ADVANCED ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORK

Akkosh.V[1], Nirmal Kumar.R[2], Vinod Kumar.V[3]

[1,2,3]PG Students, Communication Systems, SNS College Of Technology, Coimbatore, (India)

ABSTRACT

Routing in MANET is a critical task due to highly dynamic environment. A routing protocol is needed whenever a packet needs to be transmitted to destination via number of nodes and numerous routing protocols have been proposed for ad-hoc network. In this paper we try to judge the impact of both reactive as well proactive type protocols by increasing the nodes in the network. In this case, the performances of the routing protocol have been analyzed to improve and select efficient routing protocol for network setup and it is designing for practical scenario. The performance matrix includes packet delivery fraction, throughput and end to end delay.

Index Terms: Manet, Ns-2, Aodv, Dsdv, Dsr, Aomdv, Olsr

I. INTRODUCTION

A Mobile ad-hoc network is a self-configuring infrastructure less network of mobile devices connected by wireless. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to larger Internet. MANET'S are a kind of wireless ad-hoc networks that usually has a routable networking environment on top of a Link Layer ad-hoc network.

There are several ways to study MANET'S. One solution is the use of simulation tools like OPNET, Netsim and NS2. Our goal is to carry out a systematic performance study of five routing protocol for ad-hoc networks such as Ad Hoc On-Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV),Ad Hoc On-Demand Multipath Distance Vector (AOMDV) and Optimized Link State Routing (OLSR).

Mobile Ad hoc Network is an autonomous system of mobile nodes connected by wireless links. Each node operates as an end system and a router for all other nodes in the network. An Ad hoc network is often defined as an "infrastructure less" network means that a network without the usual routing infrastructure, link fixed routers and routing backbones. However, following protocols that is used for mobile ad-hoc networks:

II. ROUTING PROTOCOLS IN MANET

2.1 On-Demand (Reactive Routing)

This type of protocols finds a route on demand by flooding the network with Route Request Packets. It does not maintain a routing table. Each node in a network discovers or maintains a route based on-demand. The main advantage is that this protocol needs less routing information but the disadvantage are that produces huge control packets due to route discovery during topology changes which occurs frequently in MANET'S and it has higher latency. Ex: AODV, DSR and AOMDV

2.2 Table-Driven (Pro-Active Routing)

This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network. It maintains a routing table. Each node in a network maintains one or more routing table which is updated regularly. Each node sends a broadcast message to the entire network if there is a change in the network topology. Additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may be affected but it provides the actual information to the availability of the network.

This routing protocol maintains different number of tables. The proactive protocols are not suitable for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table leading to consumption of more bandwidth.

Ex: DSDV and OLSR

2.3 Ad hoc On-Demand Distance Vector (AODV) Routing Protocol

AODV is a reactive routing protocol which is basically a combination of DSR and DSDV algorithms. It uses the advantageous feature of both these algorithm. Dynamic, self-starting and multi-hop routing is allowed between participating mobile nodes. The basic on demand routing mechanism of route discovery and route maintenance of DSR and the use of hop by hop routing sequencing number and periodic update packets of DSDV are both available in AODV. It employs destination sequence numbers to identify the most recent path. In AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission

Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs) are message types defined by AODV

2.3.1 Route Discovery

A source node send a broadcast message to its neighboring nodes if no route is available for the desired destination containing source address, source sequence number, destination address, destination sequence number, broadcast ID and hop count. Two pointers such as forward pointer and backward pointer are used during route discovery. Forward pointers keep track of the intermediate nodes while message being forwarded to destination node. Eventually, when route request message reached the destination node, it then unicast the reply message to the source via the intermediate nodes and the backward pointer keeps track of the nodes.

2.3.2 Route Maintenance

Three types of messages exchanged between source and destination such as route error message, hello message and time out message. Route error message ensures that this message will be broadcasted to all nodes because when a node observes a failed link, it will propagate this message to its upstream nodes towards source node only. Hello message ensures the forward and backward pointers from expiration. Time out message guarantees the deletion of link when there is no activity for a certain amount of time between source and the destination node.

2.3.3 Advantages

It is an efficient algorithm for mobile ad-hoc networks and it is scalable.It takes short time for convergence and is a loop free protocol. Messaging overhead to announce the link failure is less compared DSR. Lower setup delay for connections and detection of latest route to the destination. Its adaptability to highly dynamic networks and reduced overhead.

2.3.4 Disadvantage

It requires periodic updates. If the source sequence number is very old it leads to inconsistent routes. Unnecessary bandwidth consumption occurs in response to periodic beaconing

2.4 Dynamic Source Routing (DSR) Protocol

DSR is an on demand routing protocol in which a sender determines the exact sequence of nodes through which a packet is propagated. The packet header contains a list of intermediate nodes for routing. Route cache is maintained by each node which caches the source route that it has learned.

The major components of DSR are "Route Discovery" and "Route Maintenance" which work together for determining and maintaining routes to arbitrary destinations It is designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. A route is established by flooding Route Request packets in the network

2.4.1 Route Discovery

As it is an on-demand routing protocol, so it looks up the routing during transmission of a packet. At the first phase, the transmitting node search its route cache to see whether there is a valid destination exists and if so, then the node starts transmitting to the destination node and the route discovery process end here. If there is no destination address then the node broadcasts the route request packet to reach the destination. When the destination node gets this packet, it returns the learned path to the source node.

2.4.2 Route Maintenance

It is a process of broadcasting a message by a node to all other nodes informing the network or node failure in a network. It provides an early detection of node or link failure since wireless networks utilize hop-to-hop acknowledge.

2.4.3 Advantages

Aware of existence of alternative paths that helps to find another path in case of node or link failure. It avoids routing loops.Less maintenance overhead cost as it an on-demand routing protocol. A route is established only when it is required.

2.4.4 Disadvantages

The connection setup delay is higher than in table-driven protocols. It is not suitable for large number of nodes where speed may suffer.

2.5 Destination-Sequenced Distance-Vector (DSDV) Routing Protocol

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. It eliminates route looping, increases convergence speed, and reduces control message overhead. In DSDV, each node maintains a next-hop table, which it exchanges with its neighbors.

There are two types of next-hop table exchanges: Periodic full-table broadcast and event-driven incremental updating. The relative frequency of the full-table broadcast and the incremental updating is determined by the node mobility. In each data packet sent during a next-hop table broadcast or incremental updating, the source node appends a sequence number. This sequence number is propagated by all nodes receiving the corresponding distance-vector updates, and is stored in the next-hop table entry of these nodes.

A node, after receiving a new next-hop table from its neighbor, updates its route to a destination only if the new sequence number is larger than the recorded one, or if the new sequence number is the same as the recorded one, but the new route is shorter. In order to further reduce the control message overhead, a settling time is estimated for each route.

A node updates to its neighbors with a new route only if the settling time of the route has expired and the route remains optimal.

2.5.1 Advantages

This protocol guarantees loop free path. Count to infinity problem is reduced in DSDV. Avoid extra traffic with incremental updates instead of full dump updates.

2.5.2 Disadvantages

Wastage of bandwidth. Not support for larger network. Wastage of battery power.

2.6 Ad hoc On-Demand Multipath Distance Vector (AOMDV) Routing Protocol

Among the on-demand protocols, multipath protocols have a relatively greater ability to reduce the route discovery frequency than single path protocols. On demand multipath protocols discover multiple paths between the source and the destination in a single route discovery. So, a new route discovery is needed only when all these paths fail. In contrast, a single path protocol has to invoke a new route discovery whenever the only path from the source to the destination fails.

2.7 Optimized Link State Routing OLSR Protocol

OLSR is an IP routing protocol optimized for mobile ad-hoc networks, which can also be used on other wireless ad-hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad-hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths.

III. SIMULATION BASED ANALYSIS USING NETWORK SIMULATOR (NS-2)

In this section we have described about the tools and methodology used in our paper for analysis of ad hoc routing protocol performance i.e. about simulation tool, Simulation Setup(traffic scenario, Mobility model) performance metrics used and finally the performance of protocols is represented by using excel graph.

3.1 Simulation Tool

In this paper the simulation tool used for analysis is NS-2.NS is a discrete event simulator targeted at networking research. Ns provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks. NS is an object oriented simulator, written in C++, with an OTcl interpreter as a frontend. NS meets both of these needs with two languages, C++ and OTcl. C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but can be changed very quickly, making it ideal for simulation configuration.

In NS-2, the frontend of the program is written in TCL. The backend of NS-2 simulator is written in C++ and when the tcl program is compiled, a trace file and nam file are created which define the movement pattern of the

nodes and keeps track of the number of packets sent, number of hops between 2 nodes, connection type etc at each instance of time.

3.2 Simulation Setup

NS version	Ns –allinone-2.29
Traffic	CBR(Constant Bit Rate)
CBR Packet size	512 bytes
Mobility model	Random Way point mobility
Antenna Type	Omni Antenna
Channel Type	Wireless channel
Propagation Type	Two ray ground
MAC layer Protocol	IEEE 802.11
Routing Protocol	AODV,DSR,DSDV,AOMDV, OLSR
CBR Rate	100Kb
CBR Interval	0.1

3.3 Performance Metrics Used

3.3.1 Packet Delivery Ratio

It is a ratio of the number of packets received by the destination to the number of packets send by the source

3.3.2 End to End Delay

It is defined as the time for a data packet which is received by the destination minus the time for a data packet which is generated by the source

3.3.3 Throughput

It is a ratio of the number of packets received by the sink to the number of packets sent by the source.

IV. SIMULATION RESULTS

4.1 Nodes Vs.Packet Delivery Ratio

NODES	AODV	DSR	DSDV
20	96.0082	99.876	64.9949
30	100	100	90.8905
40	99.4882	100	100
50	99.8976	100	64.6878

 ISBN: 978-81-931039-3-7

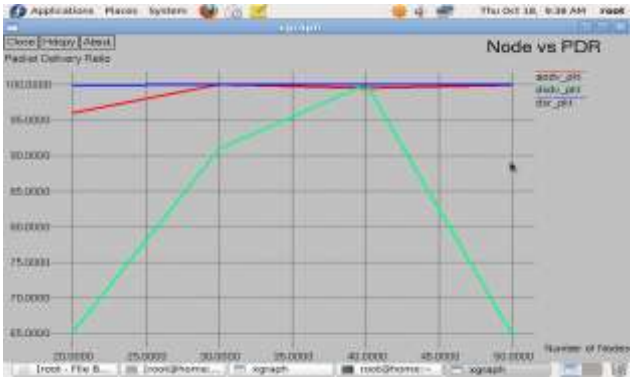

Fig.1. Node vs. pdf

4.2 Nodes Vs. End to End Delay

NODES	AODV	DSR	DSDV
20	0.0627376	0.00914423	0.00901532
30	0.0118011	0.00576586	0.00769682
40	0.0988914	0.00575494	0.0058643
50	0.00930005	0.00576553	0.00900171

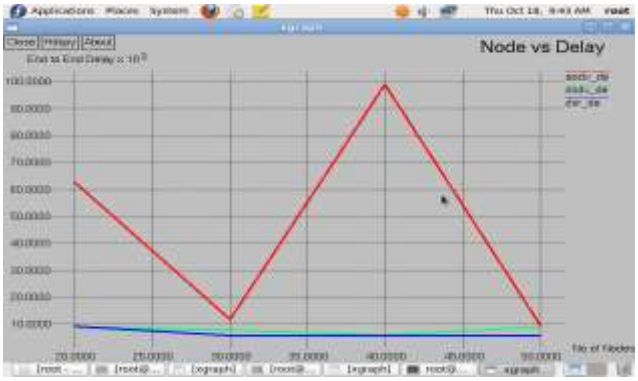

Fig.2. Node vs. delay

4.3 Nodes vs. Throughput

NODES	AODV	DSR	DSDV
20	99860.7	100000	67606.9
30	104013	100102	94541.7
40	103480	100102	104013
50	103906	100102	67283.6

 ISBN: 978-81-931039-3-7

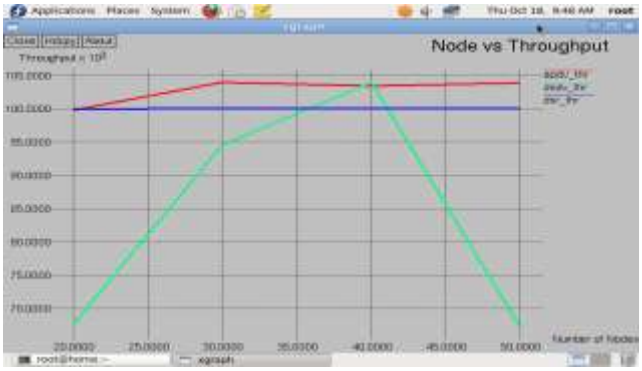

Fig.3. Node vs. throughput

4.4 Nodes Vs.Packet Delivery Ratio

NODES	AOMDV	OLSR
O	0	0
5	22	40
10	100	120
15	260	310
20	400	365
25	400	365
30	400	365

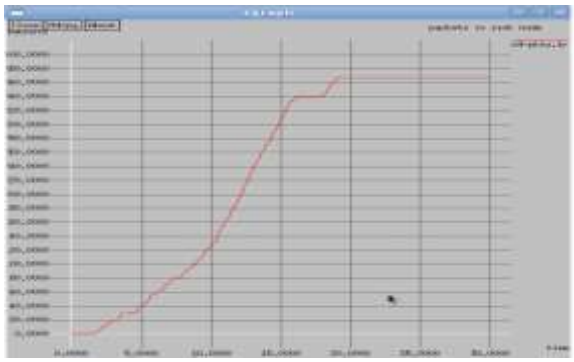

Fig. 4. Node Vs.Packet Delivery Ratio (Aomdv)

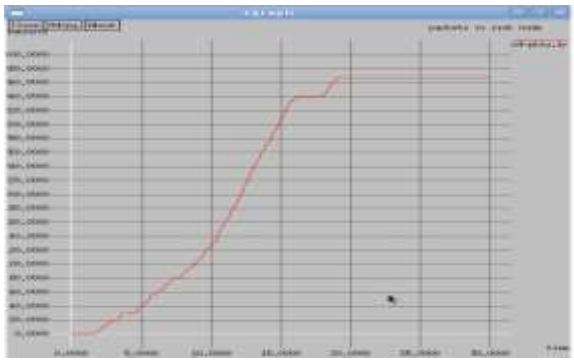

Fig.5. Node Vs.Packet Delivery Ratio (Olsr)

4.5 Nodes Vs. Delay

NODES	AOMDV	OLSR
0	**0**	**0**
5	**0.002**	**0.002**
10	**0.010**	**0.010**
15	**0.020**	**0.025**
20	**0.030**	**0.030**
25	**0.035**	**0.025**
30	**0.035**	**0.025**

 ISBN: 978-81-931039-3-7

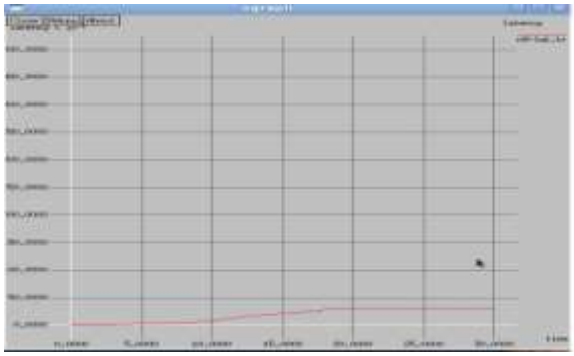

Fig.6.Nodes vs. Delay (AOMDV)

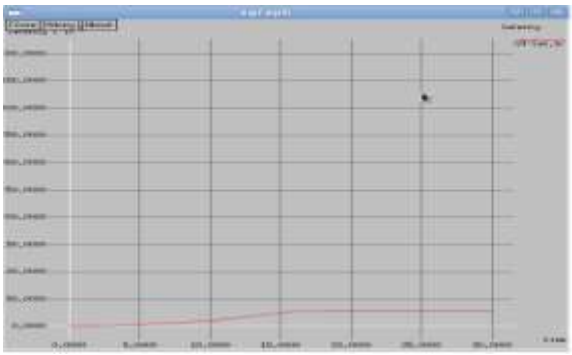

Fig.7.Nodes vs. Delay (OLSR)

4.6 Nodes Vs. Throughput

NODES	AOMDV	OLSR
0	0	0
5	20	22
10	62	84
15	180	218
20	280	260
25	280	260
30	280	260

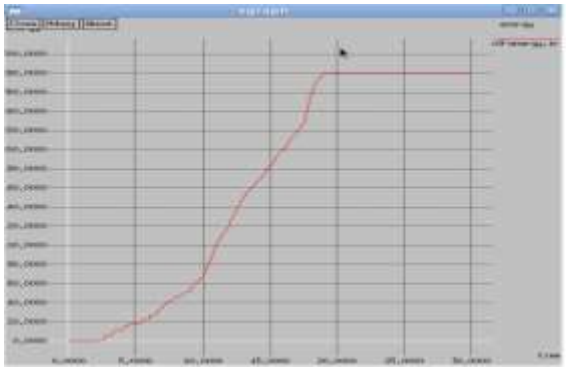

Fig.8.Nodes vs. Throughput (AOMDV)

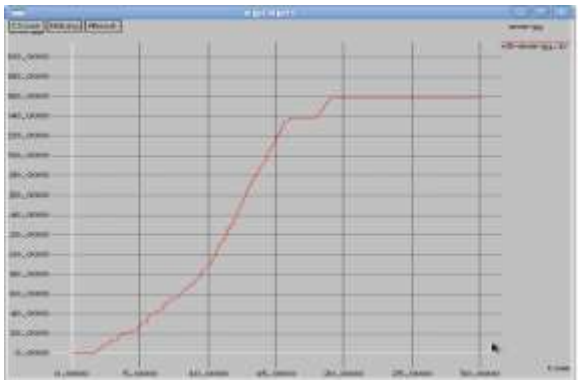

Fig.9.Nodes vs. Throughput (OLSR)

V. CONCLUSION

We have compared the performance analysis of packet delivery ratio, end to end delay and throughput using AODV, DSR, DSDV, AOMDV and OLSR.AOMDV is best for packet delivery ratio. If we increasing the nodes the packet delivery ratio should be constant. The greater value of packet delivery ratio means better performance of the protocol. AOMDV produces higher value compared with protocols. For end to end delay AOMDV is best protocol compared with AODV, DSR, DSDV and OLSR. For Throughput AOMDV is best compared with other protocols

REFERENCES

[1] Vetrivelan, N. and Reddy, V. 'Performance Analysis of Three Routing Protocols' , Proceedings of the International Multi Conference of Engineers and Computer Scientists , March 2008, Hong Kong, Vol. 2, pp.19-21

[2] Broch, J. and Jetcheva, J.'A Performance Comparison of Multi-Hop Wireless Network Routing Protocols',Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking(MobiCom'98), October 25-30, 1998, Dallas, Texas, USA, pp. 25-30.

[3] Das, S.R. and Royer, E.M. 'Performance Comparison of Two On-Demand Routing Protocols for Ad-Hoc Networks', IEEE Personal Communications Magazine, Special Issue on Mobile Ad Hoc Networks, Vol. 8, No. 1, February 2001, pp.16-29.

[4] Johnson, D. and Jetcheva, J. 'The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks', Internet Draft, draft-ietf-manet-dsr-07.txt, work in progress, 2002.

[5] Royer, E.M. and Toh, C.K. 'A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks', IEEE Personal Communications, Vol. 6, Issue 2, pp. 46-55, April 1999.

 ISBN: 978-81-931039-3-7

STUDY OF AN FORCE TORQUE SENSOR USING IN SIX DOF AT MICRO MANIPULATION APPLICATION

Shailendra Kumar Bohidar[1], Devin Nirala[2], Prakash Kumar Sen[3]

[1]*Ph.D. Research Scholar, Kalinga University, Raipur, (India)*

[2]*Student of Mechanical Engineering Kirodamal Institute of Technology, Raigarh, Chhattisgarh, (India)*

[3]*Student of M.Tech Manufacturing Management, BITS Pilani, (India)*

ABSTRACT

This paper presents the design fabrication and characterization of a piezoresistive 6 degree of freedom force and torque sensor to be used in micro manipulation. The mechanical structure of the device consists of seven suspended beams and a calibration structure, which can be replaced by micro manipulation tools such as micro grippers or probes. The geometry of the beam and the location of the piezoresistors in the structure are optimized to reduce crosstalk and improve the sensitivity. A linear regression model is fitted to the calibration data to extract the force and torque from the resistance variations detected in the piezoresistors. The device has been fabricated with an IC compatible process and successfully characterized. Aspects of control implementation concerning a joint torque sensor are discussed and a technique to its correction and calibration is presented. 6level control scheme is used for the intrinsic to the 6 time scale dynamics of the system. For the first part of the system dynamics joint model is presented. Based on this model, two variants of torque control loop are developed and their terms of application are outlined.

I. INTRODUCTION

The most significant with force torque sensor is mounting it on the joint. For force torque sensor to be sensitive, it must be flexible (not rigid). This makes the overall joint must more flexible contrary to rigidity required for precision and accuracy and causes a loss of controllability of the joint. Force and torque sensing are essential in micro manipulation both to execute operations reliably and to avoid damaging fragile objects force and torque information is used in automatic handling systems e.g. to prevent that micro grippers and other micro tool exert tool high forces on the micro parts in human tele-manipulation such detected force can be fed back to the user through hepatic interfaces typical field.[1] In this paper an asymmetrical six degree of freedom micro grippers and micro probes. The device has the capability of detecting force and torque in the mN and mN-mm range with resolution in the range respectively. Many other alternate available for wrist force torque sensor (WFTS) based not only on strain gauge but also on sonic and optic sensor. It is important to note that WFTS should not affect the positioning accuracy of the manipulator and therefore, it must have high stiffness. Some other requirement of WFTS is: it must be small, light in weight, compact, sensitive, linear, and with low internal friction. [2]

 ISBN: 978-81-931039-3-7

II. DEGREES OF FREEDOM (DOF)

The number of independent movements an object can perform in a 3-D space is called the number of degree of freedom (DOF). Thus a rigid body free in space has six degree of freedom three for positive three for orientation. These six independent movement pictures in fig.1 are:

- Three translation (T1, T2, T3), representing linear motions along three perpendicular axes, specify the position of the body in space.
- Three rotation (R1, R2, R3), which represent angular motions about the three axes, specify the orientation of the body in space.

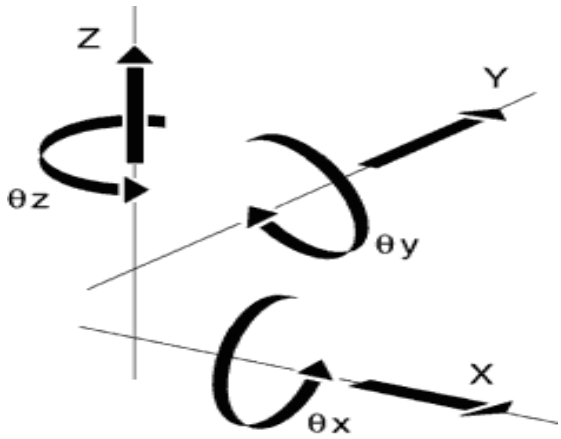

Fig.1 Representation of Six Degree of Freedom with Respect to a Coordinate Frame

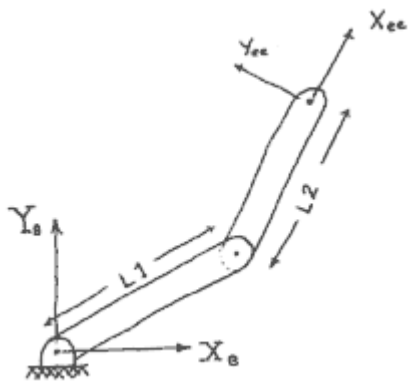

Fig. 2 A Two DOF Planar Manipulator Two Link Two Joints

Consider an open kinematic chain of two links with revolute joints at A and B (C), as in fig.1 here the first link is connected to the ground by a joint at A. Therefore link first can only about joint 1 with respect to ground and contributes one independent variable, or in other words. It contributes one degree of freedom. Link 2 can rotate about joint 2 with respect to link 1 contributing another independent variable and so another DOF. [1]

III. DESIGNING DEVICE OF FORCE TORQUE SENSOR

The proposed device consists of a silicon structure with implanted piezoresistors to measure the stress induced by the application of loads to the silicon structure. Piezoresistive sensing elements are suitable to detect force and torques with the above mentioned specifications, and are compatible with IC processes for the fabrication of micromanipulation tools, such as micro- grippers or probes the final geometry is the results of an optimization

process that has considered the dimensions of the structure and the number, the location, the interconnection of Piezoresistors, to achieve a high sensitivity and a low crosstalk, at as high as possible stiffness.[3] The 6 DOF sensors, with a total dimension 3 x 1.5 x0.03 mm^3 features an asymmetrical geometry composed of 7 suspended beams and a calibration structure. 16 measuring piezoresistors are put in the high stress concentration regions of the beams and 8 reference piezoresistors in the low stress concentration areas of the device. The calibration structure presents micro manipulation tools during the fabrication process. The device is fabricated with an IC-compatible process. A SEM picture of the device is shown in fig.3 [3]

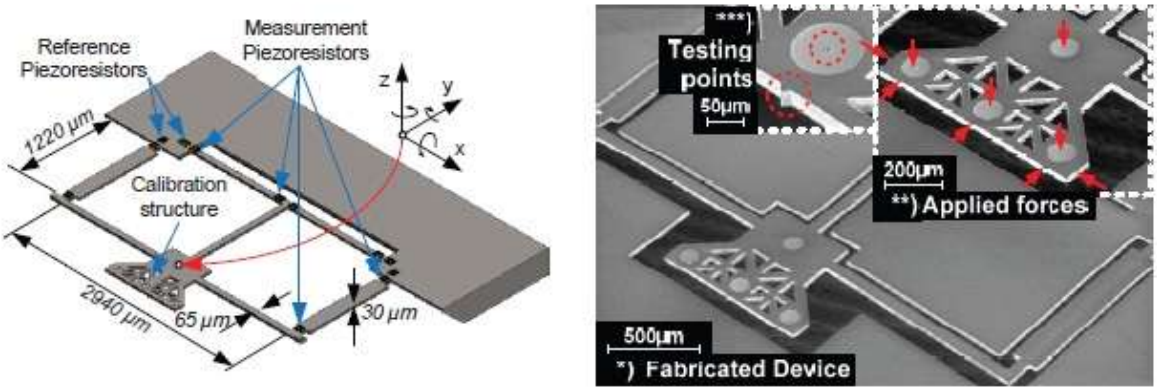

Fig. 3 Designed Structure for the 6DOF Force and Torque Sensor

IV. PERFORMANCE OF DOF IN MICRO MANIPULATION

The sensor is characterized with the strategy shown in figure 2-a. a DOF force probe from femtotools (supported by a motorized stage) is pushed against the micro fabricated features of the calibration structure. After applying the force, the piezoresistors are connected, on at a time, to an external Wheatstone bridge through a national instruments PXI2536 cross point matrix switch in this way, all resistances are measured with a single amplifier and DAQ channel.[4]

Force ramps are applied several times in nine points of the calibration structurethe resistance of all piezoresistors is recorded, together with the applied 6 DOF load. The 6 components of the loadare calculated from the 1 DOF force measurement, taking into account the direction of the force and the location of the micro-fabricated features. Using the acquired data, a linear relation is fitted between the variations of the value of the piezoresistors and the applied loads. The calibration matrix A is obtained by a linear least-square fit of equation 1 to the acquired data; such that the root means squared error RMSE between observed and fitted values is minimized. [4]

V. APPROACH TO CONTROL

Force control is already a major field in robotics. The outline of the control strategies and their applications can be found in the controlled problems arising that can be met in literature mainly concern the elasticity of the torque sensor and its influence on the controlled dynamics. In a particular lots of authors point out two time scale dynamics of the flexible joint robot (FJR). The first model of elastic joint robot was proposed by Sponge. Since then numerous controller was proposed. Some of which are outline. In this work one of the classical robot controlled architecture including two (lower & upper) levels of control was adopted. The upper level of control generates required value of torque which are commanded to the lower level and processed by each joint

 ISBN: 978-81-931039-3-7

independently. Such control architecture losses to the one with centralized computation in quality but wins significantly in simplicity while making module principle possible. [5]

5.1 Joint level torque control

For the purpose of controlling the robot two type of torque controller are use at the joint level. The torque control loop functioning at 1 kHz frequency while feedback is sampled and pre-processed at 3 kHz.

The first one is based on the research published and implements a passive adaptive torque controller. Assuming that the control of motor current is at least 10 times faster than the torque controller loop (that is quite true) and one can command the required current directly neglecting the current transient, the torque controller can be expressed as.

5.2 Upper level control

For this control level two types of control strategies are tested. The first control strategy is the force torque control with gravity compensation with additional damping. The design torque vector (2 components) is formed as. [5]

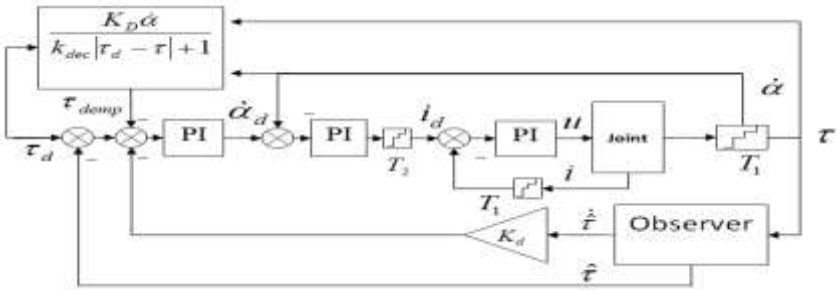

Fig.4 Torque Controller with Inner Velocity Loop

VI. .CALIBRATION SYSTEM DESIGN AND CALIBRATION TASK

In order to eliminate the coupling error between dimensions, which is the main threat to the precision of a sensor, a calibration task must be conducted to support the design of the decoupling algorithm. A standard force and torque source is the most important for the task, meanwhile the most difficult to be obtained. There are two conventional ways to obtain the standard force/torque source, calibration setup based on weights and that based on four jacks. However, the former can't provide the force/torque up to our target measurement range, while the latter is too large to be suitable for our relatively small sensor. Therefore, a calibration system is designed in this paper, and acalibration task is conducted using the new system. Fig. 4 shows the force calibration system based on a customized material testing machine. Fig. 5 shows the torque calibration system based on torque experiment setup. Both the force and torque calibration system include an L-shaped support component. With the sensor assembled on the vertical or horizontal surface of it, calibration in different dimensions can be done.

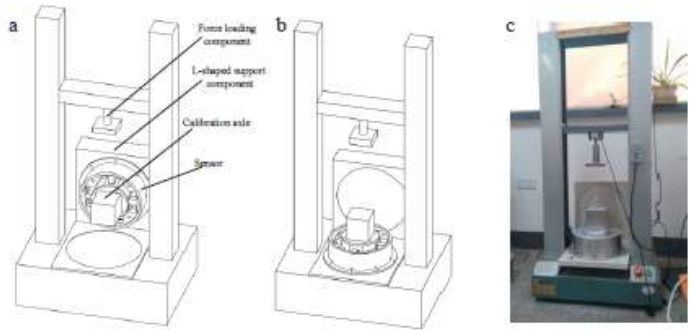

Fig. 5 Force Calibration System Based on Material Testing Machine. (A) Calibration of Fx/Fy; (B) Calibration of Fz; (C) Photo of The System

VI. CONCLUSIONS

A 6 DOF sensor has been developed and experimentally characterized, achieving a range of 4 to 30mN in forces and 4 to 50 mN·mm in torques, with calibration RMSE up to 17 to 45 μN and 14 to 40 μN·mm respectively. The calibration and processing of the measured data successfully eliminates any crosstalk between the signals, which could be caused by the asymmetrical geometry of the sensor. Such geometry makes the sensor innovative and versatile because of the simple integration of micro tools in the same substrate of the sensor: the 6 DOF piezoresistive sensor and micro-tools can be produced in the same fabrication process. As future developments, a 6 DOF force / torque sensor for wrist rehabilitation has been successfully designed and fabricated using a steel substrate and a commercial high-firing thick-film system. A suitable mechanical design allowed measurement of the forces and torques with acceptable precision joint level torque controllers were presented and discussed with their relation to the upper level control strategies. It was shown that static torque error introduces by a passive adaptive torque controller at the joint level ensures good stability properties when used with force/torque with gravity compensation control strategy at the upper level control. A torque controller with velocity inner loop shows no static error and better dynamic characteristics and proves to be useful in impedance control strategy.

REFERENCE

[1]. R K Mittal Professor Department of mechanical engineering Birla Institute of Technology and science pilani ISBN -13:978-0-07-048293-7,ISBN-10:0-07-048293-4.

[2]. Shen Y, Xi N, WJ. Force –guided assembly of micro mirrors. Proc. Of IEEE Int. Conference on Intelligent Robots and systems (IROS 2003); 3:2149-54, 27-31 Oct. Las Vegas, Nevada (US).

[3]. Wei J porta M tichem M staufer U sarro PM. A position and force distribution sensor array for monitoring the contact condition of objects in micro handling. proc. Of the 23th IEEE international conference on Micro electro mechanical system (MEMS 2010): 623-26, wanchai, Hong Kong.

[4]. P. Estevez, J. Bank, M. Porte, J. Wei, P.M. Sarro, M. Tichem, U.Staufer PME, Delft university, Delft, The Netherlands ECTM-DIMES, Delft University of technology delft the nether lands. Prodia engineering 25 (2011) 39-42.

[5]. Ozgoli S. Taghirad H.D. A survey on the control of flexible joint robots , Asian Journal of Control, Vol. 8, No. 4,pp. 1-15,dec. 2006.

 ISBN: 978-81-931039-3-7

BRIEF REVIEW ON IMAGE DENOISING TECHNIQUES

Rahul Singh[1], Preeti Singh[2], Farzana Parveen[3]

[1, 2, 3] *Assistant Professor, Department of Computer Science, CGVVM, Bhilai (India)*

ABSTRACT

An image is worth a thousand words & in this digital age, images are everywhere. There is a colossal amount of digital information being generated in form of images. But there is an elemental issue with images. Most of the digital images contain some form of noise. This noise is created either in image acquisition or transmission due to various reasons. Removing noise from digital images is a big challenge for the researchers working in the field of digital image processing. Considerable amount of research & development has been done and many techniques have been proposed till date. This paper is an attempt at the revision of the research publications put forward in the recent past. Papers addressing various different image denoising techniques have been scrutinized & their essence has been summarised.

Keywords: Denoising, Filtering, Image, Noise Models, Review, Spatial Domain, Transform Domain

I. INTRODUCTION

An image is defined as a two-dimensional function, *f(x, y)*, where x and y are spatial coordinates, and the amplitude of *f* at any pair of coordinates *(x, y)* is called the intensity or gray level of the image at that point. When *x, y*, and the intensity values of *f*, are all finite, discrete quantities, we call the image a digital image [15]. A digital image consists of finite number of elements called pixels, each of which has a particular location & values. Image Processing is a technique to enhance raw images received from cameras or other sensors. Whenever an image is captured through a camera or any other sensor, it contains some amount of noise. Noise is the disturbance or unwanted signal that is present in the image and is an unavoidable intrinsic characteristic of any image, due to the physical & natural phenomenon of the world we live in. In other words, Noise is the unwanted signal that interferes with the original signal and degrades the visual quality of digital image. The main sources of noise in digital images are imperfect instruments, problem with data acquisition process, interference natural phenomena, transmission and compression.

Denoising has been a critical and long-standing problem in the field of image processing. It is a challenging problem as the process of denoising causes blurring and introduces some anomalies in the image. Image denoising methods tend to be problem specific and depend on the type of image and noise model. Different types of images consist of different types of noise and different noise models are used to represent different noise types.

1.1 Types of Noise

Normally images are affected by different types of noise. Various types of noise have their own characteristics and are inherent in images in different ways. All the types of noises can be categorised into two models:

- Additive Noise Model
- Multiplicative Noise Model

Additive noise is the signal that gets added to the original image to generate the resultant noisy image. In the multiplicative model the noisy image is generated by multiplication of the original image and the noise signal. The most common noise types found in images are Gaussian Noise, Salt & Pepper Noise and Speckle Noise.

1.1.1 Gaussian Noise

It is evenly distributed over the signal. Each pixel in noisy image is the sum of true pixel value and a random Gaussian distributed noise value [8]. Gaussian noise is an amplifier noise which is independent at each pixel and independent of the signal intensity. Gaussian noise is statistical noise that has its probability density function equal to that of the normal distribution. It arises due to electronic circuit noise & sensor noise due to poor illumination or high temperature. It is a constant power additive noise [9].

1.1.2 Salt & Pepper Noise

The salt-and-pepper noise is also called shot noise, impulse noise or spike noise. An image containing salt-and pepper noise will have dark pixels in bright regions and bright pixels in dark regions. It can be caused by dead pixels, analogue-to-digital converter errors, and bit errors in transmission [9]. It has only two possible values, a high value and a low value. The probability of each is typically less than 0.1 [8].

1.1.3 Speckle Noise

Speckle noise is a granular noise that inherently exists in and degrades the quality of the active radar and synthetic aperture radar (SAR) images. Speckle noise in conventional radar results from random fluctuations in the return signal from an object that is no bigger than a single image-processing element. It increases the mean grey level of a local area [9]. It is a multiplicative noise. The source of this noise is random interference between the coherent returns [8].

II. DENOISING TECHNIQUES

Denoising is the process of removing or reducing the inherent noise from a given image. There are numerous techniques available for the purpose. The selection of the denoising technique depends on the type of image & the noise model present in that image. There are two fundamental approaches to image denoising:

- Spatial domain filtering
- Transform domain filtering

The detailed classification is illustrated in Fig 1. Followed by a discussion of the various denoising techniques.

 ISBN: 978-81-931039-3-7

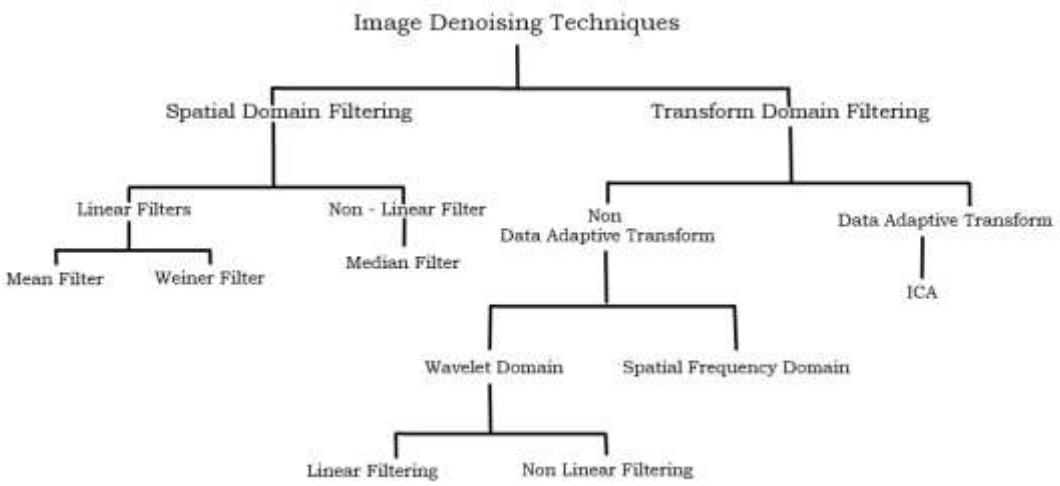

Figure 1: Classification of Image Denoising Techniques

2.1 Spatial Domain Techniques

A direct system to remove noise from an image is to utilize spatial filters, which can be grouped into nonlinear and linear filters. In image processing, filtering is a function used to perform many tasks like noise reduction, interpolation, and re-sampling. The filter is chosen based on the nature of the task performed by filter and type of the data. In image processing, filters are used to remove noise from an image while preserving the original image.

2.1.1 Non - Linear Filters

Non-linear filters are used to remove the noise from the image but there is no explicit effort made to identify the noise first. These filters often remove noise to a reasonable extent but at the cost of blurring images and consequently makes the edges in image invisible. Research work is going on & some new methods have been proposed to address those issues.

A non-linear smoothening technique is the Median filter that reduces the blurring of edges. The process replaces the current point's intensity in the image by the median of the intensities in its neighbourhood. The median of the intensities in the neighbourhood is not affected by individual noise spikes. The median filter removes impulse noise in an efficient manner. Since median filtering does not blur edges much, it can be applied iteratively. One of the major problems with the median filter is that it is relatively expensive and is hard to compute. It is essential to sort all the values in the neighbourhood into numerical in order to find out the median value which is relatively slow.

2.1.2 Linear Filters

In a linear filter, the output will change linearly with a change in the input. You could plot some sort of straight line from the relationship between the two. The Mean filter is the optimal linear filter for Gaussian noise in the sense of mean square error. It is a simple method for denoising images. Each pixel's value in the image is replaced by the mean (average) of the values of the neighbouring pixel values. This has the effect of eliminating pixel values which are unreliable of their surroundings.

Another linear filter is Wiener Filter. It is used to produce an estimate of a desired or target random process by linear time-invariant filtering of an observed noisy process, assuming known stationary signal and noise spectra,

and additive noise. The Wiener filter minimizes the mean square error between the estimated random process and the desired process.

2.2 Transform Domain Techniques

Transform domain mainly includes wavelet based filtering techniques. The transform domain filtering approach is classified on the basis functions. The transform domain filtering can be subdivided into data adaptive and non-adaptive filters.

2.2.1 Non-Data Adaptive Filters

This class of filters can again be subdivided into Wavelet Domain & Spatial Frequency Domain. Spatial frequency filtering method is a form of transform domain filtering. It uses Fast Fourier Transform (FFT) with low pass filters (LPF). In Spatial-Frequency method, denoising is done by designing a cut-off frequency. But these are time consuming and may produce non-natural frequencies in processed image [19].

Wavelet Domain can be further divided into Linear & Non-Linear Filtering techniques. For the most part Weiner Filter is the chosen linear filtering technique as it produces the most important results in the wavelet domain filtering. Wiener channel is the for the most part utilized direct sifting strategy which yields most important results in the wavelet space separating. It is utilized where information degradation can be displayed as a Gaussian methodology and exactness criterion is mean square error. In any case this sifting result is visually more insufficient than the original degraded image. Non-Linear threshold filtering uses the wavelet transform that maps noise in signal domain to that of noise in transform domain. While signal vitality gets to be more gathered into less coefficients in transformation domain noise vitality does not. Two sorts of thresholding capacities are utilized.

- Hard Thresholding
- Soft Thresholding

If the input is larger than the threshold, then it is kept as a Hard-Thresholding function, it is set to zero otherwise. The input arguments are reduced toward zero by the threshold, called Soft-thresholding function. The result may still be noisy. Signal with large number of zero coefficients is produced by large threshold. This leads to a smooth signal. Selection of an optimal threshold is done with great attention [19].

2.2.2 Data Adaptive Transforms

Independent Component Analysis (ICA) transformation methods are more important which includes key component, factor analysis and projection detection. ICA is the most widely used method for blind source partition problem. The major advantage of using ICA is it's assumption of signal to be Non-Gaussian which helps denoising of images with Non-Gaussian as well as Gaussian distribution. A demerit of ICA based techniques is the computational cost because it uses a sliding window and involves sample of at least two image frames of the same scene [19].

III. LITERATURE REVIEW

Reference [1] is a paper titled "Image Denoising and Decomposition Using Non-convex Functional" due to Bai & Feng. This paper proposes a new model for image denoising and decomposition by non-convex functional minimization. Instead of using the Banach norm as the fidelity term, the authors use the square of L2 norm of the residual component divided by BV semi-norm as the fidelity term. This non-convex fidelity term has very low value for the texture image and high value for the geometric image, so it is appropriate for image denoising

and decomposition. The gradient descent procedure is used to solve the proposed minimization problem, which leads to evolve a new nonlinear integral-differential equation to steady state [1].

Burhan Ergen presented a paper titled "Signal and Image Denoising Using Wavelet Transform" [3]. The paper focuses on wavelet denoising techniques, which offer high quality and flexibility for the noise problem of signals and image. The performances of denoising methods for several variations including thresholding rules and the type of wavelet were examined in the examples in order to put forward the suitable denoising results of the methods. The comparisons have been made for the three threshold estimation methods, wavelet types and the threshold types. The examinations have showed that most important factor in wavelet denoising is what the decomposition level is rather than the wavelet type, threshold type or the estimation of threshold value. And also, no noteworthy differences were seen in the methods from level one to level six, after this level, rigresure method has showed a better performance than the other methods in terms of SNR level. Consequently, it is determined that the wavelet type is not very important if the oscillation number is not very low, the decomposition level is absolutely depends on the frequency band of the signal to be analyzed and its sampling frequency [3].

A paper titled "Locally adaptive image denoising by a statistical multiresolution criterion" was presented in 2009 by Thomas Hotz et al. [4]. The authors demonstrate how one can choose the smoothing parameter in image denoising by a statistical multiresolution criterion, both globally and locally. Using inhomogeneous diffusion and total variation regularization as examples for localized regularization schemes, they present an efficient method for locally adaptive image denoising. The smoothing parameter serves as an edge detector in this framework. Numerical examples illustrate the usefulness of our approach. We also present an application in confocal microscopy [4].

Jani, Sharma & Sairam's study on "Effect of Blur and Noise on Image Denoising based on PDE" in [5] analyzes different traditional image denoising methods in various ways. They also propose a new approach which provides a heterogeneous way of the above challenging issue. The approach is the combination of three different approaches based on blur and noise.

A paper titled "Denoising Algorithm Based on Generalized Fractional Integral Operator with Two Parameters" was presented in 2012 by Jalab & Ibrahim [6]. A novel digital image denoising algorithm called generalized fractional integral filter is introduced based on the generalized Srivastava-Owa fractional integral operator. The structures of $n \times n$ fractional masks of this algorithm are constructed. The denoising performance is measured by employing experiments according to visual perception and PSNR values. The results demonstrate that apart from enhancing the quality of filtered image, the proposed algorithm also reserves the textures and edges present in the image. Experiments also prove that the improvements achieved are competent with the Gaussian smoothing filter [6].

Reference [7] is a comparative study on image denoising techniques for salt and pepper noise. The paper briefly describes some recent image denoising methods. Eight algorithms are discussed and their similarities and differences in terms of both structure and performance are described. The conclusion states "For lower values of noise the standard filters like median filter and adaptive median filter can denoise salt and pepper noise, but fail to remove noise effectively as the noise density increase. The comparative study explained with help of PSNR and MSE. From the performance analyses the currently proposed DAMF algorithm outperforms the other denoising techniques at low as well as high noise density" [7].

A Fast and Robust Hybridized Filter for Image De-Noising was presented by Kaur and Rajput in 2014. In this paper a new hybridized filter for the removal of salt & pepper noise has been presented. The proposed filter, which is an advanced salt & pepper noise removal filter and uses effective statistic and image processing methods to remove the noise along with support vector machine (SVMs) that is it effectively does the job by reproducing the deep image details after removing the noise, which enhances the quality of image in a better way than the existing filters. This proposed filter is supposed to remove the noise with minimum image quality degradation [10].

Marc Lebrun published a paper titled "An Analysis and Implementation of the BM3D Image Denoising Method", in 2012. This paper focuses on BM3D, a recent image denoising method which is based on the fact that an image has a locally sparse representation in transform domain. This sparsity is enhanced by grouping similar 2D image patches into 3D groups. The author proposes an open-source implementation of the method. The 3D filter in BM3D is performed on the three dimensions simultaneously. The proposed method improved on the NL-means method which denoises jointly similar patches, but only by performing a patch average [11].

Another similar paper by the author of [11] Marc Lebrun along with Arthur Leclair was published in 2012, titled, "An Implementation and Detailed Analysis of the K-SVD Image Denoising Algorithm". It is based on the K-SVD algorithm for image denoising. K-SVD is a signal representation method which, from a set of signals, can derive a dictionary able to approximate each signal with a sparse combination of the atoms. This paper focuses on the K-SVD-based image denoising algorithm. The implementation is described in detail and its parameters are analyzed and varied to come up with a reliable implementation [12].

Liu et al. (2012) presented a Translation Invariant Wavelet-based Contourlet Transform for Image Denoising in Ref. [13]. In this paper a new method of image denoising using wavelet based contourlet transform (WBCT) is proposed. Due to the lack of translation invariance of WBCT, image denoising by means of WBCT would lead to Gibbs-like phenomena. In the paper, cycle spinning-based technique is applied to develop translation invariant WBCT denoising scheme. Many simulation experiments with images contaminated by additive white Gaussian noise demonstrate that the performance of the proposed approach substantially surpasses that of previously wavelets methods using the cycle spinning both visually and in terms of the PSNR values, especially for the images that include mostly fine textures and contours [13].

Another research article titled "Nonlocal Means-Based Denoising for Medical Images" was published by Lu, He & Li. In this paper the authors investigate an adaptive denoising scheme based on the patch NLmeans algorithm for medical imaging denoising. In contrast with the traditional NL-means algorithm, the proposed adaptive NL-means denoising scheme has three unique features. First a restricted local neighbourhood where the true intensity for each noisy pixel is estimated from a set of selected neighbouring pixels to perform the denoising process. Second, the weights used are calculated thanks to the similarity between the patch to denoise and the other patches candidates. The last step is applying the steering kernel to preserve the details of the images [14]. The proposed method has been compared with similar state-of-art methods over synthetic and real clinical medical images showing an improved performance in all cases analyzed.

"A Multiresolution Framework for Local Similarity based Image Denoising [16]" was presented by Rajput & Butt. In this paper the authors present a geeric framework for denoising of images corrupted with additive white Gaussian noise based on the idea of regional similarity. The proposed framework employs a similarity function using the distance between pixels in a multidimensional feature space, whereby multiple feature maps describing various local regional characteristics can be utilized, giving higher weight to pixels having similar

regional characteristics. An extension of the proposed framework into a multiresolution setting using wavelets and scale space is presented. It is shown that the resulting multiresolution multilateral (MRM) filtering algorithm not only eliminates the coarse-grain noise but can also faithfully reconstruct anisotropic features, particularly in the presence of high levels of noise [16].

A paper titled "Hybrid Models for Denoising Ultrasonic Images" was presented in 2010 by S.N. Geethalakshmi and J. Suguna [17]. This paper considers speckle noise present in the ultrasonic images used in the medical field. Three hybrid models are designed for speckle removal by combining anisotropic diffusion based on 4th order PDE with the three conventional linear filters, kaun, lee and frost. The work does not consider memory efficiency or computational complexity.

Preethi & Latha in Ref. [18] presented an "adaptive denoising technique for colour images". A high-performance algorithm for removing impulse noise from colour image has been presented. This adaptive denoising technique is suitable for efficient removal of impulse noise in high noise environment. This algorithm is based on threshold which is adaptive in nature. This algorithm replaces the pixel only if it is found to be noisy pixel otherwise the original pixel is retained thus it results a better filtering technique when compared to median filters and its modified filters.

Wang, Szlam & Lerman in 2013 published a paper "Robust Locally Linear Analysis with Applications to Image Denoising and Blind Inpainting" [20]. The authors study the problems of denoising images corrupted by impulsive noise and blind inpainting. Our basic approach is to model the set of patches of pixels in an image as a union of low-dimensional subspaces, corrupted by sparse but perhaps large magnitude noise. A robust and iterative method for single subspace modelling was developed and extended to an iterative algorithm for modelling multiple subspaces. The authors prove convergence for both algorithms & present a comparison between their method with the other contemporary counterparts.

A "SURE Guided Gaussian Mixture Image Denoising" approach was presented by Wang & Morel in [21]. By using Gaussian factor modeling, its dedicated Expectation Maximization (EM) inference as well as a statistical filter selection and algorithm stopping rule, the authors develop SURE (Stein's Unbiased Risk Estimator) guided Piecewise Linear Estimation (S-PLE), a patch-based prior learning algorithm capable of delivering state-of-the-art performance at image denoising. The authors propose that by juxtaposing both options, a simple learned prior can perform as well if not better than a much richer yet fixed prior.

Wu, Tracey & Noonan (2013) present "James-Stein Type Center Pixel Weights for Non-Local Means Image Denoising" [22]. In this paper, the authors study the parameter selection problem of center pixel weights (CPW) in NLM. They provide a novel formulation of the CPW problem from the statistical shrinkage perspective, introduce the James-Stein type CPWs for NLM and propose a new adaptive CPW that is locally tuned for each image pixel. A claim has been made that the new proposed CPWs are more robust and effective under various noise levels [22].

A paper titled "Hyper-spectral Image Denoising with Cubic Total Variation Model" was presented in the XXII ISPRS Congress, 25 August – 01 September 2012, Melbourne, Australia, by H. Zhang. This paper proposes a cubic total variation (CTV) model by combining the 2-D total variation model for spatial domain with the 1-D total variation model for spectral domain, and then applies the termed CTV model to hyper-spectral image denoising. The augmented Lagrangian method is utilized to improve the speed of solution of the desired hyper-spectral image. The experimental results suggest that the proposed method can achieve competitive image quality [23].

V. CONCLUSION

This brief study on the topic of Image Denoising attempts to illustrate the recent research work that has been done in the field. Some research papers were discussed, all focussing on different aspects & techniques of image denoising. Although no experimental comparisons were made the essence of the reviewed papers has been presented. All algorithms have some pros & cons of their own and this can be gleaned from this review. The major role of this paper is to draw a picture of the state of the art of the image denoising techniques.

REFERENCES

[1] Bai Jian and Feng Xiangchu, "Image Denoising and Decomposition Using Non-convex Functional", Chinese Journal of Electronics, Vol.21, No.1, Jan. 2012, pg: 102-106

[2] Christylda Angelin Hannah. J, Natheldha Mary Navina. S, "A Survey on Image Denoising", International Journal of Engineering Research and Applications (IJERA), ISSN: 2248-9622, Vol. 3, Issue 1, January-February 2013, pg.153-156

[3] Ergen B., "Signal and Image Denoising Using Wavelet Transform", Advances in Wavelet Theory and Their Applications in Engineering, Physics and Technology, pg: 495-515, www.intechopen.com

[4] Hotz T. et al., "Locally adaptive image denoising by a statistical multiresolution criterion", arXiv:1001.5447v1 [stat.ME] 29 Jan 2010

[5] Jain M., Sharma S., Sairam R.M., "Effect of Blur and Noise on Image Denoising based on PDE", International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970), Volume-3 Number-1 Issue-8 March-2013, pg: 236-241

[6] Jalab H.A., Ibrahim R.W., "Denoising Algorithm Based on Generalized Fractional Integral Operator with Two Parameters", Discrete Dynamics in Nature and Society, Volume 2012, Article ID 529849, doi:10.1155/2012/529849

[7] Jena B., Patel P., Majhi B., Tripathy C.R., "Image Denoising Techniques For Salt And Pepper Noise., A Comparative Study", International Journal Of Research In Computer Applications And Robotics, ISSN 2320-7345, Vol.1 Issue.8, November 2013, pg: 27-33

[8] Kaur J., Kaur M., Kaur P. and Kaur M., "Comparative Analysis of Image Denoising Techniques", IJETAE, ISSN 2250-2459, Volume 2, Issue 6, June 2012, pg: 296-298

[9] Kaur J., Kaur R., "Digital Image De-Noising Filters A Comprehensive Study", International Journal Of Research In Computer Applications And Robotics, ISSN 2320-7345, Vol.2 Issue.4, April 2014, pg: 105-111

[10] Kaur R. and Rajput R., "A Fast and Robust Hybridized Filter For Image De-Noising", IJSETR, ISSN: 2278 – 7798, Volume 3, Issue 12, December 2014, pg: 3231-3239

[11] Lebrun M., "An Analysis and Implementation of the BM3D Image Denoising Method", Image Processing On Line, 2 (2012), pg. 175–213, http://dx.doi.org/10.5201/ipol.2012.l-bm3d

[12] Lebrun M., Leclaire A., "An Implementation and Detailed Analysis of the K-SVD Image Denoising Algorithm", Image Processing On Line, 2 (2012), pg. 96–133. http://dx.doi.org/10.5201/ipol.2012.llm-ksvd

[13] Liu G., Liu J., Wang Q., He W., "The Translation Invariant Wavelet-based Contourlet Transform for Image Denoising", Journal Of Multimedia, Vol. 7, No. 3, June 2012, pg: 254-261, doi:10.4304/jmm.7.3.254-261

[14] Lu K., He N., Li L., "Nonlocal Means-Based Denoising for Medical Images", Computational and Mathematical Methods in Medicine, Volume 2012, Article ID 438617, doi:10.1155/2012/438617

[15] Rafael C. Gonzalez, Richard E. Woods, "*Digital Image Processing, Third Edition*", Pearson Education, ISBN: 978-81-317-2695-2

[16] Rajpoot, N. M. and Butt, I. (2012), "A multiresolution framework for local similarity based image denoising", Pattern Recognition, 45(8), pg: 2938-2951, http://dx.doi.org/10.1016/j.patcog.2012.01.023

[17] S.N. Geethalakshmi and J. Suguna "Hybrid Models For Denoising Ultrasonic Images", Journal of Global Research in Computer Science, ISSN: 2229371X, Volume 1, No. 4, November 2010, pg: 38-45

[18] S.R.Preethi and P. Latha "Adaptive Denoising Technique for Colour Images", IJRET, eISSN: 2319-1163, pISSN: 2321-7308, Volume: 04 Issue: 03, Mar-2015, pg: 59-64

[19] Vijayalakshmi. A, Titus.C and Lilly Beaulah H., "Image Denoising for different noise models by various filters: A Brief Survey", IJETTCS, ISSN 2278-6856, Volume 3, Issue 6, November-December 2014, pg: 42-45

[20] Wang Y., Szlam A. and Lerman G., "Robust Locally Linear Analysis with Applications to Image Denoising and Blind Inpainting", Siam J. Imaging Sciences, Society for Industrial and Applied Mathematics, Vol. 6, No. 1, pg. 526–562

[21] Wang Y-Q. and Morel J-M., "SURE Guided Gaussian Mixture Image Denoising", Siam J. Imaging Sciences, Society for Industrial and Applied Mathematics, hal-00785334, version 1, 5 Feb 2013

[22] Wu Y., Tracey B. and Noonan J.P., "James-Stein Type Center Pixel Weights for Non-Local Means Image Denoising", arXiv:1211.1656v1 [cs.CV] 7 Nov 2012

[23] Zhang H., "Hyperspectral Image Denoising With Cubic Total Variation Model", ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume I-7, 2012, pg: 95-98

 ISBN: 978-81-931039-3-7

GREEN COMPUTING: AN EXPLORATION OF APPROACHES & IMPLEMENTATIONS

Farzana Parveen[1], Rahul Singh[2], Preeti Singh[3]

[1, 2, 3] Assistant Professor, Department of Computer Science,

Chhattisgarh Vanijya Avam Vigyan Mahavidyalaya, Bhilai, (India)

ABSTRACT

As computers have become more & more commonplace and prevailing in our day to day lives, their impact on our lives as well as the environment has grown tremendously. The amount of e-waste generated every year all around the world has reached alarming levels. Green Computing is the study and practice of environment friendly computing resources and application of techniques & methodologies to minimize power consumption & pollution caused by the use of IT. The aim of green computing is to reduce resource consumption and harmful emissions as well as decrease the use & generation of hazardous materials. It encompasses the creation of better hardware that run on less power & development of better algorithms that utilize the underlying hardware in a more efficient manner. The focal point of this paper is to highlight the impact of the IT industry & computing practices on the environment and to show the need for green computing. This paper then goes on to illuminate various solutions, which have been implemented in the recent past in order to realize the goals of greener and more eco-friendly computing.

Keywords: Blackle, Cloud Computing, Energy Efficiency, Green Data Centre, Virtualization

I. INTRODUCTION

Green Computing is an approach witch works for efficient & Eco-friendly computer resources. If we heard the term Green Computing we thought something doing green with computing, but question is HOW we can do this. When we finding the answer of it we conclude that Green computing = Great Computing. By Green Computing we can maximize energy efficiency in products lifetime, reduced CO_2 emission, promote recyclability and reduced the use of Hazardous Materials.

Figure 1: Green Computing [15]

Presently the ICT business is utilizing 3% of the world's energy resources. This energy consumption is supposed to grow at the rate of 20% per year; by 2030 ICT industry would be responsible for doubling the world's energy utilization.

Green Computing is now under the attention of Organizations as well. Organizations using Green computing Approaches to designing, building and operating Computer system to energy efficient. By using Green Computing Approaches like Virtualization, Cloud Computing, Power Management organizations can offer Green Computer that are affordable as well as Eco-friendly.

In present time people are aware about environment and they want Eco-friendly products and equipments in their life. People thought by the less use of paper they save environment but it is not as much as correct, for example if people prefer E-mail over to paper (letters), but this is not so Green. In Europe's largest IT infrastructure company, Mr. Matthew Yeager of Computer Centre claims that sending an e-mail attachment of 4.7 megabytes (MB) creates as much greenhouse gas as boiling a tea-kettle 17.5 times. He claims that an e-mail of 1 MB would be the equivalent to the emission of 19 grams of CO2 and if that mail is copied (cc'd, as we type) to 10 people; its impact is 73 grams of CO2. E-mail is thus not all that green. And e-mails with attachments are worse [8].

Today is the Era of computer if we think about Environment can we reduce the use of computer, is it the solution? No is not. We have to do some small- small steps for it like, simply turning off a PC when not in use can have a major impact on energy consumption as well as on environment.

Current Era belongs to Computer and electronic world this means in future the energy will be a serious issue as today people talk about Global Warming, CO_2 emission and climate change. We have to take it as serious thing to go greener in term of computing to achieve highly Efficient Computing Era.

II. WHY GREEN COMPUTING?

Today companies are manufacturing devices witch are more efficient and accurate but they are more energy consuming and having Toxic, dangerous gases & chemicals(Lead, mercury, Cadmium etc.) witch increasing pollution rapidly because of it the goal of companies is to design devices whose processing is better and consume less amount of energy.

Data canters are the main energy consumption sources. It needed a lot of power and cooling system, if Data canters have insufficient cooling capacity then it cause environmental pollution. Green computing technologies reduce energy consumption, recycling hazardous chemicals.

This technology is beneficial as it [1]:-

- Reduce energy consumption of computing resources during peak operation.
- Save energy during idle operation.
- Use eco-friendly sources of energy.
- Reduce harmful effects of computing resources.
- Reduce computing wastes.

III. APPROACHES TO GREEN COMPUTING

3.1 Green Data Center

Data centers or computer center has a computer system and its associated system such as telecommunication system data storage system. It needs backup power supply, some cooling system and security system. A green data center is a data center which has an efficient management of the system and associated system less power consumed environment.

 ISBN: 978-81-931039-3-7

Figure 2: Green Data Center [16]

Practical requirement of data centers are as follows:

- Provide a physical secure location for server.
- Should provide all-time network connectivity in data center.
- Should provide necessary power to operate all equipment.

Characteristics of Green Data Centers:

- Design must be simple
- Design must be scalable:
- Design must be modular.
- Design must be flexible [9]

3.2 Virtualization

Virtualization is the utilization of PC programming to mimic equipment. Inside server farms, server combination applies virtualization in its substitution of numerous stand-alone physical servers with virtual servers that run as programming on a little number of bigger PCs. To their clients, virtual servers can be arranged to still show up as physical machines on their system. To support further with vitality protection, virtualization can occur at the level of records and additionally servers. To allow this, document virtualization programming is as of now accessible that will designate records crosswise over physical circles in light of their usage rates This empowers every now and again got to documents to be put away on superior, low-limit drives, whilst records in less basic utilization are set on more power-productive, low-speed, bigger limit drives.

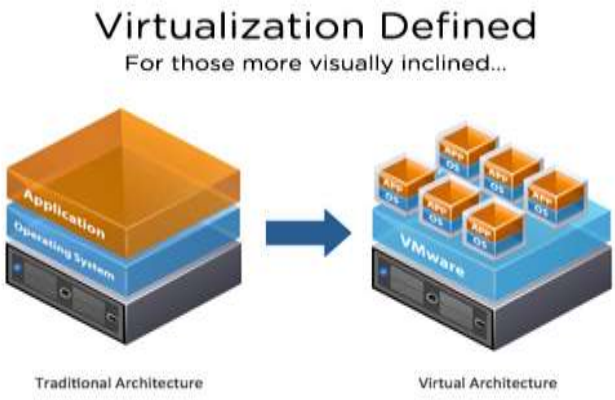

Figure 3: Virtualization [17]

3.3 Cloud Computing

It is the computing model in which programming applications, computing power, information, storage space and possibly even Artificial Intelligence are provisioned & utilized as a service over the Internet. Cloud computing has numerous profits, one of which is empowering anyone to acquire the natural advantages of virtualization. Whilst most servers in organization server farms run at 30 % capacity, most cloud merchant servers run at 80 % capacity or more. By deciding to move to cloud computing and specifically by embracing online PC computing power as PaaS or IaaS, organizations might subsequently possibly diminish their carbon foot print. And also permitting server ability to run at more ideal power consumption, distributed computing can likewise uproot the requirement for most clients to run high-power PCs and laptops.

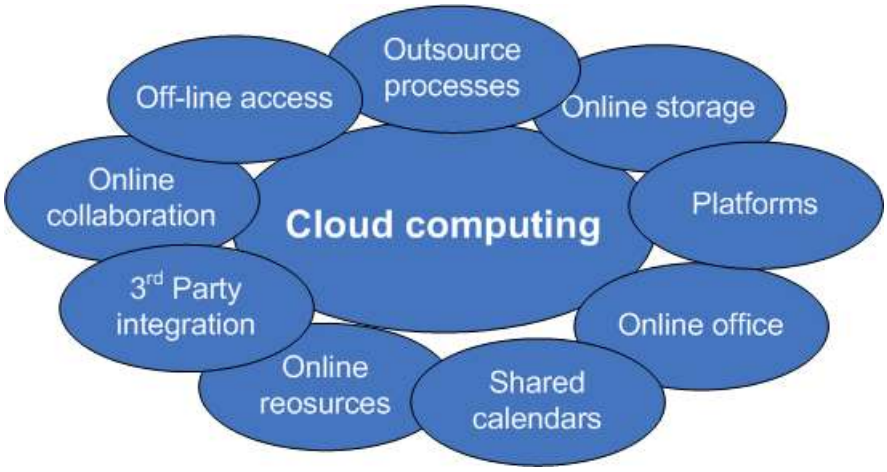

Figure 4: Cloud Computing [18]

IV. RECENT IMPLEMENTATION OF GREEN COMPUTING TECHNOLOGY [14]

4.1 Blackle

Blackle is a search-engine site powered by Google Search. Blackle came into being based on the concept that when a computer screen is white, presenting an empty word or the Google home, and your computer consumes 74W. When the screen is black it consumes only 59W.Based on this theory if everyone switched from Google to Blackle, mother earth would save750MW each year. This was a really good implementation of Green Computing. The principle behind Blackle is based on the fact that the display of different colors consumes different amounts of energy on computer monitors.

4.2 Fit-PC

A tiny PC that draws only 5w: Fit-PC is the size of a paperback and absolutely silent, yet fit enough to run Windows XP or Linux. Fit-PC is designed to fit where a standard PC is too bulky, noisy and power hungry. If you ever wished for a PC to be compact, quiet and green then fit- PC is the perfect fit for you. Fit-PC draws only5 Watts, consuming in a day less power than a traditional PC consumes in 1 hour. You can leave fit-PC to work 24/7 without making a dent in your electric bill.

4.3 Zonbu Computer

The Zonbu is a new, very energy efficient PC. The Zonbu consumes just one third of the power of a typical light bulb. The device runs the Linux operating system using a1.2 gigahertz processor and 512 MB of RAM. It also

contains no moving parts, and does even contain a fan. You can get one for as little as US$99, but it does require you to sign up for a two-year subscription.

4.4 Sunray Thin Client

Sun Microsystems is reporting increased customer interest in its Sun Ray, a thin desktop client, as electricity prices climb, according to Subodh Bapat, vice president and chief engineer in the Eco Responsibility office at Sun. Thin clients like the Sun Ray consume far less electricity than conventional desktops, he said. A Sun Ray on a desktop consumes 4 to 8 watts of power, because most of the heavy computation is performed by a server. Sun says Sunrays are particularly well suited for cost-sensitive environments such as call centers, education, healthcare, service providers, and finance. PCs have more powerful processors as well as hard drives, something thin clients don't have. Thus, traditional PCs invariably consume a substantially larger amount of power. In the United States, desktops need to consume 50 watts or less in idle mode to qualify for new stringent Energy Star certification.

4.5 The Asus Eee PC and Other Ultra Portables

The "ultra-portable" class of personal computers is characterized by a small size, fairly low power CPU, compact screen, low cost and innovations such as using flash memory for storage rather than hard drives with spinning platters. These factors combine to enable them to run more efficiently and use less power than a standard form factor laptop. The Asus Eee PC is one example of an ultraportable. It is the size of a paperback, weighs less than a kilogram, has built-in Wi-Fi and uses flash memory instead of a hard drive. It runs Linux too.

V. CONCLUSION

In this paper we were discussed some Green Computing approaches and its need, witch may help us to reduced the impact of energy consumption in the world. In this paper we also consider Blackle, Zonbu Computer, Sunray thin client and ultra portables PC witch are some recent implementation in Green Computing. For Green Computing There are some approaches like Green data Centers, Virtualization and Cloud Computing witch are very effective to reduced the carbon foot print, permitting server ability to run at more ideal power consumption, and give less power consumed environment. So as the conclusion of this paper we should say that by using or doing this approaches or solutions we will make our Environment healthy and pollution free.

REFERENCES

[1] Aggarwal S., Garg M., Kumar P., Green Computing is SMART COMPUTING – A Survey , International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, Volume 2, Issue 2, February 2012)

[2] Anwar M., Qadri S. F., and Sattar A.R., Green Computing and Energy Consumption Issues in the Modern Age, IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661, p-ISSN: 2278-8727, Volume 12, Issue 6 (Jul. - Aug. 2013), PP 91-98

[3] Chakraborty P., Bhattacharyya D., Sattarova Nargiza Y. Sovan Bedajna, Green computing: Practice of Efficient and Eco-Friendly Computing Resources, International Journal of Grid and Distributed Computing, Vol.2, No.3, September, 2009

[4] Choudhary S., A Survey on Green Computing Techniques, International Journal of Computer Science and Information Technologies, Vol. 5 (5) , 2014, 6248-6252, ISSN:0975-9646

[5] Google's Green Computing: Efficiency at Scale

[6] Jadhav N.P., Kamble R.S., Kamble S.V., Green Computing-New Approaches of Energy Conservation and E- Waste Minimization, IOSR Journal of Computer Engineering (IOSR-JCE) ISSN: 2278-0661, ISBN: 2278-8727, PP: 25-29 www.iosrjournals.org.

[7] Jindal G., Gupta M., Green Computing "Future of Computers", International Journal of Emerging Research in Management &Technology ISSN: 2278-9359, Research Article December 2012.

[8] Kaur N., Exploration of Green Computing, International Journal of Emerging Technology and Advanced Engineering , (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 1, January 2013)

[9] Malviya P., Singh S., A Study about Green Computing, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 6, June 2013 ISSN: 2277 128X

[10] Mathew A.P., "Green Computing", A Seminar Report, B.Tech. (Cse), School Of Engineering, Cochin University Of Science And Technology, November 2008

[11] N. Anupama, Green Computing, A Smart Computing, National Seminar on Impact of Toxic Metals, Minerals and Solvents leading to Environmental Pollution-2014 Journal of Chemical and Pharmaceutical Sciences ISSN: 0974-2115

[12] Pandey H., "Present Scenario Analysis Of Green Computing, Approach In The World Of Information Technology", Undergraduate Academic Research Journal (UARJ), ISSN : 2278 – 1129, Volume-1, Issue-2, 2012

[13] S. Jaya Prakash, K. Subramanyam, U.D.S.V. Prasad, Towards Energy Efficiency Of Green Computing Based On Virtualization, International Journal of Emerging trend in Engineering and Development, ISSN 2249-6149, Issue 2, Vol. 7 (November 2012)

[14] Shinde S., Nalawade S. , Nalawade A., Green Computing: Go Green and Save Energy, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 7, July 2013, ISSN: 2277 128X

[15] http://ecoccomp1220uwi.weebly.com/green-computing.html

[16] http://www.energystream-solucom.fr/2012/10/green-is-beautiful-le-green-it-by-google/

[17] http://www.vmware.com/virtualization/virtualization-basics/how-virtualization-works

[18] http://www.masternewmedia.org/cloud-computing-enterprise-content-distributors-moving-from-database-to-web-services-curation/

TESTING FOR E-COMMERCE WEBSITES AND INTERNAL OMS APPLICATION

Niranjanamurthy M[1], Dr. Dharmendra Chahar[2], Kavyashree N[3]

[1]*Assistant Professor, Department of Computer Applications, MSRIT, Bangalore,(India)*

[2] *HOD. Dept. of CS & IT, Seth G. B. Podar College, Nawalgarh (Jhunjhunu), Rajasthan, (India)*

[3]*Assistant Professor, Department of MCA, Dr. AIT, Bangalore, (India)*

ABSTRACT

Electronic commerce or ecommerce is a term for any type of business, or commercial transaction that involves the transfer of information across the Internet. This paper discussed and proposed the online shopping sites testing components and the internal Order management system modules testing and why e-commerce Application testing is important? and Principles of Effective E-Commerce Testing. For testing E-commerce sites we need to apply the Functional testing, Usability testing, Interface testing, Compatibility testing, Performance testing , Security testing, if any new enhancement that time we need to apply regression testing.

Keywords: Electronic Commerce, E-Shopping Website Testing, Browser Compatibility, Principles of Effective E-Commerce Testing, OMS Application Usability

I. INTRODUCTION

Electronic commerce (e-commerce or e-com), is the buying and selling of products or services over electronic systems such as the Internet and other computer networks. It provides technologies such as electronic funds transfer, supply chain management, Internet marketing, online transaction processing, inventory management systems, and automated data collection systems. It ensures that every page is tested, e-commerce transactions are validated and application is ready for customer use. The software's Functionality, compatibility, security, performance and usability are checked. Testing is crucial to e-commerce because e-commerce sites are both business critical and highly visible to their users; Yet the time pressures in the e-commerce world militate against the thorough testing usually associated with business criticality, so a new approach is needed to enable testing to be integrated into the development process and to ensure that testing does not present a significant time burden. Rapid Applications Development (RAD), in particular, suggests some promising approaches. Like most new ventures, though, e-commerce must find its own way and establish its own methods. For testing E-commerce website we need to check the following points with applying different test techniques the important modules are important functions or pages to be tested: Main pages, Product category pages, Product detail pages, Product search, Shopping basket, Checkout and Payment Systems. In other important conditions need to be tested are; Browser Compatibility, Mobile Device Compatibility, Performance, Check Your Links, Proof Reading, Product Pricing, Web Standards, Accessibility, Audit Your Cookies, Check Your Analytics, SEO, Social. For testing backend tool we need to concentrate or test the following modules they are : Order Management, Refunds, Activity Dashboard, Mail Configuration, Order Status message, Fraud list, Order status, Order on Hold.

II. RELATED WORK

Testing has a crucial role in the overall development process. Given unlimited time and resources, you could test a system to exhaustion. However, most projects operate within fixed budgets and time scales, so project managers need a systematic and cost-effective approach to testing that maximizes test confidence. This article provides a quick and practical introduction to testing medium- to large-scale transactional e-commerce systems based on project experiences developing tailored solutions for B2C Web retailing and B2B procurement. Typical of most e-commerce systems, the application architecture includes front-end content delivery and management systems, and back-end transaction processing and legacy integration.[1]

Customer's perceived trust towards an e-commerce Web site is crucial for the success of online business. Effective design of Web interfaces increases perceived trust of customers. Given many associated usability issues when performing tasks on a Web site, it is important for technopreneurs embarking on online business to understand issues related to usability problems of an e-commerce Web site and the techniques to identify these issues. In this study, usability evaluation was performed on an online gift shop with a group of potential consumers with age range of 18-22.[2]

An e-commerce scalability case study is presented in which both traditional performance testing and performance modeling were used to help tune the application for high performance. This involved the creation of a system simulation model as well as the development of an approach for test case generation and execution. We describe our experience using a simulation model to help diagnose production system problems, and discuss ways that the effectiveness of performance testing efforts was improved by its use.[3]

Web applications become more and more complex. Thus, systematic approaches for Web application testing are needed. Existing methods take into consideration only those actions provided by the application itself and do not involve actions provided by the browser, such as the usage of backward and forward buttons. Base on existing testing techniques, this paper addresses an approach to discovering possible inconsistencies caused by interactions with Web browser buttons and the property of a Web page related to Web browser buttons. A navigation tree considering the role of the browser buttons while navigating a Web application is constructed. Three adequacy criteria based on user actions are presented for test case selection. For illustration, a simple inquiring balance system of a Web application is exemplified.[4]

One of the challenges of testing web applications derives from their dynamic content and structure. As we test a website, we may discover more about its structure and behaviour. This paper proposes a framework for collection of testability measures during the automated testing process (termed `in-testing' measure collection). The measures gathered in this way can take account of dynamic and content driven aspects of web applications, such as form structure, client-side scripting and server-side code. Their goal is to capture measurements related to on-going testing activity, indicating where additional testing can best lead to higher overall coverage.[5]

Usability testing includes the following five elements: 1. Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design? 2. Efficiency: How fast can experienced users accomplish tasks? 3. Memorability : When users return to the design after a period of not using it, does the user recollect how to use it effectively the next time, or does the user have to start learning everything? As newly. 4. Errors: How many errors do users make, how critical are these errors and how easily can they recover from the errors? 5. Satisfaction: How much does the user like using the system? [6]

Software Testing is the process of identifying the security, correctness, completeness and quality of the developed computer software. Testing is a process of technical searching/investigation, performed on behalf of stakeholder, which is to reveal quality related information about the product with respect to the circumstances in which it is meant to operate. This includes and is not limited to the process of executing a program or application with the purpose of finding the errors. Quality is a value to some person and not absolute. Testing can never completely begin the correctness of arbitrary computer software.[7]

One of the e-commerce products that is popular nowadays is online shopping. Online shopping has been experiencing its golden years and becoming one of the potential contributions in e-commerce. The implication of this phenomenon is the spread of online shopping websites across the regional. One website originating from Egypt for example will be accessed and used by the people of all around the world. There will be a lot of advantages caused by this. Besides companies, customers gain their profits or advantages as well. E-commerce has been considered as knowledge-based economy that can support the economy of the countries applying it [2]. The importance of e-commerce has caused high competitiveness among the online business doers. Many efforts have been done to discover the factors behind both success and failure of e-commerce specifically online shopping adoption. This includes the abundant studies which are related with online shopping, e-commerce, or cultural values in e-commerce and website design conducted by many researchers and practitioners. One of the important factors in the online shopping is the cultural factors.[8]

Online Shopping Procedure:

Test Case format for E-commerce website Testing:

PROJECT NAME	TESTING TYPE	CREATED BY	REVIEWED BY	MODULE NAME	CREATED DATE	REVIEWED DATE		
				CYCLE1				
SL NO	TC ID	TC SCENARIO	USER ACTION	USER DATA	EXPECTED RESULTS	ACTUAL RESULT STATUS	BUG ID	

III. POINTS NEED TO COVER IN E-SHOPPING WEBSITE TESTING

For testing online shopping website the following important functions or pages to be tested: Main pages, Product category pages, Product detail pages, Product search, Shopping basket, Checkout and Payment Systems. In other important conditions need to be tested are; Browser Compatibility, Mobile Device Compatibility, Performance, Check Your Links, Proof Reading, Product Pricing, Web Standards, Accessibility, Audit Your Cookies, Check Your Analytics, SEO, Social.

 ISBN: 978-81-931039-3-7

3.1 Main Pages Testing Components

• Home page

• Featured products

• Special offers

•Information pages- About page, Shipping information, Returns policy, Terms page, Privacy policy

3.2 Product Category Pages Testing Components

•Any filters such as product filters, colours, sizes, types of product, etc.

• Any ability to sort products by name, price, size, etc.

• Add to shortlist or wish list facility.

• Add to basket.

3.3 Product Detail Pages Testing Components

• Product title

• Product description

• Product images

• Enlarge image

• 360 degree view of products

• Related products

• Any further product information, colours, sizes, options, extras.

• Add to shopping basket

3.4 Product Search Testing Component

• Keyword search- It may contains different options to select search categories

3.5 Shopping Basket Testing Components

• Add products to basket

• Remove product from basket

• Change quantities

• Select delivery option

• Check VAT and delivery costs add up correctly

3.6 Checkout and Payment Systems

As this is a testing plan for an ecommerce site then a specific section of the plan should be devoted to the checkout and payment area of the website.

Test the checkout process including the following aspects:

Final amount to pay – make sure that this value is correct, after the price of the products, VAT, delivery and any other charges. Test making changes to the products being ordered, changing delivery options, etc. and make sure that this final amount updates correctly.

Next is payments:

Carry out a test payment using each payment method that you are offering such as debit cards, credit cards, Paypal, Google Checkout, etc. Your payment system will most likely still be in test mode before you launch so all test payments will be carried out using the test payment details.

An example list of payment types is as follows:

• Place Paypal payment
• Place Visa payment
• Place Visa Debit payment
• Place Visa Electron payment
• Place Mastercard payment
• Place Amex payment
• Place false payment
• Test cancelling order

Check that confirmation emails are sent correctly when a payment is made, whether those confirmation emails are being sent by your website or by the payment provider.

Make sure that you can refund a payment and that any confirmation emails are sent to the recipient of the refund successfully.

You will probably want to carry out several payments again once the site is live so you can use real debit and credit cards to check the system works correctly.

This is the central aspect of your ecommerce website and so if time is short then make sure you thoroughly test the checkout and payment area.

3.7 Browser Compatibility

Extremely important, especially for ecommerce sites, as if the site doesn't work in a particular browser then nobody using that browser can buy anything from you.

This list of browsers will change, as new browsers are released and older browsers aren't used as much (here's hoping that IE7 goes away soon).

Currently, we are testing all of the functionality listed above in each of the following web browsers:

- Internet Explorer 7
- Internet Explorer 8
- Internet Explorer 9
- Mozilla Firefox (latest version)
- Google Chrome (latest version)
- Safari

3.8 Mobile Device Compatibility

If you wish your website to be used by visitors viewing it on their smartphone or tablet then you also need to test all of the functionality on each of the following mobile devices:

• Apple iPhone – 5, 5S/5C, 6 and 6 Plus
• Apple iPad – iPad 2, 3, 4, iPad Air and iPad Air 2)
• Apple iPad Mini – 1, 2 and 3
• Android Smartphone – such as Samsung Galaxy S5

 ISBN: 978-81-931039-3-7

• Android Tablet – such as Google Nexus 7

• Windows Phone – such as Nokia Lumia 635

3.9 Performance Testing

Your ecommerce website needs to load quickly in order for potential customers to not get frustrated and head elsewhere.

Carry out a performance test using an online tool such as Webpagetest and pay attention to what it tells you. For doing doing performance testing majority we can use Winrunner and Load runner tools.

3.10 Check Your Links

Running a link check helps to weed out any broken links ahead of launch and is generally well worth doing, as there is always something not linking correctly.

Proof Reading

It goes without saying but proof reading every page, including all product pages, product descriptions, search results pages and the checkout process will make sure that people are not put off by any shoddy spelling or grammar.

Product Pricing

Along with proof reading, checking your products pricing is obviously very important to make sure you are not selling something too cheap or putting people off because the price is way too high. There have been many high profile pricing errors in the past with retailers offering Sony TVs for £1 by accident, etc.

Web Standards

Often overlooked, a few checks on how your website complies with HTML and CSS standards can greatly help your website's accessibility, aid SEO, usability and other general site quality problems.

Accessibility Testing

Whilst we touched on this subject above, it is important to make sure that your ecommerce website is accessible. Therefore, check for the following:

- Test your website against WCAG 2.0 guidelines
- Try browsing your website with a screen reader and/or text browser
- Try browsing your website without a mouse, I.e. with just your keyboard

You'll undoubtedly pick up some problems you wouldn't have guessed at but it is a good idea to fix them.

Audit Your Cookies:

Since the EU ePrivacy Directive came into force in May we also need to audit the cookies that your website uses, provide information to users on what those cookies are and how they are used, and provide an opt in or opt out mechanism for visitors if they do not want their information to be used by the website.

Check Your Analytics

Make sure your analytics is installed and collecting statistics properly. Set up any goals that you need to and configure other aspects such as site search tracking, which is very useful for an ecommerce website.

SEO

An ecommerce website greatly benefits from making sure website visitors can easily find it and, if there are a lot of products, then long-tail search terms can account for a large number of visitors and customers.

I would recommend checking the following aspects:

- Structure of URLs
- Unique title tags for each page and product page
- Title tags should include product name and category
- Meta description tag for each page and product page
- Robots.txt in place
- Check that alt text has been added to images
- Internal linking
- XML sitemap

Social

Check that social buttons, icons or links are in place and work correctly like facebook, Twitter, LinkedIn, Google Plus+, Tumblr, Flickr etc.[9]

3.11 Ten Key Principles of Effective E-Commerce Testing

1. Testing is a risk management process
2. Know the value of the applications being tested
3. Set clear testing objectives and criteria for successful completion (including test coverage measures)
4. Create an effective test environment
5. Test as early as possible in the development cycle
6. User Acceptance Testing (UAT)
7. Regression testing
8. Automate as much as possible
9. Capture test incidents and use them to manage risk at release time
10. Manage change properly to avoid undoing all the testing effort.

3.12 Why E-commerce Application Testing is Important?

The first and primary reason is because e-commerce is, by its very nature, business critical and highly visible to its user's.

Any failure can be immediately expensive in terms of lost revenue and even more expensive in the longer term if disaffected users seek alternative sites.

E-commerce is a massive and growing market place but one which requires large up-front investment to enter successfully.

The history of e-commerce development has been littered with expensive failures, at least some of which could have been avoided by better testing before the site was opened to the general public.

Quality Assurance of the software or application developed

Verification and validating the product/application before it goes live in the market to prevent it from intruders and hackers.

Defect free and user friendly application. (Http://blog. precisetestingsolution.com/2012/12/what-is-ecommerce-why-testing-required.html)

IV. INTERNAL OMS APPLICATION

All the online shopping industry should maintain the backend tool called Order Management System (OMS). Order Management System should contain the following modules:

- Order Management- Summary, Customer, Item selection, Payment, Coupons and discounts, Details, History, Search, New order, Process Order, Special Refund, Add note, Activity.
- Refunds
- Activity Dashboard
- Mail Configuration
- Order Status message
- Fraud list
- Order status- Screening, Order cancellation, PO Process, Return, Reject, Fulfillment, Closed
- Order on Hold

After getting any orders from the customer/s through websites then all the related information's stored in the OMS tool. Tester should test all these information's in OMS tools applying different test techniques.

V. CONCLUSION

For testing E-commerce website we need to test the following modules with applying different test techniques the important modules are important functions or pages to be tested: Main pages, Product category pages, Product detail pages, Product search, Shopping basket, Checkout and Payment Systems. In other important conditions need to be tested are; Browser Compatibility, Mobile Device Compatibility, Performance, Check Your Links, Proof Reading, Product Pricing, Web Standards, Accessibility, Audit Your Cookies, Check Your Analytics, SEO, Social. For testing backend tool we need to concentrate or test the following modules they are : Order Management, Refunds, Activity Dashboard, Mail Configuration, Order Status message, Fraud list, Order status, Order on Hold. Usability: Online shoppers are goal-oriented. They exit e-commerce websites immediately if they cannot find the products in their shopping list. Security: Retail websites must comply with the regulations and protect online shoppers from identity theft. Performance: The number of online transactions fluctuates daily and it increases dramatically during the holiday/ shopping season. Online shopping sites testing is very important with applying Functional testing, Usability testing, Interface testing, Compatibility testing, Performance testing , Security testing, if any new enhancement that time we need to apply regression testing.

VI. ACKNOWLEDGEMENTS

I thank Dr. T. V. Suresh Kumar, Prof. and Head, Dept. of MCA, MSRIT, Bangalore-54. for his continuous support and encouragement for completing this research paper and also thanks to MSRIT management.
I thank Dr. Jagannatha, Associate Professor. of Dept. of MCA, MSRIT, Bangalore-54, for his valuable guidance and support for completing this paper.

REFERENCES

[1] Lam, W."Testing e-commerce systems: a practical guide" IT Professional (Volume:3 , Issue: 2)IEEE August 2002 Page(s): 19 – 27

[2] Goh, K.N., Chen, Y.Y. ; Lai, F.W. ; Daud, S.C. -"A Comparison of Usability Testing Methods for an E-Commerce Website: A Case Study on a Malaysia Online Gift Shop" Tenth International Conference on Information Technology: New Generations (ITNG),IEEE 2013 Page(s): 143 – 150

[3] Avritzer, A, Weyuker, E.J. "The role of modeling in the performance testing of e-commerce applications " Software Engineering, IEEE Transactions on (Volume:30 , Issue: 12) 2004 Page(s): 1072 – 1083

[4] Bin Zhu, Huaikou Miao ; Lizhi Cai "Testing a Web Application Involving Web Browser Interaction " 10th ACIS International Conference on Software Engineering, Artificial Intelligences, Networking and Parallel/Distributed Computing, IEEE 2009.Page(s):589 - 594

[5] Alshahwan, N.Harman, M. ; Marchetto, A. ; Tonella, P. "Improving Web Application Testing using testability measures" 11th IEEE International Symposium on Web Systems Evolution (WSE) 2009 Page(s): 49 – 58

[6] N murthy M, Archikam Nagaraj, Himaja Gattu, Puneeth K Shetty-"Research Study on Importance of Usability Testing/ User Experience (UX) Testing" IJCSMC Volume 3 Issue 10 2014 pg. 78-85

[7] Niranjanamurthy M, Nitesh S N, Nagesh S N, Balaji Sriraman "Comparative Study on Software Testing Techniques" IJCSMC Volume 3 Issue 10 2014 pg. 151-158

[8] Abdullah al-Qudah, Omar, Ahmad, Kamsuriah "The roles of culture in online shopping to enhance e-commerce in Jordan" International Conference on Information Technology and Multimedia (ICIMU), 2014 IEEE Page(s):113 – 117

[9] http://www.testing-web-sites.co. uk/testing-plans-checklists/testing-plan-for-an- ecommerce-site/

[10] Niranjanamurthy M, DR. Dharmendra Chahar - Analysis of E-Commerce and M-Commerce: Advantages,Limitations and Security issues - IJARCCE - Vol. 2, Issue 6, June 2013.

[11] M Niranjanamurthy, DR. Dharmendra Chahar "The study of E-Commerce Security Issues and Solutions" - Vol. 2, Issue 7, July 2013

FREE CONVECTIVE MHD FLUCTUATING FLOW PAST AN IMPULSIVELY STARTED ISOTHERMAL VERTICAL PLATE WITH CONSTANT SUCTION

Hawa Singh

Department of Mathematics, National Institute of Technology, Kurukshetra, Haryana, (India)

ABSTRACT

In this paper, the effects of radiation and viscous dissipation on unsteady magneto-hydrodynamics free convection fluctuating flow past an impulsively started isothermal vertical plate has been described. By using the similarity transformation, the governing equations for the flow are transformed into dimensionless form and then the system of nonlinear partial differential equations is solved by perturbation technique. A uniform magnetic field acts perpendicular to the plate, which absorbs the fluid with a suction velocity. A comparison is made in velocity and temperature profiles for two particular cases of real and imaginary time dependent functions. The effects of various parameters like Prandtl number, Grashof number, magnetic parameter, radiation parameter, Eckert number and Schmidt number on the velocity and temperature profiles have been studied quantitatively and are shown graphically.

Keywords: Eckert Number, Perturbation Method, Radiation, Schmidt Number, Unsteady Flow

I. INTRODUCTION

The radiation effects are found to be more significant in the following areas of applications such as soil physics, geothermal energy extraction, chemical engineering, glass production, furnace design, space technology application, fight aerodynamics and plasma physics which operates at extremely high temperature. Also, the application of radiation heat transfer becomes highly significant in the design of pertinent equipment, viscous mechanical dissipation effects are important in geophysical flows and also in certain industrial operations and are usually characterized by Eckert number. Recently, attention has been on the effects of transversely applied magnetic field and thermal perturbation on the flow of electrically conducting viscous fluid such as plasma. Various properties associated with the interplay of magnetic fields and thermal perturbation in porous medium past vertical plate find useful applications in astrophysics, geophysical fluid dynamics and engineering.

Abd EI-Naby *et al.*(2003) presented the effects of radiation on MHD unsteady free convection flow over vertical plate with variable surface temperature. Chamkha *et al.*(2001) have studied the effects of radiation on free convection flow past a semi- infinite vertical plate with mass transfer. Das *et al*. (1994) presented the effects of mass transfer on flow past an impulsively started infinite vertical plate with constant heat flux and chemical reaction concentration of the fluid under consideration. The influence of viscous dissipation and radiation on unsteady MHD free convection flow past an infinite heated vertical plate in a porous medium with time dependent suction had been examined by Israel-Cookey *et al.*(2003). Israel-Cookey and Nwaigwe (2010) have described an electrically conducting unsteady flow and radiating fluid over a moving heated porous plate in the presence of an induced magnetic field. The effect of radiation and first order homogeneous chemical reaction

with heat and mass transfer of a Newtonian, viscous, electrically conducting and heat generation/ absorption fluid on a vertical surface have been investigated by Ibrahim *et al.*(2008).

The effects of radiation on the flow past an impulsively started vertical plate in the presence of mass transfer have been investigated by Loganathan and Ganesan (2006). Subsequently, Muthucumaraswamy and Ganesan (1998, 2004) have obtained the natural convection on flow past an impulsively started vertical plate with variable surface heat flux and studied the problem of unsteady flow past an impulsively started isothermal vertical plate with mass transfer by an implicit finite difference method.

II. MATHEMATICAL FORMULATION OF THE PROBLEM

An unsteady two dimensional laminar boundary layer flow of a viscous incompressible, radiating and electrically conducting fluid along a semi-infinite vertical plate with constant suction by considering the effects of viscous dissipation into account has been discussed. The x-axis is taken along the vertical plate in the upward direction and y-axis is normal to the plate. Initially, it is assumed that the plate and the fluid are of the same temperature and concentration in a stationary condition. At the time $t^* > 0$, the plate starts moving impulsively in the vertical direction with constant velocity $\bar{u}$ against the gravitational field. It is also assumed that there is no chemical reaction between the diffusing species and the fluid. Then under the usual Boussinesq's approximation,the unsteady flow past a vertical plate is governed by the following equations:

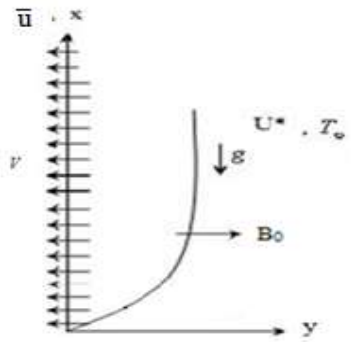

Fig A: Physical Sketch of the Problem

$$\frac{\partial v^*}{\partial y^*} = 0 \tag{1}$$

$$\frac{\partial u^*}{\partial t^*} + v^* \frac{\partial u^*}{\partial y^*} = g\beta(T^* - T_\infty) + g\beta^*(C^* - C_\infty) + \nu \frac{\partial^2 u^*}{\partial y^{*2}} - \sigma \frac{B_0^2 u^*}{\rho} \tag{2}$$

$$\frac{\partial T^*}{\partial t^*} + v^* \frac{\partial T^*}{\partial y^*} = \alpha \frac{\partial^2 T^*}{\partial y^{*2}} - \frac{1}{\rho c_p}\frac{\partial q_r}{\partial y^*} + \frac{\nu}{c_p}\left(\frac{\partial u^*}{\partial y^*}\right)^2 \tag{3}$$

$$\frac{\partial C^*}{\partial t^*} + v^* \frac{\partial C^*}{\partial y^*} = D \frac{\partial^2 C^*}{\partial y^{*2}} \tag{4}$$

The boundary conditions for the velocity, temperature and concentration fields are:

 ISBN: 978-81-931039-3-7

$$\left.\begin{array}{ll} t^* \le 0: u^* = 0, v^* = 0, T^* = T_\infty, C^* = C_\infty & \\ t^* > 0: u^* = \bar{u}, \quad v^* = -V, T^* = T_w, C^* = C_w & at\ y^* = 0 \\ \quad u^* = U^*(t^*), T^* = T_\infty, C^* = C_\infty & at\ x^* = 0 \\ \quad u^* \to U^*(t^*), T^* \to T_\infty, C^* \to C_\infty & as\ y^* \to \infty \end{array}\right\} \quad (5)$$

We assumed that thermal radiation in the form of a unidirectional flux in the y-direction i.e., q_r (transverse to the vertical surface). By using the Rosseland approximation (Brewster 1992), the radiative heat flux q_r is given by:

$$q_r = -\frac{4\sigma_s}{3k_e}\frac{\partial T^{*4}}{\partial y^*} \quad (6)$$

If the temperature difference $T^* - T_\infty$ within the flow is sufficiently small, the Taylor series for T^{*4} with neglect of the higher order terms is given by a linear temperature function:

$$T^{*4} \cong 4T_\infty^3 T^* - 3T_\infty^4 \quad (7)$$

By using equations (6) and (7), equation (3) reduces to

$$\frac{\partial T^*}{\partial t^*} + v^*\frac{\partial T^*}{\partial y^*} = \alpha\frac{\partial^2 T^*}{\partial y^{*2}} + \frac{16\sigma_s T_\infty^3}{3k_e \rho c_p}\frac{\partial^2 T^*}{\partial y^{*2}} + \frac{\nu}{c_p}\left(\frac{\partial u^*}{\partial y^*}\right)^2 \quad (8)$$

Introduce the following dimensionless quantities:

$$\left.\begin{array}{l} y = \frac{\bar{u}\, y^*}{\nu}, t = \frac{\bar{u}^2 t^*}{\nu}, u = \frac{u^*}{\bar{u}}, U(t) = \frac{U^*(t^*)}{\bar{u}}, \omega = \frac{\omega^* \nu}{\bar{u}^2}, \theta = \frac{T^* - T_\infty}{T_w - T_\infty} \\ Gr = \frac{\nu g \beta (T_w - T_\infty)}{\bar{u}^3}, Gm = \frac{\nu g \beta^* (C_w - C_\infty)}{\bar{u}^3}, M = \frac{\sigma \beta_0^2 \nu}{\rho \bar{u}^2}, R = \frac{k_e k}{4\sigma_s T_\infty^3} \\ C = \frac{C^* - C_\infty}{C_w - C_\infty}, Pr = \frac{\nu}{\alpha}, Sc = \frac{\nu}{D}, Ec = \frac{\bar{u}^2}{c_p (T_w - T_\infty)} \ . \end{array}\right\}$$

Equations (2), (4) and (8) reduce to the following non-dimensional form

$$\frac{\partial u}{\partial t} - \frac{\partial u}{\partial y} = \frac{\partial^2 u}{\partial y^2} - Mu + Gr\,\theta + Gm\,C \quad (9)$$

$$\frac{\partial \theta}{\partial t} - \frac{\partial \theta}{\partial y} = \frac{1}{Pr}\left(1 + \frac{4}{3R}\right)\frac{\partial^2 \theta}{\partial y^2} + Ec\left(\frac{\partial u}{\partial y}\right)^2 \quad (10)$$

$$\frac{\partial C}{\partial t} - \frac{\partial C}{\partial y} = \frac{1}{Sc}\frac{\partial^2 C}{\partial y^2} \quad (11)$$

The corresponding initial and boundary conditions are as:

$$\left.\begin{array}{ll} t \le 0: u = 0, \theta = 0, C = 0 & \\ t > 0: u = 1, \theta = 1, C = 1 & at\ y = 0 \\ \quad u = U(t), \theta = 0, \quad C = 0 & at\ x = 0 \\ \quad u \to U(t), \theta \to 0, C \to 0 & as\ y \to \infty \end{array}\right\} \quad (12)$$

III. METHOD OF SOLUTION

Equations (9-11) are coupled non-linear partial differential equations and these can't be solved in closed form. However, these equations can be reduced to a set of ordinary differential equations and this can be done by representing the velocity, temperature and concentration of the fluid in the neighbourhood of the plate as:

$$\left.\begin{array}{c} u(y,t)=u_0(y)+\varepsilon f(\mathrm{t})u_1(y) \\ \theta(y,t)=\theta_0(y)+\varepsilon f(\mathrm{t})\,\theta_1(y) \\ \mathrm{C}(y,t)=C_0(y)+\varepsilon\, f(\mathrm{t})C_1(y) \\ Also \\ U(\mathrm{t})=(1+\varepsilon\, f(\mathrm{t})) \end{array}\right\} \tag{13}$$

Case (I): We consider a function of time in imaginary form, $f(t)=e^{i\omega t}$.

Substituting the equation (13) into the equations (9-11), we obtain the following equations by considering harmonic and non-harmonic terms while neglecting the higher terms with order of $O(\varepsilon)^2$

$$u_0'' + u_0' - M\,u_0 = -Gr\,\theta_0 - G_m C_0 \tag{14}$$

$$\theta_0'' + N_2\theta_0' = -Ec\,N_2\left(\frac{\partial u_0}{\partial y}\right)^2 \tag{15}$$

$$C_0'' + Sc\;C_0' = 0 \tag{16}$$

subject to the boundary conditions

$$\left.\begin{array}{l} u_0=1,\ \theta_0=1,\ C_0=1\ at\ y=0 \\ u_0\to 1,\ \theta_0\to 0,\ C_0\to 0\ as\ y\to\infty \end{array}\right\} \tag{17}$$

3.1 First-Order Equations

$$u_1'' + u_1' - N_1 u_1 = -Gr\,\theta_1 - Gm\,C_1 \tag{18}$$

$$\theta_1'' + N_2\theta_1' - N_3\theta_1 = -2N_2 Ec\,u_0' u_1' \tag{19}$$

$$C_1'' + Sc\;C_1' - \omega Sc\;C_1 = 0 \tag{20}$$

subject to the boundary conditions

$$\left.\begin{array}{l} u_1=0,\ \theta_1=0,\ C_1=1\ at\ y=0 \\ u_1\to 1,\ \theta_1\to 0,\ C_1\to 0\ as\ y\to\infty \end{array}\right\} \tag{21}$$

To solve the non- linear-coupled equations (14-16) and (18-20), we further assume that the viscous dissipation parameter (Eckert number Ec) is very small for incompressible flows, and therefore, advance an asymptotic expansions for the flow velocity, temperature and concentration as follows:

$$\left.\begin{array}{l} u_0(y)=u_{01}(y)+Ec\,u_{02}(y) \\ \theta_0(y)=\theta_{01}(y)+Ec\,\theta_{02}(y) \\ C_0(y)=C_{01}(y)+Ec\,C_{02}(y) \\ u_1(y)=u_{11}(y)+Ec\,u_{12}(y) \\ \theta_1(y)=\theta_{11}(y)+Ec\,\theta_{12}(y) \\ C_1(y)=C_{11}(y)+Ec\,C_{12}(y) \end{array}\right\} \tag{22}$$

Substituting the equation (22) into the equations (14-16) and (18-20), we obtain the following sequence of approximations:

3.2 The Zeroth- Order Equations are

$$u_{01}'' + u_{01}' - M\,u_{01} = -Gr\,\theta_{01} - Gm\,C_{01} \tag{23}$$

$$u_{02}'' + u_{02}' - M\,u_{02} = -Gr\,\theta_{02} - Gm\,C_{02} \tag{24}$$

$$\theta_{01}'' + N_2\,\theta_{01}' = 0 \tag{25}$$

$$\theta_{02}'' + N_2\,\theta_{02}' = -N_2\left(\frac{\partial u_{01}}{\partial y}\right)^2 \tag{26}$$

$$C_{01}'' + Sc\,C_{01}' = 0 \tag{27}$$

$$C_{02}'' + Sc\,C_{02}' = 0 \tag{28}$$

subject to the boundary conditions:

$$\left.\begin{array}{l} u_{01} = 1,\ u_{02} = 0,\ \theta_{01} = 1,\ \theta_{02} = 0,\ C_{01} = 1,\ C_{02} = 0\ at\ y = 0 \\ u_{01} \to 1,\ u_{02} \to 0,\ \theta_{01} \to 0,\ \theta_{02} \to 0,\ C_{01} \to 0,\ C_{02} \to 0\ as\ y \to \infty \end{array}\right\} \tag{29}$$

3.3 The First - Order Equations are

$$u_{11}'' + u_{11}' - N_1 u_{11} = -Gr\,\theta_{11} - Gm\,C_{11} \tag{30}$$

$$u_{12}'' + u_{12}' - N_1 u_{12} = -Gr\,\theta_{12} - Gm\,C_{12} \tag{31}$$

$$\theta_{11}'' + N_2\theta_{11}' - N_3\theta_{11} = 0 \tag{32}$$

$$\theta_{12}'' + N_2\theta_{12}' - N_3\theta_{12} = -2N_2 u_{01}'\,u_{11}' \tag{33}$$

$$C_{11}'' + Sc\,C_{11}' - \omega Sc C_{11} = 0 \tag{34}$$

$$C_{12}'' + Sc\,C_{12}' - \omega Sc C_{12} = 0 \tag{35}$$

where

$$N_1 = M + i\omega,\ N_2 = \frac{3R\Pr\omega}{3R+4},\ N_3 = \frac{3i\,R\Pr\omega}{3R+4}$$

Subject to the boundary conditions:

$$\left.\begin{array}{l} u_{11} = 0,\ u_{12} = 0,\ \theta_{11} = 0,\ \theta_{12} = 0,\ C_{11} = 0,\ C_{12} = 0\ at\ y = 0 \\ u_{11} \to 1,\ u_{12} \to 0,\ \theta_{11} \to 0,\ \theta_{12} \to 0,\ C_{11} \to 0,\ C_{12} \to 0\ as\ y \to \infty \end{array}\right\} \tag{36}$$

Equations (23 -28) are solved with the boundary conditions (29) and equations (30-35) are solved with the boundary conditions (36), we get velocity, temperature and concentration as:

$$\begin{aligned} u(y,t) = {} & ((\alpha_1 + \alpha_2)e^{-m_1 y} + 1 - \alpha_1 e^{-N_2 y} - \alpha_2 e^{-Sc\,y}) + Ec(\alpha_{17}e^{-m_1 y} \\ & - \alpha_{10}e^{-N_2 y} - \alpha_{11}e^{-2m_1 y} - \alpha_{12}e^{-2N_2 y} - \alpha_{13}e^{-2Sc\,y} + \alpha_{14}e^{-[m_1+N_2]\,y} \\ & + \alpha_{15}e^{-[m_1+Sc]y} - \alpha_{16}e^{-[N_2+Sc]y}) + \varepsilon e^{i\omega t}((1 - e^{-m_2 y}) \\ & + Ec(\alpha_{26}e^{-m_1 y} - \alpha_{22}e^{-m_3 y} - \alpha_{23}e^{-[m_1+m_2]y} + \alpha_{24}e^{-[N_2+m_2]y} \\ & + \alpha_{25}e^{-[Sc+m_2]y})). \end{aligned} \tag{37}$$

 ISBN: 978-81-931039-3-7

$$\begin{aligned}\theta(y,t) = (&e^{-N_2 y} + Ec(\alpha_9 e^{-N_2 y} + \alpha_3 e^{-2m_1 y} + \alpha_4 e^{-2N_2 y} + \alpha_5 e^{-2Sc\,y} \\ &- \alpha_6 e^{-[m_1+N_2]y} - \alpha_7 e^{-[m_1+Sc]y} + \alpha_8 e^{-[Sc+N_2]y})) \\ &+ \varepsilon e^{i\omega t} Ec(\alpha_{21} e^{-m_3 y} + \alpha_{18} e^{-[m_1+m_2]y} - \alpha_{19} e^{-[N_2+m_2]y} \\ &- \alpha_{20} e^{-[Sc+m_2]y}).\end{aligned} \tag{38}$$

$$C(y,t) = e^{-Sc\,y}. \tag{39}$$

Case (II): Now we consider a function of time in real form, $f(t) = e^{\omega t}$.

By following the same procedure as in case (1), we draw the graphs for velocity and temperature profilesin this case.

IV. RESULT AND DISCUSSION

Here, we have formulated and solved the problem of the MHD free convection of a radiating electrically conducting fluid over a cooling $(Gr > 0)$ vertical plate by making fairly realistic asymptotic approximation and we depict the comparison of the results of two particular cases. In numerical computation, the Prandtl number $(Pr = 0.7)$ corresponding to air and other values of the material parameters are used. In addition, the boundary condition $y \to \infty$ is approximated by $y_{max} = 30$ and $y_{max} = 18$, which is sufficiently large for the velocity and temperature, respectively to approach their free stream values. In the subsequent analysis, we started with temperature profiles due to its primary importance in astrophysical environments. The temperature profiles are presented when the free convection currents are cooling the plate.

The effect of frequency of excitation on the temperature profiles has been illustrated in figures 1(a) and 1(b). From figure 1(a), it is clear that as we move far away from the plate, initially the temperature increases rapidly and thereafter decreases rapidly, whereas, in figure1(b), the frequency of excitation has insignificant effect over thermal boundary layer thickness i.e. the profiles are in very closer range.

Figures 2(a) and 2(b) depict the effects of frequency of excitationversus y on velocity profiles, for constant values of other parameters. It is noticed that as the frequency of excitation increases, the velocity field decreases. Further, it is observed that as we move far away from the plate, the velocity increases rapidly initially and thereafter, the decrease is found to be slow. However, this parameter has insignificant effect over velocity profiles i.e. the profiles are in very closer range as shown in figure 2(b), whereas, in figure 2(a), it shows relatively more effect on velocity profiles.

The effect of magnetic intensity on the temperature profiles is shown through figures 3(a) and 3(b) and all other participating parameters in the temperature field are held constant. From both figures, the effect of magnetic field is found to have zero effect on the temperature throughout the thermal boundary layer thicknesses.

Figures 4(a) and 4(b) represent the dimensionless velocity profiles for different values of magnetic intensity. Smaller values of magnetic field have much effect over velocity profiles. For sufficiently higher values the relation between the magnetic parameter and velocity profiles is properly linear. In both figures, it is noticed that as magnetic parameter increases the velocity profile decreases.

 ISBN: 978-81-931039-3-7

V. CONCLUDING REMARKS

The governing equations for unsteady MHD free convection fluctuating flow past an impulsively started isothermal vertical plate with radiation and viscous dissipation were formulated. Our work is important in geophysical flows and in certain industrial operations, which is usually characterized by the Eckert number. The plate velocity was maintained at a constant value and the flow was subjected to a transverse magnetic field. Numerical evaluations of the equations are done using Shooting method and some graphical results are obtained in PDE Solver Software.

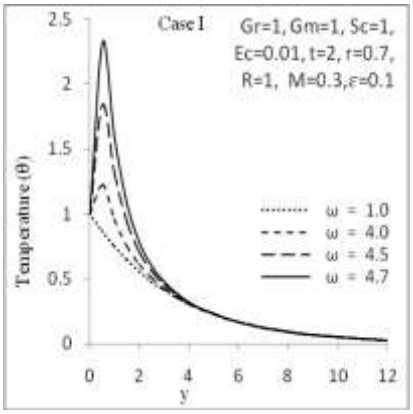

Fig. 1(a) Effect of Frequency of Excitation on Temperature Field

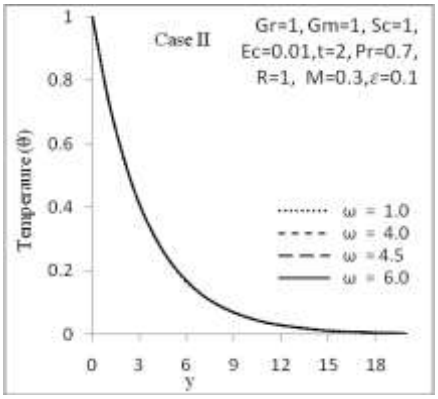

Fig. 1(B) Effect of Frequency of Excitation on Temperature Field

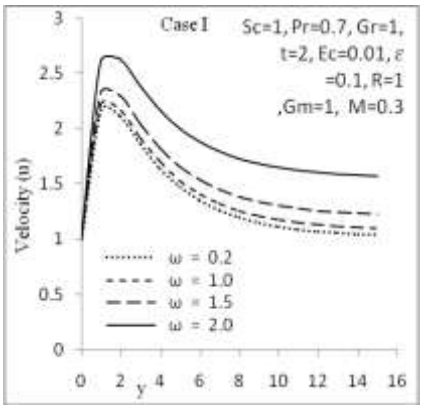

Fig. 2(a) Effect of Frequency of Excitation on Velocity Field

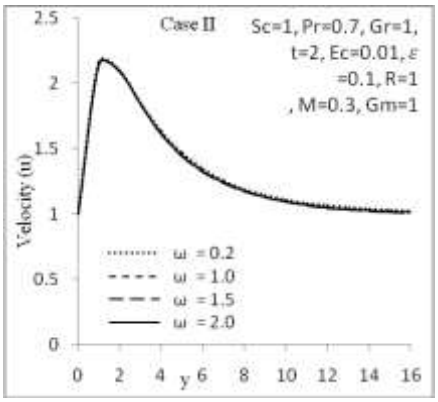

Fig. 2(b) Effect of Frequency of Excitation on Velocity Field

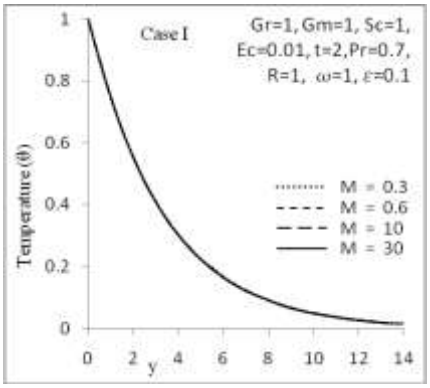

Fig. 3(a) Effect of Magnetic Intensi on Temperature Field

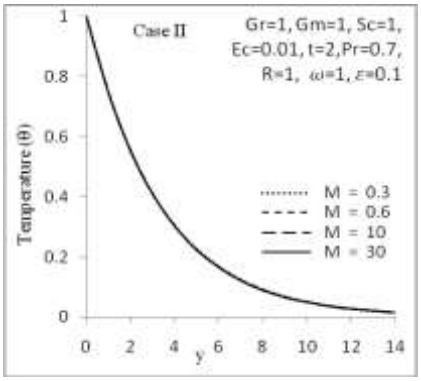

Fig. 3(b) Effect of Magnetic Intensity on Temperature Field

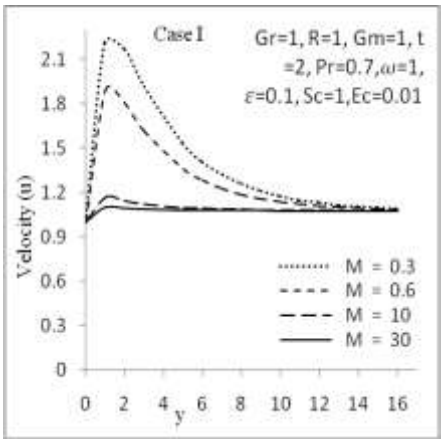

Fig. 4(A) Effect of Magnetic Intensity on Velocity Field

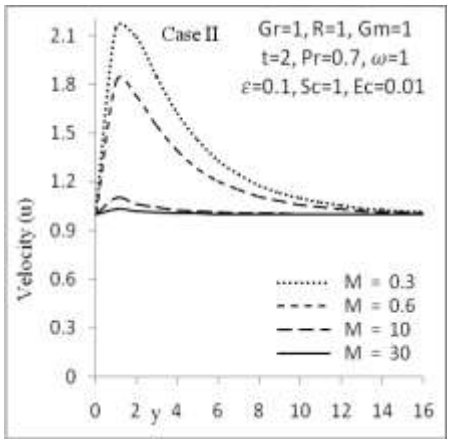

Fig. 4(B) Effect of Magnetic Intensity on Velocity Field

REFERENCES

[1]. M.A.Abd EI-Naby, M.E.Elbarbary Elsayed,Y. Abdelazem Nader, Finite difference solution of radiation effects on MHD free convection flow over a vertical plate with variable surface temperature. J. Appl. Mathematics, 2(2),2003,65-86.

[2]. M.Q. Brewster, Thermal Radiative Transfer and Properties. John Wiley & Sons. Inc., New York, 1992.

[3]. A.J.Chamkha,H.S. Takhar, V.M. Soundalgekar, Radiation effects on free convection flow past a semi-infinite vertical plate with mass transfer. Chemical EngineeringJ., 84(3), 2001, 335-342.

[4]. U.N.Das, R. Deka, V.M. Soundalgekar,Effects of mass transfer on flow past an impulsively started infinite vertical plate with constant heat flux and chemical reaction. Forschung Im Ingenieurwesen,60(10), 1994, 284-287.

[5]. C. Israel-Cookey, A. Ogulu, V.B. Omubo-Pepple, Influence of viscous dissipation and radiation on unsteady MHD free convection flow past an infinite heated vertical plate in porous medium with time dependent suction. Int. J. Heat Mass Transfer, 46(13), 2003, 2305-2311.

[6]. C. Israel-Cookey,C. Nwaigwe,Unsteady MHD flow of a radiating fluid over a moving heated porous plate with time dependent suction. American J. of Sci. Ind. Res.,1(1), 2010, 88-95.

[7]. F.S. Ibrahim, A.M. Elaiw, A.A. Bakr, Effect of the chemical reaction and radiation absorption on the unsteady MHD free convection flow past a semi- infinite vertical permeable moving plate with heat source and suction. Comm. Nonlinear Sci. Numer Simulat.,13, 2008,1056-1066.

[8]. P. Loganathan,P. Ganesan, Effects of radiation on flow past an impulsively started infinite vertical plate with mass transfer. J.Engineering Physics and Thermophysics, 79(1), 2006, 65-72.

[9]. R. Muthucumaraswamy, P. Ganesan, Flow past an impulsively started vertical plate with variable surface temperature and mass flux. Heat and Mass Transfer, 34(6), 1998, 487-493.

[10]. R. Muthucumaraswamy, Natural convction on flow past an impulsively started vertical plate with variable surface heat flux.Far East J. Applied Mathematics,14(1), 2004,99-109.

[11]. H. Schlichting,Boundary-Layer Theory,7th edition, MacGraw-Hill, 1979.

 ISBN: 978-81-931039-3-7

APPENDIX

$$m_1 = 0.5[1+\sqrt{(1+4M)}]$$

$$m_2 = 0.5[1+\sqrt{(1+4N_1)}]$$

$$m_3 = 0.5[N_2+\sqrt{(N_2^2+4N_3)}]$$

$$\alpha_1 = Gr/(N_2^2 - N_2 - M)$$

$$\alpha_2 = Gm/(Sc_2^2 - Sc - M)$$

$$\alpha_3 = \frac{N_2 m_1^2 (\alpha_1+\alpha_2)^2}{4m_1^2 - 2m_1 N_2}$$

$$\alpha_4 = \frac{\alpha_1^{\ 2} N_2^3}{2N_2^2}$$

$$\alpha_5 = \frac{\alpha_2^2 N_2 Sc^2}{4Sc^2 - 2N_2 Sc}$$

$$\alpha_6 = \frac{2m_1 N_2^2 (\alpha_1+\alpha_2)\alpha_1}{(m_1+N_2)^2 - N_2(m_1+N_2)}$$

$$\alpha_7 = \frac{2m_1 N_2\, Sc(\alpha_1+\alpha_2)\alpha_2}{(m_1+Sc)^2 - N_2(m_1+Sc)}$$

$$\alpha_8 = \frac{2\alpha_1\alpha_2 N_2^2\, Sc}{(N_2+Sc)^2 - N_2(N_2+Sc)}$$

$$\alpha_9 = -(\alpha_3 - \alpha_4 - \alpha_5 + \alpha_6 + \alpha_7 - \alpha_8)$$

$$\alpha_{10} = \frac{Gr\,\alpha_9}{N_2^2 - N_2 - M}$$

$$\alpha_{11} = \frac{Gr\,\alpha_3}{4m_1^2 - 2m_1 - M}$$

$$\alpha_{12} = \frac{Gr\,\alpha_4}{4N_2^2 - 2N_2 - M}$$

$$\alpha_{13} = \frac{Gr\,\alpha_5}{4Sc^2 - 2Sc - M}$$

$$\alpha_{14} = \frac{Gr\,\alpha_6}{(m_1+N_2)^2 - (m_1+N_2) - M}$$

$$\alpha_{15} = \frac{Gr\,\alpha_7}{(m_1+Sc)^2 - (m_1+Sc) - M}$$

$$\alpha_{16} = \frac{Gr\,\alpha_8}{(N_2+Sc)^2 - (N_2+Sc) - M}$$

$$\alpha_{17} = (\alpha_{10} + \alpha_{11} + \alpha_{12} + \alpha_{13} - \alpha_{14} - \alpha_{15} + \alpha_{16})$$

$$\alpha_{18} = \frac{2m_1 m_2 N_2\ (\alpha_1+\alpha_2)}{(m_1+m_2)^2 - N_2(m_1+m_2) - N_3}$$

$$\alpha_{19} = \frac{2\alpha_1 m_2 N_2^2}{(N_2+m_2)^2 - N_2(N_2+m_2) - N_3}$$

$$\alpha_{20} = \frac{2\alpha_2 N_2\, Sc}{(Sc+m_2)^2 - N_2(Sc+m_2) - N_3}$$

$$\alpha_{21} = -(\alpha_{18} - \alpha_{19} - \alpha_{20})$$

$$\alpha_{22} = \frac{Gr\,\alpha_{21}}{m_3^2 - m_3 - N_1}$$

$$\alpha_{23} = \frac{Gr\,\alpha_{18}}{(m_1+m_2)^2 - (m_1+m_2) - N_1}$$

$$\alpha_{24} = \frac{Gr\,\alpha_{19}}{(N_2+m_2)^2 - (N_2+m_2) - N_1}$$

$$\alpha_{25} = \frac{Gr\,\alpha_{20}}{(Sc+m_2)^2 - (Sc+m_2) - N_1}$$

$$\alpha_{26} = (\alpha_{22} + \alpha_{23} - \alpha_{24} - \alpha_{25})$$

 ISBN: 978-81-931039-3-7

RECONFIGURABLE FILTER BANK CHANNELIZER FOR SOFTWARE DEFINED RADIO

Prof. Anuradha S. Deshmukh

Department of Electronics & Telecommunication,

Datta Meghe Institute of Engineering Technology & Research Wardha, Maharashtra, (India)

ABSTRACT

The most computationally demanding block in the digital front end of a software defined radio (SDR) receiver is the channelizer which operates at the highest sampling rate. Reconfigurability and low complexity are the two key requirements of the SDR channelizers. A new reconfigurable filter bank (FB) architecture for SDR channelizers is proposed. The proposed FB offers reconfigurability at the architectural level and at the channel filter level and is capable of extractingchannels of nonuniform bandwidths corresponding to multiple wireless communication standards from the digitized wideband input signal.

Keywords: Software Defined Radio , Channelization . Digital Filter Banks . Reconfigurability, Low Complexity

I. INTRODUCTION

The fundamental idea of a software defined radio (SDR) is to replace most of the analog signal processing in the transceivers with digital signal processing in order to provide the advantage of flexibility through reconfiguration. The most computationally demanding block in the digital front-end of a software defined radio (SDR) receiver is the channelizer which operates at the highest sampling rate. Channelizers are employed in the SDR receivers for extracting individual channels (frequency bands) from the digitized wideband input signal. SDR can be regarded as an ultimate communications solution which can ideally cover any cellular communication standard in a wide frequency spectrum with any modulation and bandwidth. An SDR receiver typically employs a channelizer to extract multiple narrowband channels from the received wideband signal using digital filter banks. Since the filter bank channelizer is placed immediately after the analog-to-digital converter (ADC), it must operate at the highest sampling rate in the digital front-end of the receiver. Therefore, computationally efficient low complexity architectures are required for the implementation of the channelizer. The compatibility of the filter bank with different communication standards requires dynamic reconfigurability. Low complexity, high-speed, and reconfigurable channelizers are required in the SDRreceivers.

II. LITERATURE REVIEW

The per-channel (PC) approach is an efficient channelization approach, if the number of channels to be received is low [3]. But the complexity of the PC approach is directly proportional to the number of channels. Hence the PC approach is not efficient when the number of channels is large.

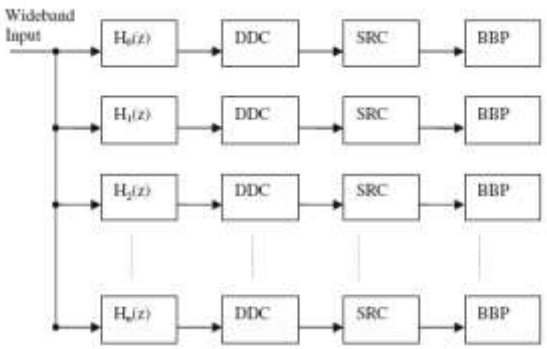

Figure 1: Per-Channel Approach Based Channelization

Uniform DFTFB can be realized by implementing one low-pass filter (LPF) and a corresponding modulator such as DFT. Thus instead of implementing N separate channel filters, a single LPF followed by DFT is only required [3]. The limitation of the DFTFB is that the channel filters have fixed equal bandwidths corresponding to the specification of a given standard. DFTFBs cannot extract channels with different bandwidths known as non uniform channels, because

they are modulated FBs with equal bandwidth for all bandpass filters. To use the same DFTFB for another standard, the sample rate at the input of the DFTFB must be

adapted accordingly. This requires additional sample rate converters (SRCs), which would increase the complexity and cost of DFTFBs.

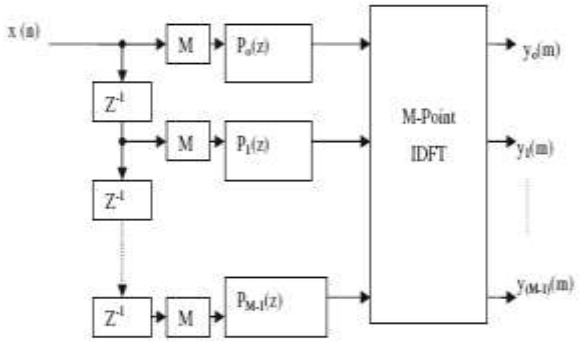

Figure 2 Dft Filter Bank

An FB channelizer based on modified Goertzel algorithm was proposed in [3] as a solution to the second problem (fixed channel stacking) of the DFTFB. We call the architecture in [3] as Goertzel filter bank (GFB) in the rest of this paper. Since the GFB is also a type of modulated FB, the first problem remains unsolved. In addition to the above three limitations reported in [3], a fourth limitation with the DFTFB and the GFB, related to the reconfigurability of the SDR receiver, can be stated as follows.

a) The prototype filter needs to be reconfigured. Generally DFTFB/GFB employs the polyphase decomposition. Hence reconfiguration can involve changing the number of polyphase branches and the coefficients which is a tedious and expensive task.

R. MAHESH et.al. in paper [3] entitled "Reconfigurable Low Area Complexity Filter Bank Architecture Based on Frequency Response Masking for Non uniform Channelization in Software Radio Receivers" proposed a new reconfigurable FB based on the FRM approach for extracting multiple channels of non uniform bandwidths. The FRM approach is modified to achieve following advantages: 1) incorporate reconfigurability

at the filter level and architectural level, 2) improve the speed of filtering operation, and 3) reduce the complexity.

III. PROPOSED RECONFIGURABLE FILTER BANK

3.1 Filter Level Reconfigurability

Filter reconfigurability means changing the coefficients of each filter in Fig. 1 according to the specifications of the new standard. It is well known that one of the efficient ways to reduce the complexity of multiplication operation is to realize

it using shift and add operations [9—11]. In contrast to conventional shift and add units used in previously proposed reconfigurable filter architectures, a binary common subexpressions (BCSs) based shift and add unit has been employed in the filter architectures. In [13], two new reconfigurable FIR filter architectures based on a binary subexpression elimination (BSE) algorithm [12] has been proposed. The architecture in [13] consisted of a shift and add unit which will generate all the 3-bit BCSs using 3 adders. In this paper, the architecture in [13] is modified for reducing its complexity In [13], the filter coefficients are stored in a LUT without any coding. As a result of this, if the first few bits are zeros, the adders employed in the architecture are unnecessarily used. . This problem is solved by incorporating a programmable shifter in the proposed reconfigurable FIR filter architecture.

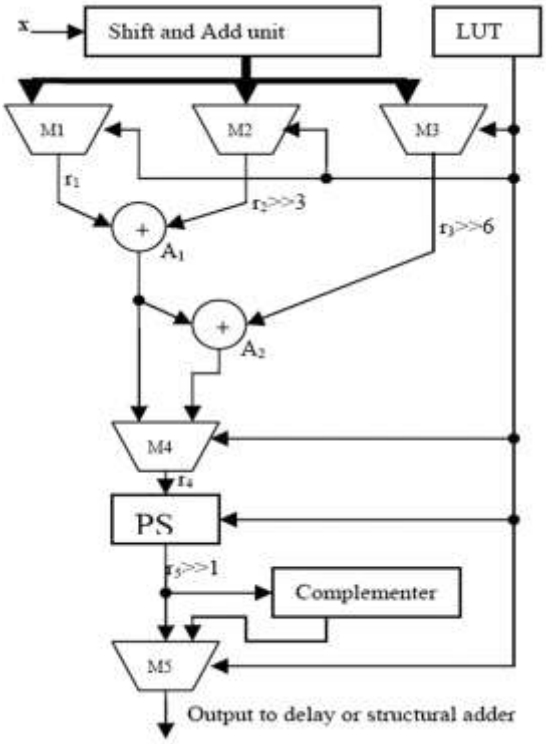

Fig.3. Proposed Reconfigurable Filter Architecture

The proposed architecture of the filter for an 8-bit coefficient is shown in Fig. 3. M1 and M2 are 8 : 1 multiplexers; M3 is a 4 : 1 multiplexer and M4 and M5 are 2 : 1 multiplexers. The input is given to the shift and add unit whose output is shared among the multiplexers. The architecture of the shift and add unit is shown in Fig. 4. The shift and add unitis used to realize all the 3-bit BCSs of the input Msignal ranging from [0 0 0] to [1 1 1]. In Fig. 4, "xÀk" represents the input x shifted right by k units. All the 3-bit BCSs [0 1 1], [1

0 1], [1 1 0], and [1 1 1] of a 3-bit number are generated using only 3 adders, whereas a conventional shift and add unit would require 5 adders. Since the shifts to obtain the BCSs are known beforehand, the shifts can be hardwired. All these eight BCSs (including [000]) are then fed to the multiplexer units as shown in Fig. 3. Thus the use of 3-bit BCSs reduces the number of adders needed to implement the shift and add unit compared with conventional shift and add units. The filter coefficients are stored in the LUT in a coded format SDDDDXXXXXXXX, where S is the sign bit, DDDD is the shift value of the most significant non-zero bit in the coefficient, and X represents the bit values after the coefficients are shifted left so that the most significant bit (MSB) to the right of the decimal point (position value corresponding to 2_{i1}) is always "1." position corresponding to 2_{i4}, thus DDDD = 0100 and the new coded format for storing the coefficient is 0**0100**10011*000*. It must be noted that 3 zeros are inserted in the coefficient to avoid the use of adder A_2 when the output of M3 is 0 (coefficient part is shown in italics). Each row in the LUT corresponds to one coefficient. The reconfigurability can be achieved by changing the coefficients in the LUT. If an adder is not selected by the multiplexer when the corresponding bits in the coefficient are zero, the corresponding adder will not be loaded and hence there will not be dynamic power consumption by the adder. Hence the proposed architecture will offer good savings in dynamic power.

IV. PROBABLE OUTCOME

- The proposed architecture will inherently be less complex with respect to area.
- The proposed architecture will have optimized delay.

V.CONCLUSION

The proposed FB architecture can be easily reconfigured for multi-mode operation. The FRM technique is modified to improve the speed and reduce the complexity. the proposed FB offers area reduction of 85%, power reduction of 48.5%, and improvement in speed of 56.7% over the PC approach. The proposed FB has been implemented on Xilinx Virtex 2v3000ff1152-4 FPGA and tested using real-time inputs from a vector signal generator. The proposed FB can extract nonuniform bandwidth and very narrow bandwidth channels compared with conventional FBs. Design examples show that the proposed FB offers complexity reduction of 84% over the conventional PC approach.

REFERENCES

[1] Hentschel, T.Channelization for software defined base-stations. Annales des,Telecommunications (May—June (2002)

[2] Pucker,L."Channelization techniques for software defined radio". Spectrum Signal Processing Inc,Burnaby B.C,Canada,Nov.2003.

[3] Mahesh, R., Vinod, A. P., "Reconfigurable Low Area Complexity Filter Bank Architecture Based on Frequency Response Masking for Non uniform Channelization in Software Radio Receivers" IEEE Transactions On Aerospace And Electronic Systems April 2011.

[4] R. Mahesh & A. P. Vinod & Edmund M-K. Lai & Amos Omondi, "Filter Bank Channelizers for Multi-Standard Software Defined Radio Receivers", J Sign Process System (2011).

[5] Fung, C. Y. and Chan, S. C. "A multistage filter bank-based channelizer and its multiplier Less realization." In Proceedings of IEEE International Symposium on Circuits and Systems, vol.3, Phoenix, AZ, May 2002.

[6] Abu-Al-Saud, W. A. and Stuber, G. L. "Efficient wideband channelizer for software radio Systems using modulated PR filter banks" IEEE Transactions on Signal Processing,2004.

[7] Lim, Y. C. "Frequency-response masking approach for the synthesis of sharp linear phase digital filters. IEEE Transactions on Circuits and Systems (Apr).

[8] Mahesh, R. and Vinod, A. P. "Reconfigurable low complexity FIR filters for software radio receivers." In Proceedings of 17th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Helsinki, Finland, Sept. 2006.

[9] Mahesh, R. and Vinod, A. P. "Reconfigurable frequency response masking filters for software radio channelization" IEEE Transactions on Circuits and Systems-II, 3 (Mar.2008).