = \delta_i^L$ when $\delta_i < 0$

$\delta_i^a = \delta_i^U$ when $\delta_i \geq 0$

where the last term is the penalty function, L_f is the normalizing factor, β is the penalty coefficient, M is the number of degrees of freedom, σ_i is stress in member i , δ_i is the displacement in the direction of degree of freedom i and σ_i^a and δ_i^a are allowable stres--ses and displacements, respectively.

IV. Methods for Increasing the Speed of RCGA (Optimum RCGA)

Typically in structural optimization problems with GAs, a population (pop) of many individuals with a high crossover rate (p_c) and very low mutation rate (p_m) is used [6]-[14]. Following the typical condition, RCGA with pop = 40, p_c = 0.7, p_m = 0.01 was tested for two sample space structures:

a) *Sample structures*

The samples contain 18 and 25 bar truss with sizing and geometry variables. Displacement method is used for analyzing the structure. The value of β (penalty coefficient) is increased by constant 10 in each 10 iteration and a value of 1000 is used for normalizing factor L_f.

i. *The 18 bar planar truss*

This classic, statically determined cantilever plane truss has been studied by different researchers [12]-[19]. The dimensions of the 18 bar truss are given in Fig.2. The modulus of elasticity is 6.895E4 Mpa and the density is 0.0272 N/cm^3. The single loading condition is a set of vertical loads acting on the upper joints of the structure. The lower joints 3, 5, 7 and 9 are allowed to move in any direction in the x-y plane. Thus the locations of these joints are geometry variables. All the members of the structure have been categorized into four groups, as shown follow:

(1) $A_1=A_4=A_8=A_{12}=A_{16}$, (2) $A_2=A_6=A_{10}=A_{14}=A_{18}$,
(3) $A_3=A_7=A_{11}=A_{15}$, (4) $A_5=A_9=A_{13}=A_{17}$

So there are eight design variables: four geometry and four sizing variables. The sizing limit on the sizing variable is between 22.58 cm^2 and 116.128 cm^2 . Stress and Euler buckling constraint are imposed with an allowable stress of 137.9 Mpa and critical Euler buckling stress. The critical buckling stress of each member is determined by $4EA_i/(L_i^2)$ (L_i is the length of the ith member). The single loading condition is a set of vertical loads (P = - 89.96 kN) acting on the upper joints of the truss.

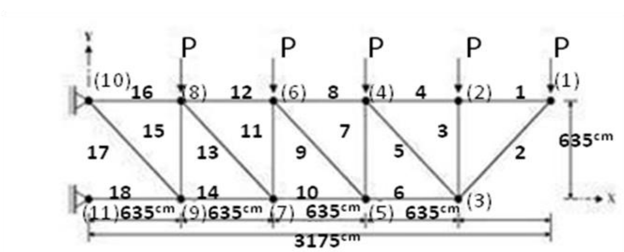


Fig. 2- 18 bar planar truss structure

ii. *The 25 bar space truss*

The 25 bar transmission tower that is shown in Fig. 3 has been optimized by different researchers [9]-[12]. In this example the material density is 0.0272 N/cm^3 and the modulus of elasticity is 6.895E4 Mpa. The structure is subjected to two loading conditions that are shown in Table 1. There are 25 members that are divided into 8 groups:

(1)A_1 , (2)A_2~A_5 , (3)A_6~A_9 , (4)A_{10}~A_{11} , (5)A_{12}~A_{13} , (6)A_{14}~A_{17} , (7)A_{18}~A_{21} , (8)A_{22}~A_{25}.

The truss is required to remain symmetric with respect to both X-Z plane and the Y-Z plane. The coordinates of joints 1 and 2 were held constant, and joints 7-10 were required to lie in the X-Y plane. Due to the symmetry of the structure, there are a total of 13 design variables, which include eight sizing variables and five independent coordinates variables (X_4, Y_4, Z_4, X_8 and Y_8) for each load case. Stress and Euler buckling constraint are imposed with an allowable stress of 275.8 Mpa and critical Euler buckling stress. The critical buckling stress of each member is determined by $100.01\pi EA_i/(8L_i^2)$. The sizing limit on the sizing variable is between 0.0645 cm^2 and 6.451cm^2.

Table 1 Loading Conditions For 25 Bar Space Truss

Node	Case1(kN)			Case2(kN)		
	p_x	p_y	p_z	p_x	p_y	p_z
1	0.0	88.9	- 22.23	4.44	44.45	-22.22
2	0.0	-88.9	-22.23	0.0	44.45	-22.22
3	0.0	0.0	0.0	2.22	0.0	0.0
6	0.0	0.0	0.0	2.22	0.0	0.0

From the results the speed of convergence was not desirable. For achieving more speeds, a variety of sets of conditions with 40<pop<100, 0.6<p_c<0.9 and 0.001<p_m<0.1 were used. Although in all these cases convergence occurred and the parameters were obtained with enough accuracy, we did not have desirable increase in speed of the algorithm and the number of iteration remained around 9000 times.

For increasing the speed of convergence in the algorithm following observations were made [13]:

1- Increasing P_m .
2- Decreasing p_c (An increase in p_c causes the uniformity of the population, and the algorithm loses its efficiency).
3- Decreasing the population (Although the increase in pop decrease the number of iterations, the computation time per iteration increases and this altogether decreases the speed of the algorithm).

Regarding these facts the following conditions are used:

pop=6
p_c=0.25
p_m=0.75

After each iteration, the weakest individual in the new generation is replaced by the strongest in the old generation.

A new mutation operator, called class mutation, was used. After performing the above modifications, the number of iteration is reduced from 9000 to 2000 and the number of structural analysis is reduced from

360000 to 12000 times. In fact the speed of convergence is increased about 30 times. Since the last two steps have an important effect in speed up, they are explained in the following paragraph.

b) *Placing the strongest of old generation*

Since the process is highly randomized, to preserve the characteristics of the old generation, or in other words, to prevent the extinction of the old generation, after each iteration and the execution of the crossover and mutation operators the strongest individual from the previous population replaces the weakest one in new generation [13].

c) *Class mutation operator*

The results obtained with multiple mutation was not desirable Fig.4, perhaps due to the over-randomizing the process and the fact that in optimizing sizing and geometry, simultaneously a large number of design variables are encountered consisting of cross sectional areas and nodal coordinates which result in a design space with large dimensionality. So the class mutation with the following definition was used:

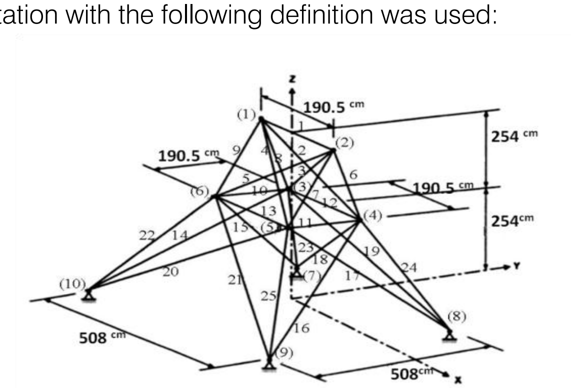


Fig. 3- 25 bar space truss structure

For class mutation the parameters with close physical concepts were classified into groups [13]. For example in 25 bar truss we have our groups as follows:

$A_1, A_2, A_3, A_4, A_5, A_6, A_7, A_8$

X_4, X_8

Y_4, Y_8

Z_4

The class mutation operator selects each class with the rate p_m (in this article 0.75), then randomly selects a member of the class and changes its value randomly. The comparison of the results for class mutation and multiple mutation is given in fig.4. Tables 2 and 3 compare the results obtained with the present method and other references for 18 and 25 bar trusses respectively. The optimized geometries for 18 and 25 bar trusses are given in Figs. 5 and 6.

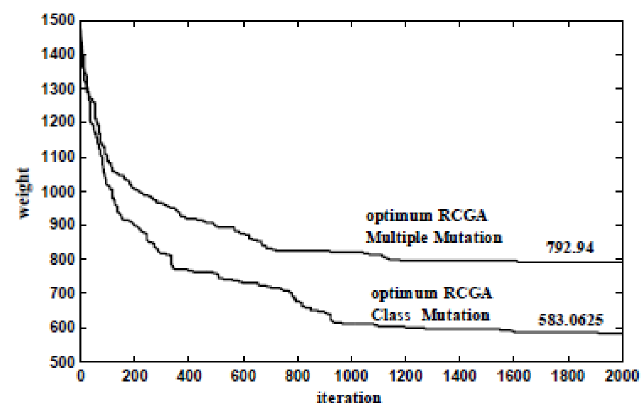


Fig. 4- Comparison of RCGA with multiple mutation and RCGA with class mutation in 25 bar truss

Table 2 Comparison of Design Variables For 18 Bar Plane Truss

Design variables	Imai[2]	Felix[17]	Yang[18]	Soh[12]	Rajeev[19]	Present Work
A_1 (cm^2)	72.51	73.16	81.35	81.22	80.64	74.8237
A_2 (cm^2)	101.16	124.38	116.77	115.54	104.83	113.9946
A_3 (cm^2)	51.16	70.77	35.29	35.48	51.61	33.4392
A_4 (cm^2)	41.87	34.19	22.83	22.90	25.80	33.8721
X_3 (cm)	2263.3	2526.2	2322.8	2310.8	2265.4	2322.0786
Y_3 (cm)	364.7	412.2	464.8	468.6	369.0	470.7841
X_5 (cm)	1544.8	1898.3	1643.3	1626.3	1550.9	1642.3716
Y_5 (cm)	267.7	261.3	374.3	375.4	300.2	370.5560
X_7 (cm)	969.5	1226.5	1052.0	1041.4	978.9	1055.9971
Y_7 (cm)	145.03	83.82	255.0	246.3	184.1	230.0145
X_9 (cm)	459.7	563.1	508	510.2	468.3	515.9065
Y_9 (cm)	-8.12	43.43	81.02	81.28	59.43	36.0527
Weight(N)	**20772.1**	**25422.8**	**20259.9**	**20166.9**	**20544.7**	**20164.28**

Table 3 Comparison of Design Variables For 25 Bar Space Truss

Design variables	Vanderplaats[1]	Yang[18]	Soh [7]	Yang [12]	Zheng[9]	Present Work
$A_1(cm^2)$	0.206	-	-	-	0.51	0.2219
$A_2(cm^2)$	3.638	-	-	-	4.96	2.5864
$A_3(cm^2)$	5.232	-	-	-	4.38	5.6774
$A_4(cm^2)$	0.180	-	-	-	0.51	0.2922
$A_5(cm^2)$	0.303	-	-	-	0.06	0.5516
$A_6(cm^2)$	0.625	-	-	-	0.06	0.9277
$A_7(cm^2)$	4.832	-	-	-	3.09	4.7974
$A_8(cm^2)$	3.554	-	-	-	3.09	3.7941
$X_4(cm)$	32.76	57.48	55.82	57.09	31.97	49.4593
$Y_4(cm)$	121.99	106.65	110.66	124.23	221.99	120.1051
$Z_4(cm)$	246.98	251.05	245.97	255.49	254	248.7924
$X_8(cm)$	93.98	39.57	35.89	64.03	158.97	44.2605
$Y_8(cm)$	238.98	209.21	206.09	249.25	254	233.2187
Weight(N)	**594.0**	**610.5**	**588.7**	**584.2**	**583.8**	**583.0625**

* - These values are not available

V. Conclusion

This article presents a new Real Coded Genetic Algorithm search which is called optimum RCGA with the class mutation operator for optimization of sizing and geometry of pin connected structures. The combination of modified optimum RCGA with displacement method was used for configuration optimization of structures. The method was examined for two sample pin connected structures (18 and 25 bar structures). The results proved that the modified optimum RCGA is able to find better solutions in comparison with other methods.

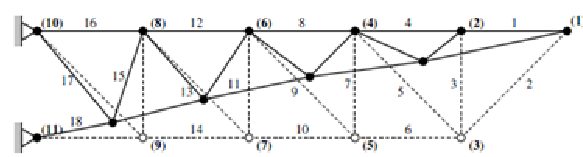


Fig. 5- 18 bar planar truss structure: initial structure and optimal structure

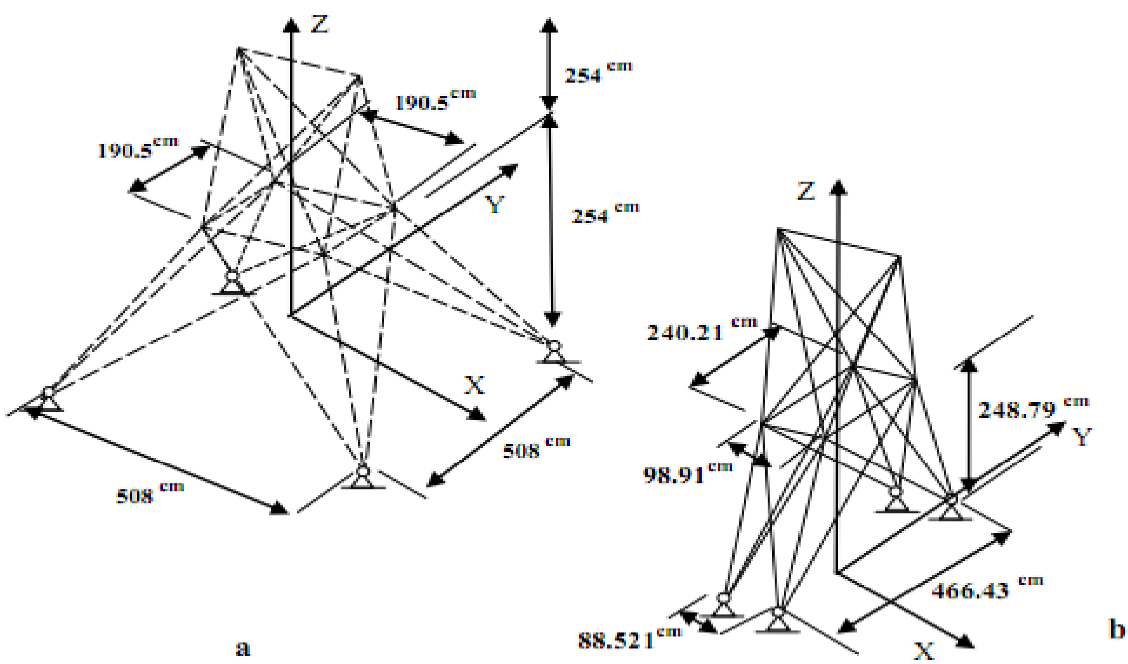


Fig. 6 25 bar truss: a initial structure, b optimal structure

References Références Referencias

1. Vanderplaats GN, Moses F, "Automated design of structures for optimum geometry", *J Struct Div*, ASCE, vol. 98, pp 671-690, 1972.
2. Imai K, Schmit LA, "Configuration optimization of trusses", *J Struct Div*, ASCE, vol. 107, pp 745-756, 1981.
3. Pedersen P, "Optimum joint position for space trusses", *J Struct Div, ASCE*, vol.99, pp 2459-2475,1973.
4. Lipson SL, Gwin LB, "The complex method applied to optimal truss configuration", *Comput Struct*, vol. 7, pp 461-468, 1977.
5. Adeli H, Cheng NT, "Integrated genetic algorithm for optimization of space structures", Journal of Aerospace Engineering, vol. 6, pp 315- 328, 1993.
6. Haupt RL, Haupt SE, *"Practical genetic algorithms*", John Wiley & Sons Inc, New Jersey, 2004.
7. Soh CK, Yang JP, "Fuzzy controlled genetic algorithm for shape optimization", J Comput Civ Eng, ASCE, vol. 10, pp 143-150, 1996.
8. Kaveh A, Kalatjari V, " Size/ geometry optimization of trusses by the force method and genetic algorithm", ZAMM. Z. Angew. Math. Mech, vol. 84, pp 347-357, 2004.
9. Zheng QZ, Querin QM and Barton DC, " Geometry and sizing optimization of discrete structure using the genetic programming method", Struct Multidisc Optim, vol. 31, pp 452-461, 2006.
10. Ali N, Behdinan K, Fawaz Z, "Applicability and viability of a GA based finite element analysis architecture for structural design optimization", Comput Struct, vol. 81, 2259-2271, 2003.
11. Hwang, S.F. and He, R.S, "*Engineering optimization using a real-parameter genetic-algorithm-based hybrid method*", Engineering Optimization, vol. 38, no. 7, pp 833- 852, 2006.
12. Yang JP, Soh CK, "Stuctural optimization by genetic algorithms with tournament skeleton", J Comput Civ Eng, ASCE, vol. 11, pp 195-200, 1997.
13. Raie A, Rashtchi V," Using a genetic algorithm for detection and magnitude determination of turn faults in an induction motor, Electrical Eng, vol. 84 ,pp 275-279, 2002.
14. Michalewicz Z, Genetic Algorithms + Data Structures = Evolution Programs. {Springer Verlag, New York}, 1992.
15. Goldberg DE, Genetic Algorithms in search, optimization and machine learning. {Addition Wesley, New York}, 1989.
16. Behravesh A, Ebadi MM, Rashtchi V. Optimization of Space Structures with Fuzzy Constraints Via Real Coded Genetic Algorithm(RCGA), Proceedings of the World Congress on Engineering 2009, vol. II, WCE 2009, July 1 - 3, London, U.K.
17. Felix JE, "Shape optimization of trusses subjected to strength, displacement, and frequency constraints", Master thesis, Naval Postgraduate School, 1981.
18. Yang JP, "Development of genetic algorithm-based approach for structural optimization", Ph.D. thesis, Nanyang Technology University, Singapore, 1996.
19. Rajeev S, Krishnamoorthy CS, " Genetic algorithm based methodologies for design optimization of trusses", J Struct Eng, ASCE, vol. 123, pp 350-358, 1997.

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A Novel Approach for Reduction of Huffman Cost Table in Image Compression

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Abstract- Huffman codes are being widely used as a very efficient technique for compressing image. To achieve a high compressing ratio, the cost table need to be reduced. A new approach has been defined which reduces the cost table of the traditional Huffman Algorithm. This paper presents a minor modification to the Huffman coding of the binary Huffman compression algorithm. A study and implementation of the traditional Huffman algorithm is studied. In this paper a new methodology has been proposed for the reduction of the cost table for the image compression using Huffman coding Technique. Compared with the traditional Huffman coding the proposed method yields the best results in the generation of cost tables. The advantages of new binary Huffman table are that the space requirement and time required to transmit the image is reduced significantly.

GJCST Classification: I.4.2, E.4

A NOVEL APPROACH FOR REDUCTION OF HUFFMAN COST TABLE IN IMAGE COMPRESSION

Strictly as per the compliance and regulations of:

A Novel Approach for Reduction of Huffman Cost Table in Image Compression

Singuru Srihari[α], Mohan Krishna Samantula[Ω], Gona Raja Kumar[β], T.V. Trinadh[Ψ]

Abstract- Huffman codes are being widely used as a very efficient technique for compressing image. To achieve a high compressing ratio, the cost table need to be reduced. A new approach has been defined which reduces the cost table of the traditional Huffman Algorithm. This paper presents a minor modification to the Huffman coding of the binary Huffman compression algorithm. A study and implementation of the traditional Huffman algorithm is studied. In this paper a new methodology has been proposed for the reduction of the cost table for the image compression using Huffman coding Technique. Compared with the traditional Huffman coding the proposed method yields the best results in the generation of cost tables. The advantages of new binary Huffman table are that the space requirement and time required to transmit the image is reduced significantly.

I. Introduction

In computer science and information theory, Image compression[1,2,3,9] is the process of encoding Image using less than an un-encoded representation would use, through use of specific encoding schemes. Huffman coding as a high efficient method is playing a larger role in image compression [1,2,3,9]. Therefore, how to save the algorithm's storage space and how to increase its compression ratio have always been concerned. The compressed image obtained by Huffman algorithm[4,6,7,9] consists of two parts, one is the compressed source file and the other is the file head (Huffman Table) used to decode or the mapping table between the symbols in the source file and the related codes in the compressed image. The nature of Huffman coding[2,4,8] algorithm decides the constancy of the source image's compression ratio, so the algorithm's compression ratio is directly related to the cost of Huffman table. This paper studies and implements the high compression ratio Huffman algorithm based on Huffman cost table. In the study, we manage to obtain more reduced Huffman table using traditional Huffman tree.

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II. Various Techniques

Some of the Image Compression techniques are,
1. Binary Huffman Coding
2. Shannon Coding
3. Arithmetic Coding
4. Huffman Shift Coding

III. Binary Huffman Algorithm

The binary Huffman coding[2,4,8] is the process of dividing the image into matrix of colour codes representing various colours and then it will calculate the probabilities of occurrences of each pixel, put them into descending order and then will append the binary digits to each probability/pixel in a systematic way such that no two or more pixels should have same binary code. After obtaining these values we can make two types of files. One representing compressed file and other is Huffman cost table[1,2,3,4] used to decode or the mapping table between the symbols in the source file and the related codes in the compressed image.
Algorithm for constructing the Binary Huffman tree is,

Step1. Start
Step2. Convert image into matrix of colour codes.
Step3. Calculate probabilities for each colour code.
Step4. Select the two parentless nodes with the lowest probabilities.
Step5. Create a new node which is the parent of the two lowest probability nodes.
Step6. Assign the new node a probability equal to the sum of its children's probabilities.
Step7. Repeat Step 1 until there is only one parentless node left.
Step8. Stop

The flow chart for the above algorithm is,

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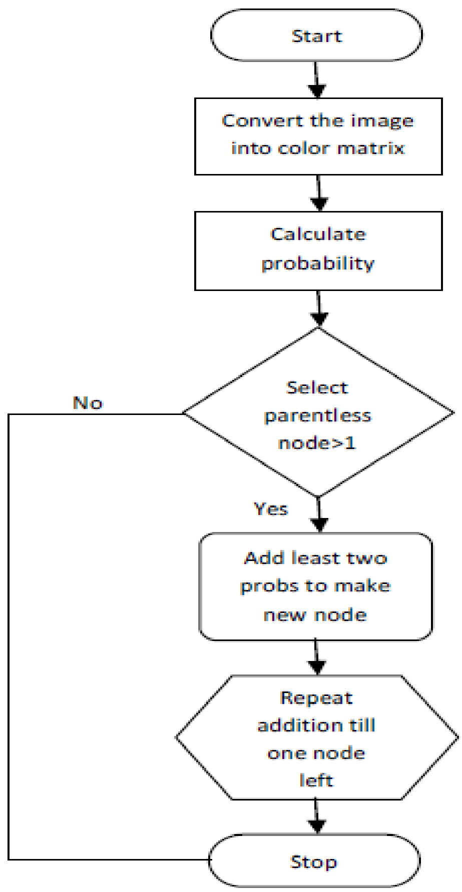


Once a Huffman tree[5,6,9] is built, Canonical Huffman codes, which require less information to rebuild, it will be generated by the following steps:

Step1. Start

Step2. Assign binary digits 0 and 1 to the last iteration probabilities.

Step3. For the previous iteration assign the same codes of parent node to its children nodes.

Step4. Then append binary digits 0 and 1 again to child nodes respectively.

Step5. If it is not a parent node then assign the same code as in the next iteration.

Step6. Repeat the process until all symbols or pixels are assigned codes.

Step7. Stop

Encoding Data

Once a Huffman code has been generated, data may be encoded simply by replacing each symbol with its code.

Decoding Data

If you know the Huffman code for some encoded data, decoding may be accomplished by reading the encoded data one bit at a time. Once the bits read match a code for symbol, write out the symbol and start collecting bits again.

IV. Proposed Approach for Reducing the Cost Table

In our proposed system the binary Huffman coding is divided into two parts. First part is separate the highest two probabilities from the image and assign 0 and 1 to those probabilities and for second part do binary Huffman coding for remaining probabilities as it is. By doing this we can send the pixel with highest occurrences by single bit itself, otherwise if we do Normal binary Huffman coding we may occur more than one bit code for the highest probability pixel, so its waste of memory to send more bits for more times for higher probability pixel.

V. Assumption

The third probability of an image must be lesser than the sum of probabilities of the image from fifth probability.

VI. Experimental Results

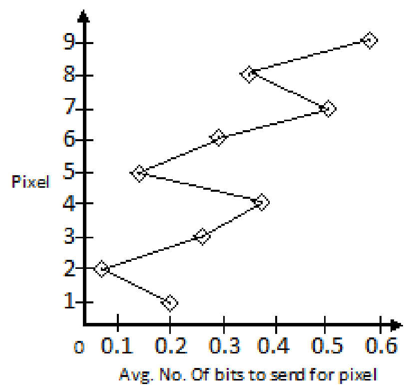
This software tutorial gives a comparative study on both the two algorithms Huffman and proposed. According to the experimental results obtained, it is observed that the efficiency of the proposed cost table is high and the space and time complexity is low.

a) *According to traditional Binary Huffman algorithm*

Pix	Prob		Ite-1		Ite-2		Ite-3		Ite-4		Ite-5		Ite-6		Ite-7	
9	.30	00	.30	00	.30	00	.30	00	.30	00	.30	00	.40	1	.60	0
7	.17	010	.17	010	.17	010	.18	11	.22	10	.30	01	.30	00	.40	1
4	.13	011	.13	011	.13	011	.17	010	.18	11	.22	10	.30	01		
8	.12	100	.12	100	.12	100	.13	011	.17	010	.18	11				
6	.10	101	.10	101	.10	101	.12	100	.13	011						
3	.09	110	.09	110	.09	110	.10	101								
1	.05	1110	.05	1110	.09	111										
5	.03	11100	.04	1110												
2	.01	11101														

Pix	9	7	4	8	6	3	1	5	2
Prob	.30	.17	.13	.12	.10	.09	.05	.03	.01
Avg	.60	.51	.39	.36	.30	.27	.20	.15	.05

Efficiency
Avg. Number of bits per pixel to send: **2.83**
Compression ratio is: **[(4-2.83)/4]*100**
= 29.25%
The number of iterations is: **7**



b) *According to Proposed algorithm*

Pix	Prob		Ite-1		Ite-2		Ite-3		Ite-4		Ite-5	
9	.30	0										
7	.17	1										
4	.13	01	.13	01	.13	01	.18	00	.22	1	.31	0
8	.12	10	.12	10	.12	10	.13	01	.18	00	.22	1
6	.10	11	.10	11	.10	11	.12	10	.13	01		
3	.09	000	.09	000	.09	000	.10	11				
1	.05	0010	.05	0010	.09	001						
5	.03	00110	.04	0011								
2	.01	00111										

Pix	9	7	4	8	6	3	1	5	2
Prob	.30	.17	.13	.12	.10	.09	.05	.03	.01
Avg	.30	.17	.26	.24	.20	.27	.20	.15	.05

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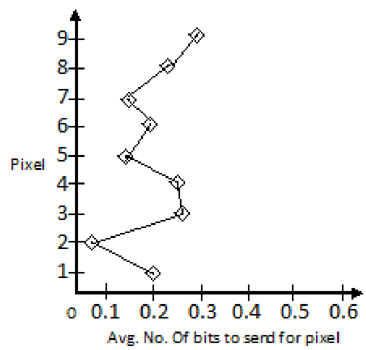
Efficiency

Avg. Number of bits per pixel to send: 1.84

Compression ratio is: [(4-1.84)/4]*100

= 54%

The number of iterations is: 5



VII. Conclusion and Future Scope

With the advancements in compression technology, it is now very easy and efficient to compress the images. Various image compression techniques are available. The most common image compression standard is JPEG (Joint Picture Experts Group). Many advances are being made for improving the image quality. Applied fields that are making use of this technique in the coming future include astronomy, acoustics, nuclear engineering, sub-band coding, signal and image processing, neurophysiology, magnetic resonance imaging, speech discrimination, optics, fractals, turbulence, earthquake-prediction, radar, human vision, and pure mathematics applications such as solving partial differential equations.

References Références Referencias

1. ARM Corp. Technical Reference Manual Revision: r3p2
2. ARM Corp. ARM Architecture Reference Manual, Advanced SIMD Extension and VFPv3 supplement
3. Optimization of Audio Codecs on NEON, www.iqmagazineonline.com/archive26/pdf/Pg36-39.pdf
4. Chirantan Kumar, Pranav Mishra, Prachi Choudhary ,Kaustubh Joshi, Video Codec Optimizations on Cortex A8, "Proceedings of the 5th International Conference on Wireless communications, networking and mobile computing" Beijing, China, 4697-4700, 2009.
5. MPEG, Coding of moving pictures and associated audio for digital storage media at up to 1.5 Mbit/s, part 3: Audio. "International Standard IS 11172-3, ISO/IEC JTC1/SC29 WG11", 1992.
6. Vladimir Z Mesarovic, Raghunath Rao, Miroslav V Dokic, Sachin Deo, Selecting an Optimal Huffman Decoder for AAC, "Audio Engineering Society Convention 111" New York, USA, Nov. 2001.
7. Gutemberg G.S, Lima M.A.M, Filho W.O.G, Perkusich A, Morais M.R.A, Lima A.M.N, A Fast and Memory Efficient Huffman Decoding Method for the MPEG-4 AAC Standard,"ICCE 2008" Las Vegas, USA, Jan. 2008.
8. System reference manual of BeagleBoard, "http://beagleboard.org/static/BBSRM latest.pdf".
9. ARM Corp. RealView Compilation Tools Compiler Reference Guide Version 4.0.

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$M_{in}H_{op}$ (MH) Transmission strategy to optimized performance of epidemic routing protocol

By Qaisar Ayub, Sulma Rashid, M. Soperi Mohd Zahid
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Abstract- Delay tolerant network aims to provide the network architecture in environments where end-to-end path may never exist for long duration of time. Furthermore, dynamic topology changes, limited buffer space and non stable connectivity make routing a challenging issue. The research contribution regarding DTN routing protocols can be categorized in to single and multi copy strategies. A single copy strategy makes less use of network resources but suffers from long delay and less delivery probability. Multi copy schemes enjoy better delivery probability and minimum delivery delay at the cost of heavy use of network resource. Moreover, DTN nodes operate under short contact duration and limited transmission bandwidth. Therefore, it is not possible for a node to transmit all messages from its forwarding queue. Hence the order at which the messages are forwarded becomes very vital. In this paper we propose a forwarding queue mode named MinHop. We prove through simulations that the proposed policy performs better then FIFO in terms of delivery probability, overhead, message drop and relay.

Keywords: Store and carry networks, Forwarding strategies, routing, DTN, Minimum hop transmission

GJCST Classification: C.2.2, C.2.1

Strictly as per the compliance and regulations of:

$M_{in}H_{op}$ (MH) Transmission strategy to optimized performance of epidemic routing protocol

Qaisar Ayub[α], Sulma Rashid[Ω], M. Soperi Mohd Zahid[β]

Abstract- Delay tolerant network aims to provide the network architecture in environments where end-to-end path may never exist for long duration of time. Furthermore, dynamic topology changes, limited buffer space and non stable connectivity make routing a challenging issue. The research contribution regarding DTN routing protocols can be categorized in to single and multi copy strategies. A single copy strategy makes less use of network resources but suffers from long delay and less delivery probability. Multi copy schemes enjoy better delivery probability and minimum delivery delay at the cost of heavy use of network resource. Moreover, DTN nodes operate under short contact duration and limited transmission bandwidth. Therefore, it is not possible for a node to transmit all messages from its forwarding queue. Hence the order at which the messages are forwarded becomes very vital. In this paper we propose a forwarding queue mode named MinHop. We prove through simulations that the proposed policy performs better then FIFO in terms of delivery probability, overhead, message drop and relay.

Keywords- Store and carry networks, Forwarding strategies, routing, DTN, Minimum hop transmission.

I. Introduction

Delay-tolerant networks (DTNs) provide a unique feature of establishing network infrastructure through intermittently connected mobile nodes. This technology [6] have been massively employed in areas like military network[1],wildlife tracking[2], underwater [3][5] and ocean sensor networks[4] where end-to-end path is not stable due to dynamic topology changes, network partitioned, node mobility and long delays.

DTN routing protocol follows three phase store-carry-forward strategy by which a node store arriving message in its buffer, carries the message while moving around and forward it when comes under the transmission range of other node. Moreover low band width, buffer space and limited contact time make routing most challenging part of this rebellion technology.

Depending on resource consumption, routing for DTN can be divided in to two classes. First class of routing minimizes the resource expenditure by controlling the replication of message like single copy [7], first contact [7], and direct delivery [7]. Furthermore, these strategies produce long delay and less delivery probability. The second class of router forwards the multiple copies of each message across network like Epidemic routing [9], Prioritized epidemic [13,]Spray&wait [11], Prophet [8], MaxProp [10], Probabilistic forwarding [12]. Multi copy algorithms results in less delay while elevates the delivery probability.

Despite the effort on improvising the new routing protocols for DTN environment, one area which has not been deeply investigated is the use of message forwarding strategies.

Since moving nodes set up end-to-end contact for very short time, therefore it is not possible for a node to transmit all buffered messages from its forwarding queue to encounter node. Hence the order at which the messages are forward can provide a significant optimization.

Previous work [19, 12, 21], and [29] addressed the forwarding strategies to optimize DTN protocols for resource constraint environments. In addition the combination of forwarding and drop polices [14, 15, 16, 17, 18, 20, 22, 23, and 24] provide better results and gives a motivation towards further investigation in this dilemma.

In this paper we proposed a forwarding strategy named $M_{in}H_{op}$ which utilize the local knowledge of router and transmit the message with minimum value of hop count. Simulation results have proved that the proposed policy performs better then FIFO in terms of message relayed message drop, delivery probability and overhead ratio.

Rest of paper have been organized as follows, Section II present existing forwarded polices, Section III router under observation, performance metrics are in Section IV, Section V depicts approach and $M_{in}H_{op}$ algorithm in section VI .while section VII is about simulation setup and results with conclusion in section VIII.

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II. Existing Forwarding Strategies

a) *First in First out (FIFO)*

In FIFO queue mode all messages are arranged according to in coming arrival time. When forwarding opportunity arises the oldest messages will be transmitted first.

b) *Random Queue Mode (RND)*

The message is arbitrarily selected for the transmission. Here all the messages have equal likely turn to transmit.

c) *GRTR*

"Assume A, B are nodes that meet while the destination is D, $P_{(X, Y)}$ denote the delivery predictability that a node X has for Destination Y. GRTR forward the message to node only if $P_{(B\text{-}D)} > P_{(A\text{-}D)}$" [12].

d) *GRTRSort*

"GRTRSort looks at difference $P_{(B\text{-}D)} - P_{(A\text{-}D)}$ values for each message between the nodes and forward the message only if $P_{(B\text{-}D)} > P_{(A\text{-}D)}$." [12]

e) *GRTRMax*

"Select messages in descending order of $P_{(B\text{-}D)}$ forward the message only if $P_{(B\text{-}D)} > P_{(A\text{-}D)}$." [12]

f) *Transmit Smallest message first (TSMF)*

According to TSMF forwarding strategy the message with small sizes are placed on top of forwarding queue [21].

g) *ARER*

ARER [25] is the forwarded policy which assigned forwarded probability with a metric Replications Density intended for all message in its queue. Moreover, ARER assembles the forwarding chain and the dropping priority based on their allocate weight. The weight is examined by the Replication Density, the delivery predictability, and TTL.

h) *Lifetime DESC (Descending Order)*

Lifetime DESC [26] scheduling policy orders messages based on time-to-live (TTL). Messages with longer TTLs will be scheduled to be sent first.

i) *BUBBLE*

Bubble [27] a novel social-based forwarding algorithm which exploit two social and structural metrics, namely centrality and community, using real human mobility traces.

j) *Transmit Max Hop Count First (TMHF)*

In THMF the forwarding queue sent the message with maximum hop count [29].

III. Epidemic Routing Under Observation

Epidemic routing inspired by [9] replicate the messages across all intermittently connected mobile nodes called carriers. The carrier nodes then become responsible and diffuse the message to further island of nodes.

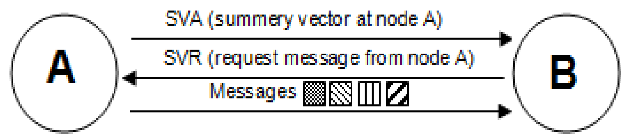

Fig.1 Epidemic routing protocol

Fig 1 depicts the working of epidemic router. When A and B comes in the transmission range of each other, A forwards its summery vector (SV_A) to B. Summery vector is the representation of messages buffered on each node. Node B sends SV_R which is the representation of messages not buffered at B. Finally A sends the message requested in SV_R. Epidemic router proves better delivery probability at the cost excessive network resources.

IV. Performance Metrics

a) *Relayed*

Relay is the hop-by-hop transmission of message. Minimum relay reduce the consumption of network resources. Objective of algorithm is to minimize the relay of messages.

b) *Drop Ratio*

Drop ratio is a measure to count the numbers of messages dropped by a node due to congestion. The objective of algorithm is to minimize the drop ratio.

c) *Delivery Probability*

The ration of message received over message send. Higher value of delivery probability indicates that huge number of messages delivered. The objective is to maximize the delivery probability.

d) *Overhead Ratio*

It is the negation of number of messages relayed to number of message delivered. Low value of overhead means less processing required delivering the relayed messages. Objective of algorithm is to minimize the value of overhead.

V. Proposed Forwarding Mechanisim

Epidemic routing protocol replicate the each messages across all intermittently connect mobile nodes. This random transmission quickly propagates the message towards destination. However due to short end-to-end connectivity and limited transmission bandwidth the order of message transmission can influence the performance of router. In this section we will provide the theoretical understanding about existing (FIFO forwarding) and proposed (MinHop forwarding) policy. We only consider delivery probability.

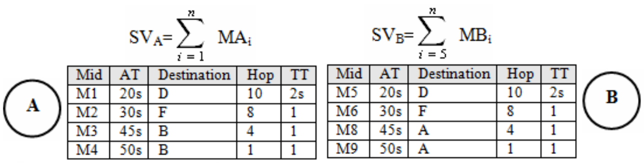

Fig.2 FIFO order at node A and B

Case 1: Epidemic with FIFO forwarding order

Let A, B are two intermittently connected mobile nodes. Fig.2 represents the messages buffered at each node. Further AT represents Arrival time, TT is transmission time, λ is meeting rate and λ=1/E [U] where E [U] is average meeting time.

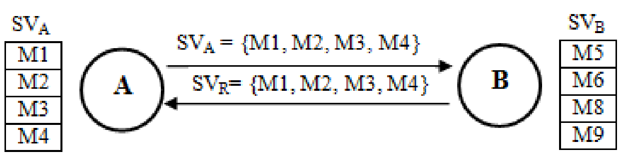

Fig.3 Exchange of summery vectors

Fig 3 depicts the exchange of summery vectors under epidemic routing protocol. For clear understanding we use message id as an alternative to index.

After receiving SV_A node B performs the subtraction with SV_B and transmit SV_R to node A which represents the set messages not buffered at B.

$$SV_{R\,(B\text{-}A)} = \sum_{i=5}^{n} MB_i - \sum_{i=1}^{n} MA_i$$

Fig.4 Summery vector request (SV_R)

Fig 5 represents the transmission of messages from A to B upon receiving (summery vector request) SV_R. The available E [U] transmission time is 3s hence by FIFO forwarding order M1, M2 with destinations D, F will be forwarded to B.

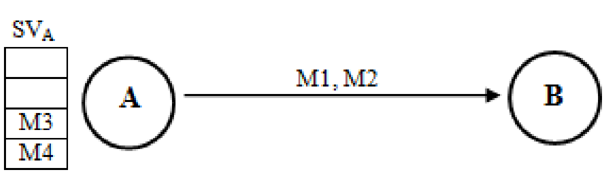

Fig.5 FIFO order at node A and B

SortFIFO ($SV_{R\,(B\text{-}A)}$) = SortFIFO ($SV_B \cap SV_{A)}$ = {M1, M2, M3, M4}

Case 2: Epidemic with $M_{in}H_{op}$ forwarding order

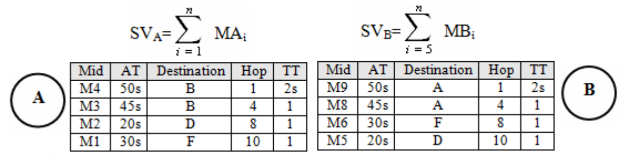

Fig.6 MinHop order at node A and B

Sort $M_{in}H_{op}$ ($SV_{R\,(B\text{-}A)}$) = Sort $M_{in}H_{op}$ ($SV_B \cap SV_{A)}$ = {M4, M3, M2, M1}

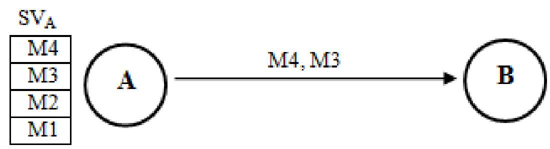

Fig.7 Transmission of messages $M_{in}H_{op}$

From Fig 7 we can see that with available transmission time E [U] M4, M3 with destination B will be forwarded to node B. Hence it increases the delivery probability.

VI. Proposed Algrothem

Step 01:
if (current router not linked with nodes) then
return no message transmission
Step 02:
If (router number of messages are zero) then
return no message transmission
Step 03:
else
Messages = SORT(messages with hop count value)
TrasnimteMessages (Messages)

VII. Simulation and Results

We use opportunistic network environment [ONE] Simulator [28] to check the performance of existing (FIFO) and proposed ($M_{in}H_{op}$). This simulator provides store-carry-forward implementation of DTN routing protocols. It supports various mobility models and customized heterogeneous grouping of nodes facilitates to carry out the experiments in a more practical environment.

We configure epidemic router with random way point movement model on the Helsinki city map of 4500 x 3400m area. The simulation end length was equivalent to 240000s. Messages are created for random source and destinations by varying size between 500K-1MB, with the inter message creation interval [30s, 40s]. Furthermore Bluetooth bandwidth 2Mbps has been uniformly distributed across all nodes with 10m of transmission range. We use FIFO existing forwarding strategy with our $M_{in}H_{op}$ and perform

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experiments by varying the number of nodes from 120 to 360 by an increment of 60 nodes per simulation. We use two homogeneous (pedestrians) and one heterogeneous (car) group with buffer size 2MB and infinite TTL.

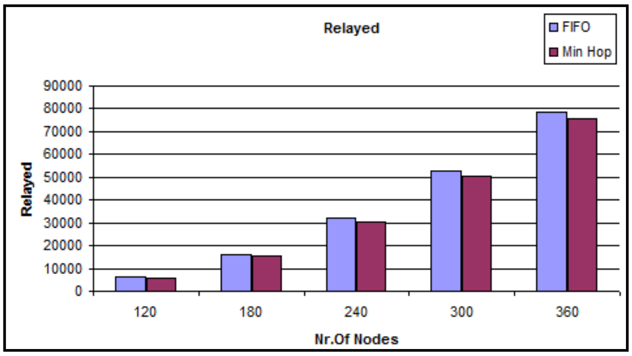

Fig.8 Relayed w.r.t Nr of nodes

Fig 8 depicts the result of epidemic routing protocol in terms of message relay by varying number of nodes per simulation. Since the default behavior of epidemic router is to replicate the message on all encounter nodes which results in high number of transmissions for each message. These redundant transmissions raise router overhead while waste resources like bandwidth, buffer and processing power. Thus minimizing transmissions eventually reduces resource consumption. We can see that the proposed MinHop gradually minimizes the message relays.

$$\text{Relayed improvement} = \left[\frac{\text{FIFO Relayed} - \text{MinHop Relayed}}{\text{FIFORelayed}}\right] \times 100 \quad (1)$$

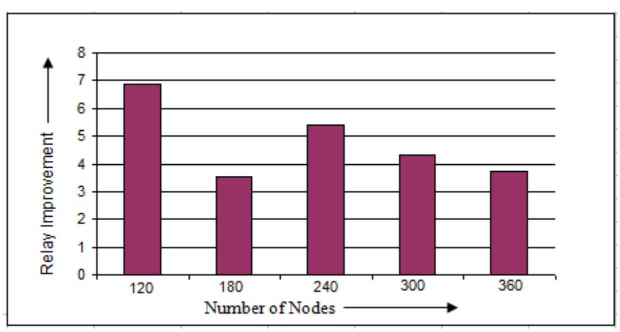

Fig.9 Relayed improvement

From Equation 1 we plot a graph to show relayed improvement of $M_{in}H_{op}$. We can examine in Fig 6 that the proposed policy considerably minimizes transmission of message at 6.8%, 3.5%, 5.4%, 4.3% and 3.7% for 120,180,240, 300 and 360 nodes correspondingly.

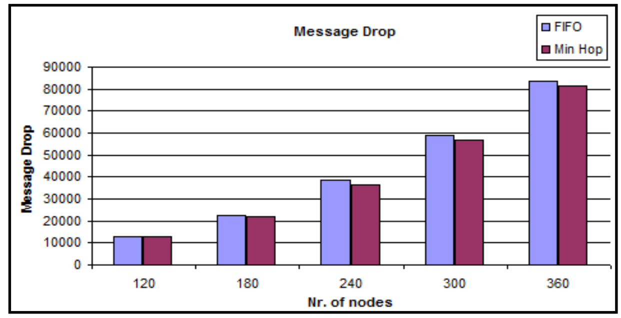

Fig.10 Message Drop w.r.t Nr of nodes

Fig 10 plots the comparisons between existing FIFO and proposed $M_{in}H_{op}$ forwarding policies in terms of message with respect to number of nodes. As DTN is resource constraint network [30] with limited buffer space. Therefore a node must drop a message when its buffer runs out of capacity. Several solutions [20] [22] [23] [24] prove that minimizing message drop can affect the router performance. Moreover dropping a message also squanders all resources consumed by the message during it's strive to destination. On the other hand this drop indirectly gives high opportunity for message relays. Therefore minimizing message drop is considered as positive direction towards improvement. From Fig 04 we can observe that the proposed message forwarding ($M_{in}H_{op}$) limits the message drop as compared to FIFO.

$$\text{Message Drop Improvement} = \left[\frac{\text{FIFO Message Drop} - \text{MinHop Message Drop}}{\text{FIFOMessageDrop}}\right] \times 100 \quad (2)$$

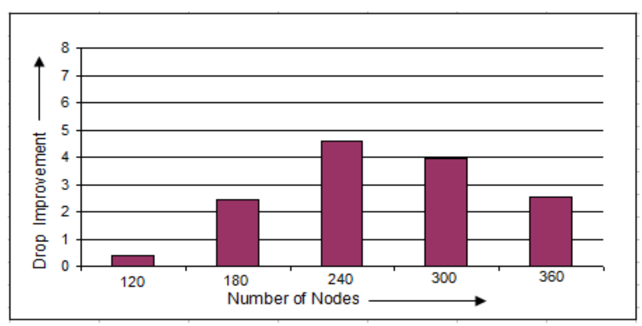

Fig.11 Drop improvement

From Fig 11 we present the effect of $M_{in}H_{op}$ on reducing the message drop by using equation 2. The proposed policy reduces the message drop at 0.3%, 2.4%, 4.6%, 3.9% and 2.5% for 120,180,240, 300 and 360 nodes respectively.

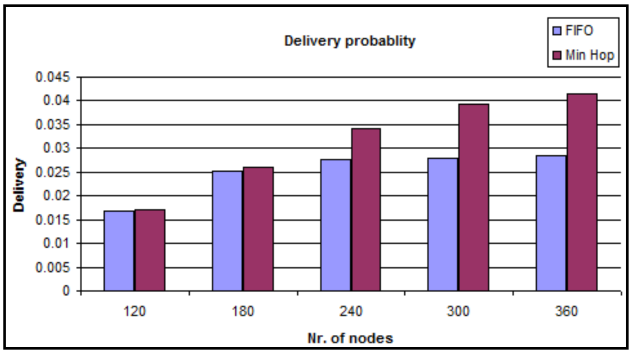

Fig.12 Delivery w.r.t Nr of nodes

Fig 12 compares the delivery probability of $M_{in}H_{op}$ forwarding strategy with FIFO by increasing number of nodes. Delivery probability always is considered the most essential measure in DTN routing. Moreover high value of delivery confirms effective utilization of network resources such as bandwidth, buffer space and processing power. We can easily observe that at each simulation instance proposed policy $M_{in}H_{op}$ shows betters results as compared to FIFO.

$$\text{Delivery Improvement} = \left[\frac{\text{Min Hop Delivery Probability} - \text{FIFO Delivery Probability}}{\text{Min Hop Delivery Probability}}\right] \text{x } 100 \quad (3)$$

Fig 13 clearly shows the improvement in the delivery probability by computing the results from equation 3. The proposed policy raises delivery probability at 1.7%, 2.7%, 19%, 29% and 31% with respect to varying number of nodes.

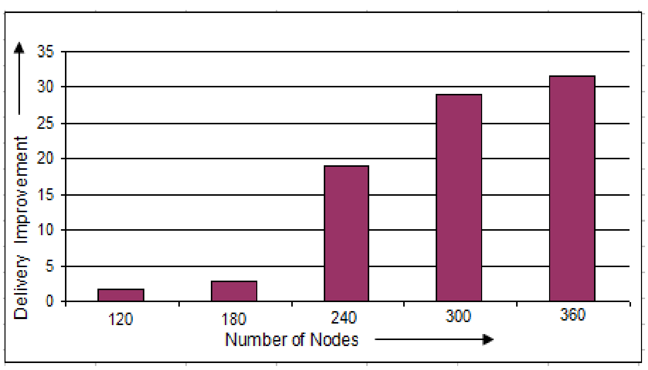

Fig.13 Delivery Improvement

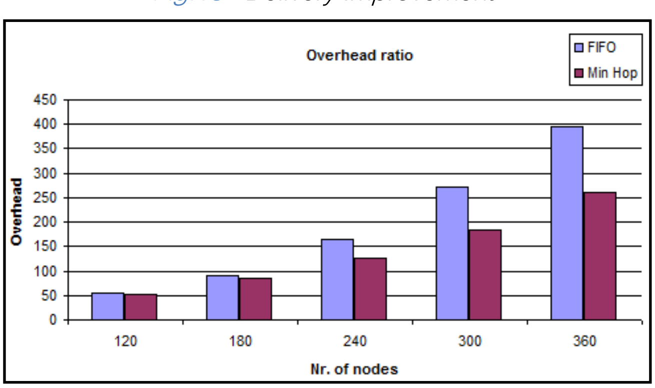

Fig.14 Overhead w.r.t Nr. of nodes

Fig 14 examines the significance of proposed $M_{in}H_{op}$ Forwarding as compared to FIFO in terms of reducing the overhead. Overhead gives the estimated value to measure consumption of processing power and other network resource. Therefore minimum overhead proves effective use of network resources. From Fig 14 we can see that proposed $M_{in}H_{op}$ reduces the overhead as compare to FIFO.

$$\text{Overhead Improvement} = \left[\frac{\text{FIFO Overhead Ratio} - \text{Min Hop Overhead Ratio}}{\text{FIFO Overhead Ratio}}\right] \text{x } 100 \quad (4)$$

Fig 15 provides a boarder view in reducing the overhead. The proposed policy $M_{in}H_{op}$ minimizes the overhead at 2.38%, 6.3%, 23%, 32% and 34% for all node configurations.

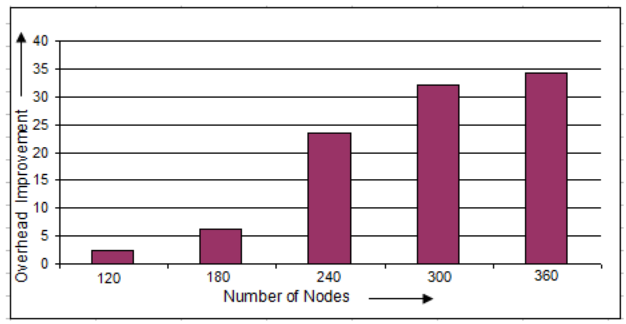

Fig.15 Overhead improvement

VIII. Conclusion

In this paper, we have investigated the problem of efficient message forwarding mechanism in Disruption Tolerant Networks. We proposed a local knowledge based forwarding scheme $M_{in}H_{op}$ for Epidemic Routing. The algorithm solves shortcomings of epidemic router under limited buffer and bandwidth. Simulation results have shown that $M_{in}H_{op}$ optimized Epidemic routing in term of improved relayed, overhead, message drop and delivery by a significant margin.

The future work is to combine the existing forwarding strategies with new one and explore the different routing algorithms performances under spare and congestion DTN environments.

References Références Referencias

1. Disruption Tolerant Networking. [Online]. Available: http://www.darpa.mil/ato/solicit/DTN/
2. P. Juang, H. Oki, Y. Wang, M. Martonosi, L. S. Peh ,and D (2002). Rubenstein. Energy-efficient computing for wildlife tracking: design tradeoffs and early experiences with zebranet. In Proc. ASPLOS'02, Oct.2002.
3. J. Heidemann, W. Ye, J. Wills, A. Syed, and Y. Li, "Research challenges and applications for underwater sensor networking," in

Proceedings of the IEEE Wireless Communications and Networking Conference, 2006.
4. Maffei, K. Fall, and D. Chayes. Ocean Instrument Internet. In Proc. AGU Ocean Sciences Conf., Feb 2006.
5. J. Partan, J. Kurose, and B. N. Levine. A Survey of Practical Issues in Underwater Networks. In Proc. ACMWUWNet, pages 17–24, Sept. 2006.
6. SCOTT, J., HUI, P., CROWCROFT, J., AND DIOT, C. Haggle: Networking Architecture Designed Around Mobile Users. In Proceedings of IFIP WONS (2006).
7. T. Spyropoulos, K. Psounis, and C. Raghavendra A, C. S. "Single-copy routing in intermittently connected mobile networks," IEEE/ACM Transactions on Networking (TON), vol. 16, pp. 63-76, Feb. 2008.
8. A. Lindgren, A. Doria, and O. Schelen, "Probabilistic routing in intermittently connected networks," SIGMOBILE Mobile Computing and Communication Review, vol. 7, no. 3, 2003.pp 19-20.
9. Vahdat and D. Becker. Epidemic Routing for Partially-connected Ad hoc Networks. Technical Report CS-2000-06, Duke University, July 2000.
10. J. Burgess, B. Gallagher, D. Jensen, and B. N.Levine . MaxProp: Routing for Vehicle-Based Disruption- Tolerant Networks. In Proc. IEEE Infocom, April 2006.
11. T. Spyropoulos, K. Psounis, and C. S. Raghavendra." Spray and wait: an efficient routing scheme for intermittently connected mobile networks", In SIGCOMM Workshop on Delay Tolerant Networking (WDTN), 2005
12. A.indgren and K. S. Phanse, "Evaluation of queuing policies and forwarding strategies for routing in intermittently connected networks,"in Proc. of IEEE COMSWARE, pp. 1-10, Jan. 2006.
13. R Ramnathan, R. Hansen, P. Basu, R. R Hain and R Krishnan, " Prioritized Epidemic Routing for Partially Connected Ad Hoc Networks ", in proceeding of ACM MobiOpp'07, 2007.
14. Soares, V.N.G.J., F. Farahmand, And J.J.P.C. Rodrigues. Scheduling And Drop Policies For Traffic Differentiation On Vehicular Delay-Tolerant Networks. 2009: Ieee.
15. Li, Y., et al. Adaptive optimal buffer management policies for realistic DTN. 2010: IEEE.
16. Krifa, A., C. Barakat, and T. Spyropoulos. An optimal joint scheduling and drop policy for delay tolerant networks. 2008: IEEE.
17. Yin, L., et al. Buffer scheduling policy in DTN routing protocols. 2010: IEEE.
18. Krifa, A., B. Chadi, and T. Spyropoulos, Message Drop and Scheduling in DTNs: Theory and Practice. 2010.
19. Zhang, X., H. Zhang, and Y. Gu. Impact of source counter on DTN routing control under resource constraints. 2010: ACM.
20. Sulma Rashid, Qaisar Ayub,"Effective buffer management policy DLA for DTN routing Protocols under congestion", International Journal of Computer and Network Security, Vol 2, NO 9, Sep 2010. pp .118-121.
21. Qaisar Ayub, Sulma Rashid and Dr.Mohd Soperi Mohd Zahid. Article: Optimization of Epidemic router by new forwarding queue mode TSMF. International Journal of Computer Applications 7(11):5–8, October 2010. Published By Foundation of Computer Science.
22. Qaisar Ayub, Sulma Rashid," T-Drop: An optimal buffer management policy to improve QOS in DTN routing protocols", Journal of Computing, Vol 2, ISSUE 10.
23. Rashid, S., et al., E-DROP: An Effective Drop Buffer Management Policy for DTN Routing Protocols. International Journal, 2011. 13(7): p. 8-13.
24. Sulma Rashid, Qaisar Ayub, M. Soperi Mohd Zahid , A.Hanan. Abdullah. "Optimization Of DTN Routing Protocols By Using Forwarding Strategy (TSMF) And Queuing Drop Policy (DLA)", International Journal Of Computer And Network Security, Vol 2,Issue 10,October 2010. Pp .71-75.
25. Wang, X., et al. Adaptive Randomized Epidemic Routing for Disruption Tolerant Networks. in 2009 Fifth International Conference on Mobile Ad-hoc and Sensor Networks. 2009: IEEE.
26. Soares, V.N.G.J., et al. Improvement of Messages Delivery Time on Vehicular Delay-Tolerant Networks. in International Conference on Parallel Processing Workshops. 2009: IEEE.
27. Hui, P., J. Crowcroft, and E. Yoneki, Bubble rap: social-based forwarding in delay tolerant networks. IEEE Transactions on Mobile Computing, 2010.
28. Keranen, J. Ott, T. Karkkainen, "The ONE Simulator for DTN Protocol Evaluation," SIMUTOOL, 2009.
29. Qaisar Ayub, Sulma Rashid and Soperi Mohd M Zahid. Article: TMHF: Transmit Max Hop First forwarding Strategy to Optimize the Performance of Epidemic Routing Protocol. International Journal of Computer Applications

18(5):40-45, March 2011. Published by Foundation of Computer Science.
30. Balasubramanian, A., B. Levine, And A. Venkataramani, DTN Routing As A Resource Allocation Problem. ACM SIGCOMM Computer Communication Review, 2007. **37**(4): P. 373-384.

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A Rare Example of Pitfall in Corporate Data Modeling Practices for Information Systems

By Hae Kyung Rhee

Abstract- Although Entity Relationship Model have turned out to be de facto corporate data modeling vehicle, current exercise for its application to real-world business processes is disclosed to surprisingly face a pressing peril of an alarming level in terms of data consistency and the degree of unnecessary data redundancy. In this paper, the matter-of-fact legacy practice, once thought to be a confidential or secret, obtained from some major broadcasting company is articulately reported and its demerits as well as its antagonistic side effect due to abnormality are discussed in depth. We were able to remold such an ill-manifested case to a legitimate ER model vindicated through an endeavor of a couple of months long. The two cases then are compared both qualitatively and quantitatively. The result of analysis has shown that ill-formed data models contain more than a ratio of 40 percent of unnecessary data redundancy, which leads us to have an implication that it is heavily contingent to seek a corrective measure for cutting down the ratio.

Keywords: Data modeling Entity Relationship model; Data consistency; Data obesity.

GJCST Classification: H.2.1

A RARE EXAMPLE OF PITFALL IN CORPORATE DATA MODELING PRACTICES FOR INFORMATION SYSTEMS

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A Rare Example of Pitfall in Corporate Data Modeling Practices for Information Systems

Hae Kyung Rhee

Abstract- Although Entity Relationship Model have turned out to be de facto corporate data modeling vehicle, current exercise for its application to real-world business processes is disclosed to surprisingly face a pressing peril of an alarming level in terms of data consistency and the degree of unnecessary data redundancy. In this paper, the matter-of-fact legacy practice, once thought to be a confidential or secret, obtained from some major broadcasting company is articulately reported and its demerits as well as its antagonistic side effect due to abnormality are discussed in depth. We were able to remold such an ill-manifested case to a legitimate ER model vindicated through an endeavor of a couple of months long. The two cases then are compared both qualitatively and quantitatively. The result of analysis has shown that ill-formed data models contain more than a ratio of 40 percent of unnecessary data redundancy, which leads us to have an implication that it is heavily contingent to seek a corrective measure for cutting down the ratio.

Keywords: Data modeling; Entity Relationship model; Data consistency; Data obesity

I. Introduction

a) *Background- What We Have Dug Out*

Although this era of history is called information age, it seems to many of us that it meant to be the age of computerized or automated program rather than the age of data, since response time to data we need to retrieve is getting slower than ever. The slowness could be due to data inconsistency [FiKi2010, CiFrMa2009] or replication or redundancy for the pursuit of mere convenience or due to data deluge phenomenon [KaBoZe2010] or data overload phenomenon[ShRi2011]. Although the issue of data deluge has been recently brought into a focal point, the issue of data inconsistency is considered to be more imminent and fundamental in that it could aggravate the problem of deluge if not legitimately rectified and also in that the impact of deluge phenomenon to the issue of inconsistency is more or less inefficacious.

The issue of propriety of data modeling has not been diminished since the days of as early as early 1990s just under the presumption that it is more or less vague to debate whether a data item should be required to be classified either as an entity or as a relationship or even as an attribute. However, as the occasions of prolongation in response time to queries submitted by users have been reported from a number of sources these days, we judged this might be the right time to shed light again on the issue of corporate data modeling, since such a modeling is mostly carried out by persons of non-expertise and there seems to be a lot of serious flaws as they have often been confessed by a slew of field practitioners.

We still do not know the exact origin of problem inducing slowness of response, but in this report we are able to reveal some of the reasons that impede responsiveness with the entity-relationship models we obtained in the real-world 2

corporate data modeling practices. The so-called data maps, ER models [DaGrRo2006], are not easy to obtain, since most corporate is reluctant or hesitant to disclose their internals of blue-print of data design, particularly at the level of data attribute, as it is more or less considered to be a sort of secret due to confidentiality associated with database or a sort of shame due to field practitioners' lack of expertise in proper and legitimate data modeling.

One prototypical example of data modeling practices is from one of the major world-class broadcasting companies. We could not reveal the name of the corporate, but the practices are not only limited to that company.

They are pretty much prevalent these days when readers of this paper have a chance to have a glimpse at the ER models like Fig. 1. The diagram like Fig. 1 is canonically called as the ER model, even though it fails to follow the simple and basic rule of connecting a relationship to an entity. In ER world, a relationship is practically either a binary, i.e. two-way relationship, or ternary. Anything more than ternary is in reality hard to come by and at the same time hard to think of.

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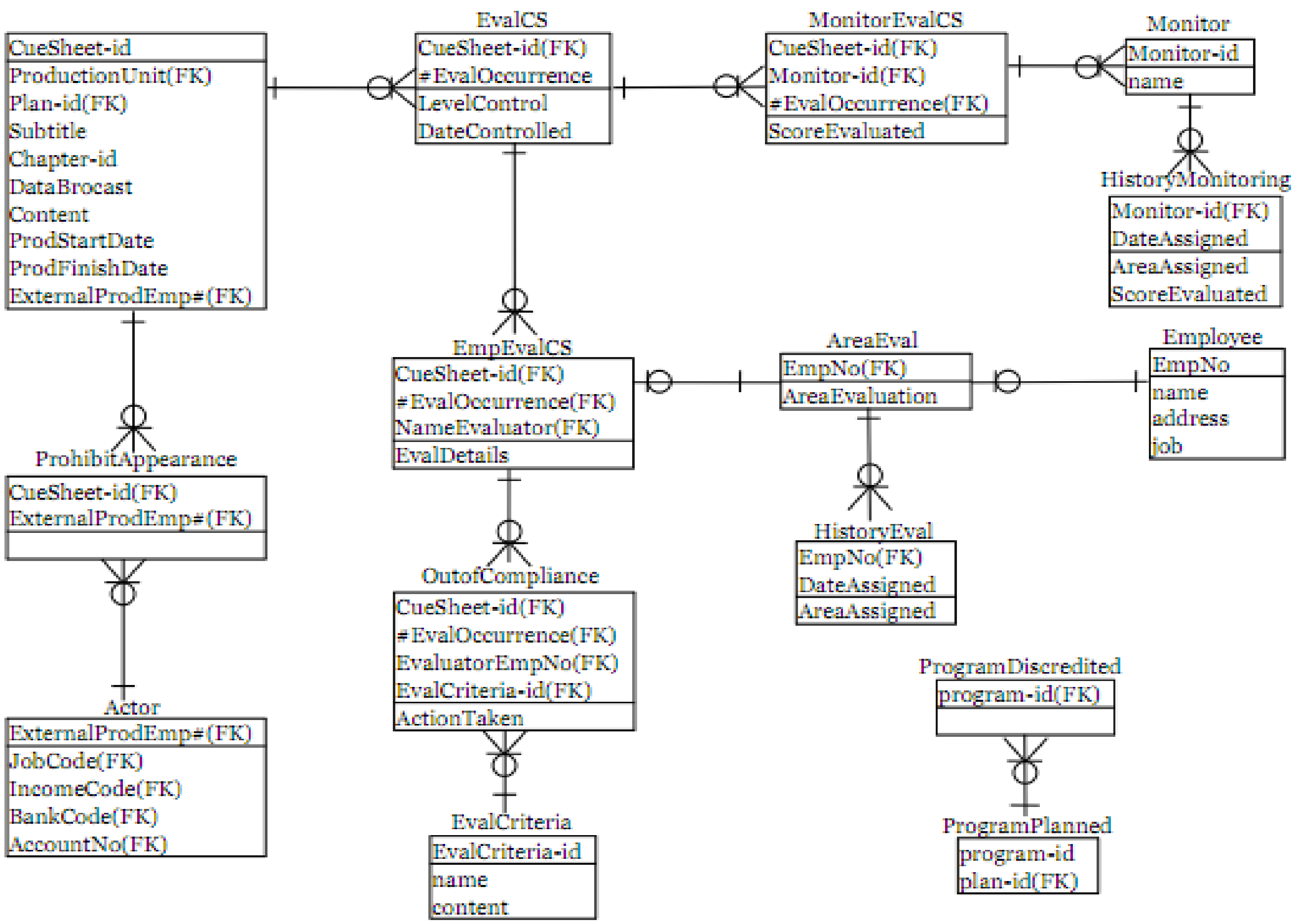

Fig. 1. Real-World Data Modeling Practice in Major Broadcasting Company

For instance, a binary relationship is used to describe an action, denoted by a verb, that identifies the subject of the action and the target object of the action in a way as in Fig. 2.

Fig. 2. Action Meant to Be a Relationship between Two Entities

b) *Motivation*

i. Is Omission and Over-Simplification or Abstraction of Data Tolerable in Real-World Modeling?

It is obvious to find the drawing nature of Fig. 1 does not obey or intentionally dishonor the rule of binary relationship in that the diagram can be translated into Fig. 3 if we take it seriously in the perspective of relationship. It is extremely abnormal or insane in that a relationship frequents a direct connection to another relationship without going through a certain entity. In reality, there are many regular entities omitted, either unconsciously or consciously, in the real-world data model of Fig. 1.

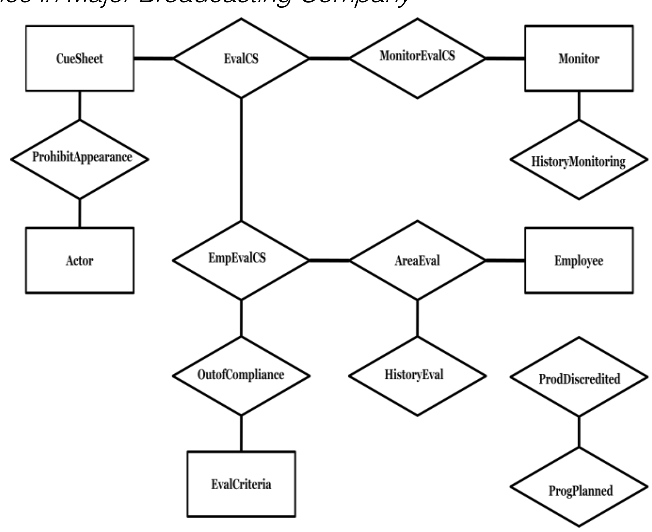

Fig. 3. ER Modeling Practice Out of Normalcy

This sort of abstraction or over-simplification might be originated from lack of knowledge associated with the philosophy and paradigm of conceptual data modeling, but unfortunately this customary misact is never tolerable, since it inevitably bring a serious blunder to the quality of data models. It must be carefully observed that it is obviously too far-fetched to the wrong direction from the basic guideline for entity-relationship modeling, which is the clear doctrine even the UML[ArElLa2006], the mostly favored data modeling tool these days, take its fundamental basis.

ii. *Is Real-World Model Merely Entity-Oriented Model?*

In this sense, the model is not relationship-oriented, e.g. business action-oriented or behavior-oriented [YaElOu2010], but rather it is fairly entity-oriented by omitting either sometimes a subject entity or other times a target entity. Not surprisingly, internal data models in most of the renowned ERPs are nonetheless no different from an ER model as in Fig. 1. Consequence of frequent adoptions of such ill-manifested data models by frequenting omission of entities shall cause a tremendous degradation of information systems, in terms of quality of response time and travail of maintaining consistent view to attribute-level data items, under which those type of data models prevail.

iii. *Objectives- How Much Far-Fetched is the Field Legacy Practice in Terms of Data Quality?*

Once the real-world practice is obtained, we were able to translate it to an ER model that could be considered to be normal and sane, albeit this

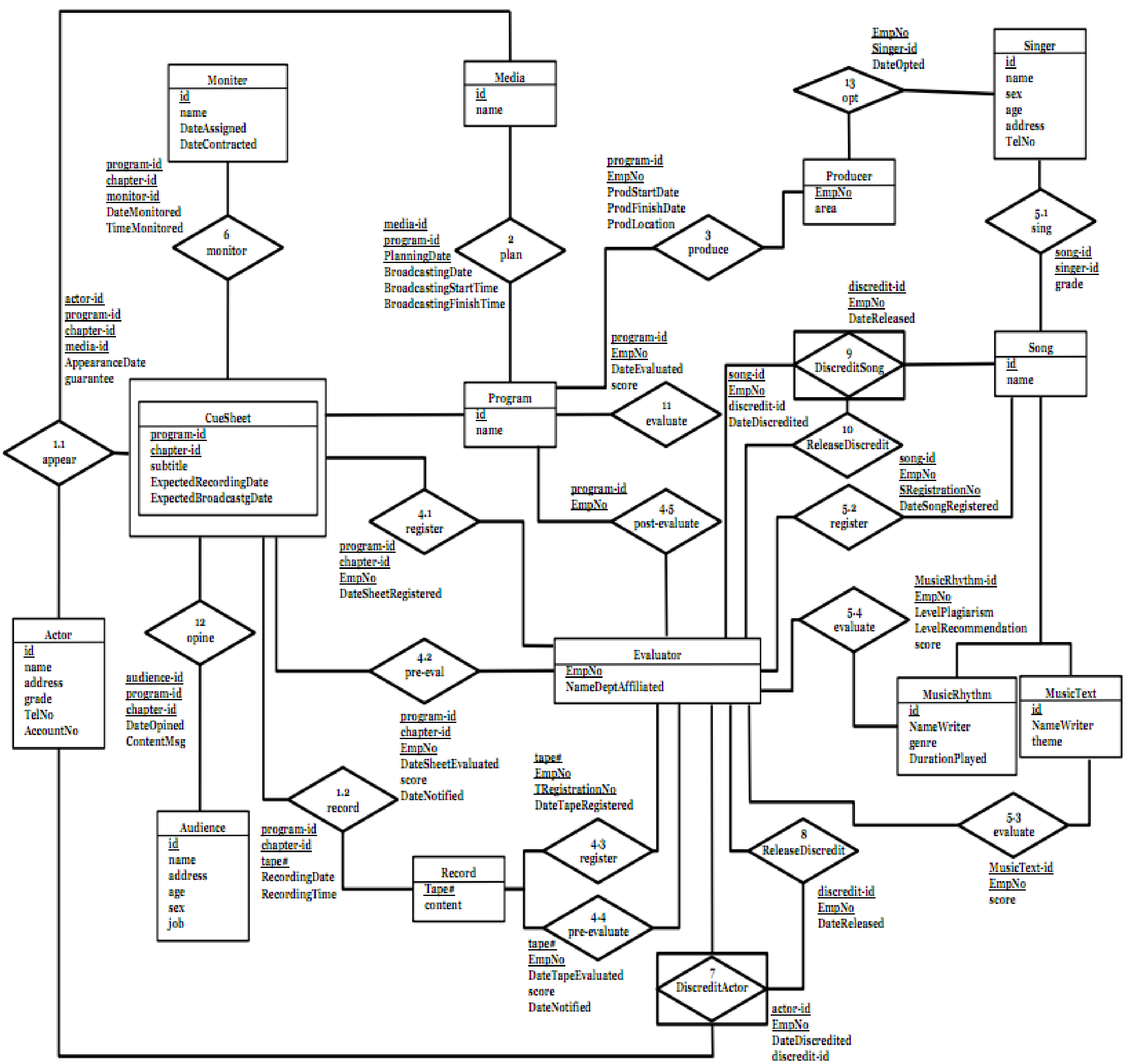

Fig. 4. The ER Model Translated with Scrutiny

translation job took a labor of a couple of months long to discover how attribute-level data is associated with business processes. The final ER model obtained is depicted in Fig. 4. It seems to be classic in the sense that the philosophy of connecting an entity to another entity is fully honored in a way that any two entities are permitted to be linked always through a relationship that make two of them directly associated with each other. Notethat, in Fig. 4, key attributes are underlined for entities and relationships, and weak entities are denoted by double rectangles.

For instance, in Fig. 4, entity *CueSheet* is a weak entity deduced from a regular entity *Program*.

Relationship turned entity, i.e. entity upgraded from a relationship for the sake of the action which is directly subsequent to the relationship is denoted by diamond enclosed by rectangle. For instance, *DiscreditActor* is the action prerequisite to the action *ReleaseDiscredit*.

The awkwardness of data models of type Fig. 1 leads us to contemplate on the cause and effect of technical blunders brought by data modelers of non-reputing the veracity of genuine ER modeling principles. The significance of them is then compared against the case of data models of type Fig. 4 to see how much deviation or damage has been brought by improper data modeling practices prevalent in legacy IT field. By conducting careful examinations to them, we are able to deduce a couple of insights that are considered to be very valuable to the readers who might be interested in corporate-wide data management through decent data modeling. The scope of this paper is to present such insights one by one to the degree as much as we can deliver them both qualitatively as well as quantitatively.

II. Notion of Corporate Data Map

Note that the case of Fig. 1 or Fig. 4 is one particular business process in the broadcasting company we contacted. The company is comprised of approximately 800 different such business processes. As it can be observed in Fig. 4, corporate data map is simply more or less like a road map in that where there is a way out should there be a way in as well in a way of forming circular paths as in Fig. 5.

As a road map of, say, a country is fully connected in a sense that there is always a connection to any isolated area, for instance, islands, a data map should has a property of full connection or perfect reachability in a way of never allowing any data silos[Moon2009]. Nevertheless, observe that there are data silos in Fig. 1. There are two. Allowing existence of silos incurs problems not only of data duplication but of slowness in response time due to difficulty in locating query response initiation spot. Once we designated a spot in a wrong silo, there would a waste of time proportional to the amount of unnecessary joins to get reached each individual one of terminal nodes in that silo. In contrast, Fig. 4 never allows data silos.

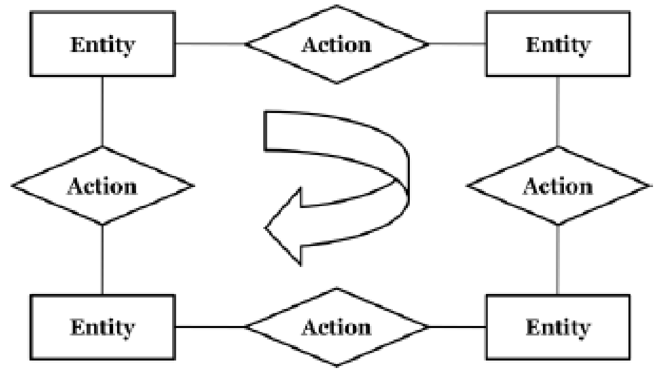

Fig. 5. A Circular Path in Corporate Data Map.

This property must be maintained and guaranteed even if we connect a slew of different data map segments altogether to get a single corporate-wide data map. Note that the major broadcasting company in this study contains 800 such separate data segments that can be connected altogether to get one single integrated corporate data map. Fig. 4 is just one of those segments.

It is evident that merely repeating data modeling practices as in Fig. 3 only contributes to forge of chaos in which ignominies of ER directives inadvertently prevail. Also note that there are 45 unique data attributes in Fig. 1, whereas 86 unique data attributes are included in Fig. 4. In this sense, acquisition of data map of full connectedness allows us to view data flow as well as process flow twice as much accurate and detail than the version of abstraction non-meticulously adopted in Fig. 1. The burden we need to pay with corporate data modeling fashion of Fig. 1 is huge. Let us compare this type of absent-minded approach, say of Fig. 1, as opposed to the type of thoughtful or considerate approach that is incumbent to take a stance of genuine and authentic approach, say of Fig. 4.

III. Skewedness Versus Balancedness

Absent-minded data modeling, AMD for short hereafter, is the canonical example of skewed design. Note that all the 6

links, i.e. relationships between entities, are just stretching out to the end, never returning or regressing to the point of origin of a link already disseminated. For instance, have a look at links from CueSheet to EvalCS to EvalCSMonitor to Monitor, then to HistoryMonitoring. There is only links that are forging out whenever a link is established. That sort of instance also appeared all over the data map of Fig. 1 in that the same observation holds from CueSheet to EvalCS to EvaluatorCS to OutofObeyance to EvalCriteria and from CueSheet to EvalCS to EvaluatorCS to Evaluator to Employee. The data map of Fig. 1 is just full of such cases.

Thoughtful or considerate data modeling, TCD for short hereafter, is the canonical example of balanced design. It guarantees the notion of balanced tree [RaGe2007] in that once a node is designated to be the root of a tree, then there is a threshold of depth of its left subtree and of depth of its right subtree as well. In case there is a circular loop in a component of data map, those two depths happened to be always the same. Look at, in Fig. 4, a case of such circular path from CueSheet to Program to post-evaluate to Evaluator to register and back to CueSheet. Once a node is at random chosen to be the root of a tree, then the maximum depth of both left subtree of it and right subtree of it is always limited to 2. Such cases are prevalent in Fig. 4. Note that there are 14 different circular paths in Fig. 4, whereas there is none in Fig. 1. This is clear-cut contrast between balanced data modeling versus skewed data modeling.

The merit of well-balancedness is the guarantee of agile responsiveness, whereas the preference of skewedness only promotes a retard in response. Note that in TCD the number of joins required to get the desired answer to any query made is just 2, whereas in AMD it is 4. This suggests that response time in TCD is twice as much agile than AMD. Consequently, the cost we need to tolerate is untimely response accrued from the skewedness, whereas much more timely response would be envisioned if the balancedness of design is sought.

IV. Issue of Data Inconsistency

If we turn our attention to the issue of data inconsistency, it is self-evident that AMD obviously fails to provide a consistent view to even the same data. Look at, in Fig. 1, that notion of key attribute is definitely violated in that foreign keys, denoted in FK, appear their existence even in the non-key sections of entity or relationship. It is a strict rule that any key components should appear only in the key sections of an entity or a relationship, otherwise it is the case of overuse or tenet misuse.

Look at an entity *Actor* in Fig. 1. There are five different FKs as its non-key attributes. This is just absurd and it is an obvious sign of defamation to the notion of what the key is. The definition and principle of key must be preserved in the database at all times. It cannot be compromised or changed for mere convenience. The pursuit of this sort of ignominious act is definitely a sort of 'crime'.

It might be unconsciously committed due to misinterpretation of knowledge, but such commitment happens to bring very serious maintenance burden to corporate in that consistency is never guaranteed to be automatically preserved in such a database by the information system. Note that an information system is never the engine of superficial superpower that automatically insures data consistency. Accountability of such maintenance is entirely up to data modelers in charge. They are one hundred percent obliged to enforce data consistency. A proper and minimal use of foreign keys only waives them from manual enforcement of consistency.

Most of complaints with regard to reliance to ERP tools are instigated by the problem of data inconsistency even if intelligent ERP tools are considerately adopted. Information systems are just like any living fauna or flora in that they themselves in reality gradually evolve perhaps quarter by quarter. There is no guarantee of data consistency even though ERP approach is in use for whole information systems. Suppose a particular ERP tool has already been deployed for some part of IS for a certain business area of a company.

There would be no guarantee of placing the same ERP tool for some other part of IS, since technology evolves very rapidly in IT field. There is a quite a big probability of choosing some ERP tool other than the previous one in cases that the one that has been selected has more decent capabilities than any other candidates. Consequently, securing data consistency could be at serious peril as the degree of data replication would soon ascent to be prevailed in case that a certain part of data repository of IS happens to be replicated partly with some other parts of data repository.

V. Degree of Data Redundancy

In case data attributes are replicated, regardless of whether willingly or willy-nilly, maintaining data consistency remains careful craftsmanship of data modeler in order to keep track of where the replicated copies are and ensure their values to be identical only manually. Field practitioners usually tend to not willing to understand such a limit of capability of database engines. Engines do their role of automatically maintaining data consistency if foreign keys are used only sparingly in a way that only a relationship is permitted to borrow or import them via entities just directly connected to it.

For instance, in a relationship sing in Fig. 4 a foreign keys pair {song-id, singer-id}, which is comprised of foreign keys only, is forged. Note that song-id is borrowed from entity Song and singer-id is borrowed as such borrowed from Singer. This way of use of foreign keys sparingly is only appraised to be the genuine data modeling in the arena of relational modeling and object-relational modeling.

Any way of forging foreign keys other than this way of generation of foreign keys is considered to be out of normalcy in any circumstances. This form of

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import intrinsically induces data replication inevitably and this is dubbed inevitable redundancy [ElIpVe2007]. It should be bear in mind in corporate data modeling that any unnecessary redundancy can never be disguised under the name of inevitable redundancy whether it is intentional or unconscious.

Note that there are 42 occasions of data attribute replication in the data model of Fig. 1 of which 25 of them are obviously unnecessary. Since there are 61 attributes altogether in the data model of Fig. 1, about 40 percent of them are of unnecessary redundancy. Note also that the ratio of total data redundancy in the data model of Fig. 1 in reality amounts to 70 percent, which is computed from 42 divided by 61. This is surprisingly high and the major reason for this is due to misuse or overuse of foreign keys.

In contrast, in the data model of Fig. 4, there are 38 occurrences of data replication, so the ratio of data redundancy is about 30 percent, but all this is of purely inevitable redundancy type. Note that there is no surfeit in deployment of foreign keys. In sum, the burden cost we need to pay for the misuse or overuse of foreign keys is much more than huge in that normally corporate database carry unnecessary burden of 40 percent of entirety of it.

VI. Conclusions

The major contribution of this paper is to disclose the ashamed privy parts in corporate data modeling that have been concealed and sedated so long with respect to serious pitfalls of their inmost details. It has been in a sense almost thoroughly out of conscience from even data modeling experts for the past couple of decades. Shedding a light on this issue is considered to be imminent in that so many discontents with information systems, without regard to whether they are on basis of ERP or not, have been reported in the real-world front [Cukier2010].

Unless the resolutions to the problem of data inconsistency and the problem of unnecessary replication of data are rendered, commencing to discourse about the issue of data deluge seems to be insensible. The degree of data redundancy is revealed to be enormously paramount. According to the outcome of a recent study, the level of data obesity [Rhee2010], measured in terms of the ratio of the total number of unnecessary data attributes to the number of all of the attributes resident in a corporate database, is reported to be about 50 percent in average at best.

This implies that more than 40 percent, which has been discovered in the case study in this article, in actuality goes with unnecessary parts of database. We believe that to help field practitioners design data models legitimately an automated tool [LeKiMo2010] enabling to corroborate data modeling labor by hand must be devised as soon as algorithmic solution to this problem would be discovered.

References Références Referencias

1. [FiKi2010] C. W. Fisher, B. R. Kingma(2010). Criticality of data quality as exemplified in two disasters. Information Systems, Vol. 39, 109-116.
2. [CiFrMa2009] C. B. Cinzia Cappiello, C. Francalanci, A. Maurino(2009). Methodologies for data quality assessment and improvement, ACM Computing Surveys Vol. 41, No. 3, Article 16, 52.
3. [KaBoZe2010] D. Katz, M. Bommaroti, J. Zelner(2010, March 1). The Data Deluge. The Economist print edition.
4. [ShRi2011] T. Shanker, M. Richtel(2011 Jan. 16). Data overload can be deadly. The New York Times print edition.
5. [DaGrRo2006] I. Davies, P. Green, M. Rosemann, M. Indulska, S. Galo(2006). How do practitioners use conceptual modeling in practice? Data and Knowledge Engineering Vol. 58, 358-380.
6. [ArElLa2006] E. Arisholm, S. Elisabeth Hove, Y. Labiche(2006). The impact of UML documentation on software maintenance: An experimental evaluation. IEEE Trans. Software Engineering Vol. 32, No. 6, 365-381.
7. [YaElOu2010] M. Yakout, A. K. Elmagarmid, H. Elmeleegy, M. Ouzzani, A. Qi(2010). Behavior based record linkage. Proc. VLDB Vol. 3, No. 1, 439-448.
8. [Moon2009] S. Moon(2009). Data Architecture, Hyungseol Publishing Co.
9. [RaGe2007] R. Ramakrishnan, J. Gehrke(2007). Database Management Systems , McGraw-Hill(Third Edition).
10. [ElIpVe2007] A. K. Elmagarrmid, P. G. Ipeirotis, V. S. Verykios(2007). Duplicate record detection: A Survey. IEEE Trans. Knowledge and Data Engineering Vol. 19, No. 1, 1-16.
11. [Cukier2010] Cukier, K. (2010, Feb. 25). Data, Data Everywhere. A Special Report on Managing Information, The Economist. Retrieved May 1, 2010, from http://www.economist.com/specialreports/displaystory.cfm?story_id=15557443.html
12. [Rhee2010] H. Rhee(2010). Corporate data obesity: 50 percent redundant. Journal of Computer Science and Technology, Vol. 10, No. 5, 7-11.
13. [LeKiMo2010] S. Lee, N. Kim, S. Moon(2010). Context-adaptive approach for automated entity relationship modeling. Journal of Information and Science and Engineering, Vol. 26, 2229-2247.

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(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

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Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

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21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

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26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. **Think technically:** Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

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General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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· Shun use of extra pictures - include only those figures essential to presenting results

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Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

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The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

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- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
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- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
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- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

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- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

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- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

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- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
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What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

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The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
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- Present a background, such as by describing the question that was addressed by creation an exacting study.
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Approach

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The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

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- Give details all of your remarks as much as possible, focus on mechanisms.
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- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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