RPAR: Pharaonis approach based Reserve Path Adaptive Routing Topology for handling QoS constraints in Mobile Ad hoc Networks

Shaik Jaffar[1], Dr.M.V Subramanyam[2]

[1]Associate professor, Madina Engineering college, kadapa, A. P, India,

[2]Principal, Santhi ram Engineering College, Nandyal, Kurnool Dist, A.P, India

Abstract:
Specially structured and independent nodes are the special the of Ad hoc. To exchange data, Nodes always use a medium which is wireless due to that, message or data can be transferred only when both are in broadcast range. The difficult behavior which needs no efforts is the result of biologically motivated pharaonis method. In spite of having limited knowledge and by following basic rules that were understood from surroundings, universally accepted activities like finding shortest route can be seen when individuals work as groups. With respect to this, our earlier proposal was the pharaonis approach called swarm intelligence based conditional broadcasting (SIBCAST) in mobile ad hoc networks. As per the motivation gained from our earlier work SIBCAST, here we propose another paper on Pharaonis approach based Reserve Path Adaptive Routing (RPAR) topology. The basic objective of this work is to handling the QoS constraints. We are using the earlier proposal algorithm that was inspired by biologically inspired pharaonis approach to obtain these characteristics, with the help of different analysis tests we will prove that this is the best choice when there are different situations.
Keywords: *Mobile ad hoc Networks, Pharaonis intelligence, swarm optimization, proactive and reactive routing, SIBCast, Reserve Path routing.*

1. Introduction

By using different paths in place of routing entire information through single path, Multipath routing topologies have differentiated with respect to performance and process when compared with single-path routing. Load management and minimizing failure were the major concerns eith respect to conventional multipath routing. Load management eliminates the problem of capability restrictions of a single route. This was possible as it transfers date through different routes. The multipath strategies application in mobile ad hoc networks are very natural, it controls the role of defective wireless links, minimizing any delay and achieve load management. Along with that as per the power and bandwidth restrictions, a fair distribution among the mobile hot is mandatory. But the existing routing topologies in this situation are single-path topologies which are not focusing on load management issue. An uneven transmission of data will not only result in delay in data processing but also consume excess energy. An on-demand multipath routing scheme was projected by Nasipuri et al [3] which will use different routes, whenever there is a problem with the main one. Multipath routing's performance with respect to load management is not exploited to the maximum extent. Only a Split Multipath Routing (SMR) was proposed by S.J. Lee et al, which was focused on the process of identify and use multiple paths that are available to use.

The primary concern of the multipath routing in ad hoc networks is considering the combinations of different routs while selecting the route. The importance of route combinations on Alternate Path Routing (APR) with respect to mobile ad hoc networks was examined by M. R. Pearlman et al [5]. The basic qualities of the channel like rout combination and the topology of the network will effect the advantages that can be enjoyed by the APR tactics. While transforming the data if the routs are placed physically very close to interfere with one another Route combination can be observed physically. As a result, multiple paths' nodes continuously struggle to enter in to the medium they distribute; in turn this will result in poor performance when compared with single route topology. That’s why node-disjoint routes will not be a appropriate in-order to enhance the results in this context.

In this paper we are exploring the similar and related work in section II. Later in Section III we will explore the proposed Pharaonis approach based Reserve Path Adaptive Routing topology. The considered basic routing topology SIBCAST will be detailed in Section IV. At the end in section V will provide the information about simulations, results analysis and conclusion of the proposal.

2. Related Work:

Sung-Ju Lee et al. [8] anticipated Split Multipath Routing (SMR) which is an on-demand routing scheme. Maximally disjoint routes' manifold routs are being setup-ed and used in this. By using manifold routs, cost of operations and recuperation process are controlled to the maximum extent. Through multiple routs the data packets will be transmitted as per packet scheduling process.

A2OMDV the extension to AOMDV, this was proposed by DUCKSOO SHIN et al. [9]. The systematic and standard route change of AOMDV is addressed in A2OMDV. The best path from the available multiple paths will be selected by the source node by establishing the condition of the node. At the time of delay, the A2OMDV will be performing in an improved manner through profound loads. An AODV protocol for multipath routing was projected by N. Jaisankar et al. [10]. In this paper scalability up-gradation and urbanization of multiple routes were discussed in this paper. The routing overhead acquired in sustaining the connection connecting source and destination nodes can be compact by formative the multiple paths in a single route detection. Due to the node mobility or battery failure, the main path possibly will fail. The secondary paths are used to pass on data packets so that extra overhead is produced by a new route discovery.

A "Link Optimization Ad-hoc On-demand Multipath Distance Vector Routing" (LOAOMDV) was projected by Bo Xue et al. [11]. In LOAOMDV, a novel route reply process can be placed using 4 bits information of the RREP packet. The mislaid reverse path is placed and the number of nodes shared between multiple routes is minimized. The average delay in transmission of packets from source to destination is minimized, network survivability is enhanced, the ratio of packets delivered can be improved and ratio of packet loss due to dropouts is minimized in this topology.

Juan J. G´alvez et al. [12] has proposed a spatially disjoint multipath routing protocol without location information. This routing protocol is also capable of measuring the distance among the routs along with determining the multiple paths. Every geographical region will be covered in this route identifying model.

According to Ash Mohammad Abbas et al. [13] in single route identification when a protocol identifies good number of node-disjoint routes the path minimization is inevitable. By applying these techniques path reduction is highlighted. In this work they have proved that in single route identification it is impossible to create a potential algorithm to evaluate all available disjoint nodes those could be available among the specific nodes.

To develop the available on demand routing protocols a different protocol was proposed by Kun-Ming Yu et al. [14]. In case of network topology transformation, the data packets will be transmitted dynamically in different support routs in these routing protocols.

Ant colony behavior and the related framework of Ant Colony Optimization (ACO) [16] have inspired to develop number of routing algorithms in routing topology SIBCAST [15]. One of such works is ACO routing algorithms are AntNet [17] and ABC [18].

For the wired networks ACO routing algorithm is being developed. Highly controlled and dispersed working style is incorporated here in this algorithm and they will adjust as per the transformation in traffic model. However the complicated and dynamic changes are there in MANETs: apart from this there will be dynamic changes with respect to varied nodes, traffic disparities, and the topology. The communal wireless channel's partial realistic bandwidth is one more source for added criticality. In spite of having the data transmission speed of wireless communication is high , IEEE 802.11 DCF [19] algorithms that are available in MAC, are creating a great overhead in all these cases delay and control packets, minimizing the bandwidth that are effectively available. Consequently there are huge autonomic control confronts, and in order to be sure with respect to a basic network function latest models are essential.

3. Reserve Path Adaptive Routing Topology based Pharaonis approach to manage QoS constraints.

i. Rout Trace Swarm Agent $RTSA$ will be transmitted by source node S when there is a need to have a route to node L and route is not known at source node S .
ii. Once $RTSA$ reaches L from S , $RTSA$ will be transmitted by L as Route Confirmation Swarm Agent $RCSA$, in backward manner $RTSA$ will

transmit through the parent $RTSA$ identified route. In the route from S to L the emission table and routing table of all the nodes will be updated by the $RCSA$. In order to record emission attribute value sav_{ni} of each forwarding neighbor ni every node n will maintain a emission table. Biological swarm agent's pheromone repository and the emission attribute value are similar in nature.

iii. SIBCAST will choose a different path in order to balance the load whenever there is a shortage of route in any intermediate node X.

iv. Based on hop level time taking record and hops count to be at destination, SIBCAST specifically selects the route by choosing to the best forwarding hop level neighbor ni whenever S knows the route at L

4. RPAR used SIBCast Topology [15]

For wired networks Swarm Agent Optimized routing algorithms stimulated SIBCAST's style. In an indirect agent interaction it applies swarm agents to update and follow emission tables to change the circumstances learning method. Indiscriminate routing of the knowledge packets with the learned tables is consistent. SIBCAST could be a hybrid algorithm when compared with alternative Swarm Agent Optimized routing algorithms, as it is primarily deal with specific tasks of Manet environments. As long as nodes individually get the routing information about destination that they are communicating with, it will be reactive, however it will be proactive due to the trail of the nodes to improve or at least maintain routing info till communication is on. We used to maintain difference among the test setup, like a pair of destination in the beginning of the session initial routing information will be at the reactive mechanism, and the regular mode of functioning such as route maintenance and improvement during the routing process will be proactively adapted to changes in network. In order to provide the steerage to the swarm agents the routing info collected through indirect agent interaction is distributed among the nodes of the Manet in hop level neighbor. Herewith in the following information we are offering a detailed analysis and discrimination of the SIBCAST.

Wired networks' swarm agent optimized routing algorithms has stimulated the SIBCAST. In this emission tables are followed and updated through indirect agent interaction with respect to changes in the circumstances learning process. In order to accomplish this task swarm agents are being used in this system. Accord to the updated table's data packets are transmitted orderly. The basic advantage of the SIBCAST when compared with remaining Swarm Agent Optimized routing algorithms is, it is a hybrid algorithm, this quality will fetch while dealing with the specified MANET confronts. In general node will only get the routing details for destinations that they corresponding at present, where as SIBCAST is proactive as nodes are active in maintaining and improving rout information till communication is on. We brought difference among the route setup, that is on demand system to get initial routing details about a target at the beginning of a session, and perfection and route management, which is an actual and regular process through the course of a session to proactively acclimatize to network changes. In a hop level neighbor information exchange process routing information procured by using indirect agent interaction learning distributed among the node of Manet in order to furnish secondary instructions for the Swarm agent. Each of these components are described here under in a concise manner. .

4.1 SIBCAST Pheromone Indicator

The emission tables that are placed at regionally at all nodes, outlined the routes. At node i in emission table ST_i an entry g_{ni} that consider as pheromone demonstrate the quality of the routing from node i to through subsequent node ni consists a price representing the estimated quality of transforming from i over neighbor ni to reach target d. This quality is achieved with the collaboration of range of hopes and route end-to-end delay. In ad hoc networks with mobility factor, these are very regularly used quality standards. Joining the plenty of hops with end-to-end delay among current node i to immediate node ni and target node d is a procedure to clear out predicted great movements within the estimated time collected by the swarm agents. As SIBCAST all alone manages the information about destinations which are live at the time of communication, more over due to the nodes conversion, emission table will be highly dynamic with respect to filling.

4.2 Route Detection in SIBCAST

The route to node d will be determined by the source node s and that will be through Route Trace Swarm Agent $RTSA$. At every adjacent hop that got $RTSA$, will transmit the received one to the other hops. This application is a continuous process for all $RTSA$ as long as it doesn't reach the required targeted node d. As and when getting the $RTSA$, the targeted node d will initiate to transfer Routing-route Confirmation Swarm Agent $RCSA$ which is developed from $RTSA$. Once the route discovery accomplished by origin $RTSA$, $RTSA$ will transmit in backward manner. In the routing route after going through every node i, in the routing route selected by $RTSA$, pheromone indicator value g_{ni} of relay hop node ni of the present node i will be updated by $RCSA$. The pheromone indicator value updating procedure is as follows:

While swarm-agent $RCSA$ is getting transmitted, it will gather information about the time $t_{ni\to i}$ spent to arrive at every node i from relay hop node ni the '$RCSA$'is transmitting from. By using equation (a) the calculated time $t_{i\to d}$ to send a data packet to target node d from node i through $\{ni, ni+1, ni+2 ... ni+n\}$ will be measured.

$$t_{i\to d}^{ni} = t_{(ni+n)\to d} + \sum_{k=n}^{1} t_{(ni+k-1)\to(ni+k)} \ldots\ldots \text{(a)}$$

By using equation (b) and (c) the pheromone indicator value will be calculated

$$\left(t_{i\to d}^{ni}\right)' = \left[t_{i\to d}^{ni}\right]^{-1} * 100 \ldots\ldots \text{(b)}$$

$$g_{ni} = \frac{\left(t_{i\to d}^{ni}\right)'}{hc_{i\to d}^{ni}} \ldots\ldots \text{(c)}$$

In the above equation (c), $\text{hc}_{\text{i}\to\text{d}}^{\text{ni}}$ represent the hop count in route to target node d from present node i through relay hop node ni.

For a data packet to travel to targeted node d from node i the inverse value of the estimated time $t_{i\to d}^{ni}$ represents the effectiveness of the route among nodes i to targeted node d through relay node ni. So the equation (b) is important.

After getting Swarm agent $RCSA$, emission table of the source node s will be updated with pheromone indicator value g_{ni} of all adjacent hop ni.

4.3 QoS Constraints handling Strategy

A. Adaption of the Reserve path:

For route discovery we change the SIBCAST's proactive approach. In broadcasting manner to the targeted node n_d the source node n_s will identify the path. The relay node information will be carried by the broadcasted route request $rreq$ packet which can be participated in routing path. While passing these packets of route request $rreq$, the overhearing nodes of each relay node will be recognize by the transport layer and then route request $rreq$ will carry that. Route response $rrep$ packet will be prepared as and when the targeted node gets this route request $rreq$ then a list of relay nodes and their over hearing nodes will be developed. Therefore as they get a route response packet, every relay node will modify its routing table with all adjacent node information, and the list of overhearing nodes of that node and successor node in the routing path. Once the route response $rrep$ packet received by the source node n_s, optimal path will be selected. Relay node identity acknowledgement $ack(pn)_i$ will be sent by the source node n_s for the selected routing path's relay node pn_i. The relay node pn_i will send a request for route $rreq$ to pn_{i+2} while relay node pn_i is trying to find appropriate paths among relay node pn_i and two hop level following relay node pn_{i+2}, after getting relay node identity acknowledgement $ack(pn)_i$. From overhearing nodes of the relay node pn_i and relay node pn_{i+1} only route request $rreq$ will be broadcasted. pn_{i+2} will develop route response $rrep$ and sends to pn_i through the path selected by $rreq$ after getting the route request from pn_i. So after realizing route response $rrep$, pn_i identifies a suitable path between relay nodes pn_{i+2} and pn_i, at the end it will be stored in the routing table. For the path restoration between nodes $pn_i \; and \; pn_{i+2}$ the identified required path is being used , path restoration will take place among pn_i *and* pn_{i+2} as any congestion is identified at pn_{i+1} and couldn't be controlled.

B. RPAR topology

i. $rreq$ will be prepared by n_s and will be broadcasted it to the neighbor leap level nodes
ii. After getting $rreq_i$ a leap level node n_i verifies that $rreq_i$ is broadcasted by it or not.
iii. If found that the $rreq_i$ broadcasted earlier, then $rreq_i$ will be discarded by n_i, otherwise from the transport layer n_i will collect information about neighbor leap nodes and includes its details and identity of leap nodes to '$rreq_i$', then broadcasts $rreq_i$. This process is iterative at each node that receives $rreq$ until it reaches the targeted node n_d.
iv. Upon receiving $rreq_i$ the targeted node n_d initiates the transmission of a packet $rrep_i$, which indicates the route response packet that will have the information about the nodes traversed by $rreq_i$ to reach n_d and about their all leap nodes. The route followed by route request $rreq_i$ is used in backward manner by $rrep_i$ to reach source node n_s.
v. In the routing path the details about antecedent node an_{i-1}, successor node an_{i+1} and overhearing nodes of present relay node an_i will be collected in every in between node an_i of the path that utilized route response packet $rrep_i$.
vi. With the information gathered in the earlier stage relay node $an_i\infty$ will update its outing table.
vii. Till response packet reaches the source node n_s, the process mentioned in steps 6 and 7 will be recurrent.
viii. Required path that contains optimal nodes will be identified by Source node n_s.
ix. "n_s" transmits $ack(an)_i$ for $i = 1..n$ in the selected path for all relay nodes 1 to 'n'.
x. After getting $ack(an)_i$, pn_i will instantiate to identify different available paths between an_{i+2} and an_i, so that the other path must be using only overhearing nodes of the 'an_{i+1}' and 'an_i'.
xi. Then at routing cache substitute path flanked by an_i *and* an_{i+2} will be stored by an_i.

4.4 Routing Route maintenance

The end to end delay for data packet dp_i will be measured after verifying the time $t(dp_i)$ taken by dp_i to travel from source node s to destination node d by the destination node d after getting a packet dp_i. a swarm agent $RCSA$ will be initiated when the delay of dp_i is more than the delay threshold τ, then it starts and transfers towards source node that prefers the route used by data packet dp_i. The process of updating pheromone indicator value g_{ni} at each hop level relay node in the route will be performed by '$RCSA$'. This process is discussed previously in equations (a), (b) and (c).

4.5 Handling link failures

in fixed time gap to every neighbor relay leap node a swarm agents $RCSA$ will be initiated by the targeted node d. Due to that there will fixed time interval ς will for updating the emission table with the pheromone indicator values.

If time since last update of g_{ni} is more than time interval ς in emission table of any node i the pheromone indicator value of any neighbor relay hop ni is not valid . This represents the failure of the link between node i and targeted node d.

5. EXPERIMENTAL RESULTS

By prototype model that build using NS2[20] the discussed Pharaonis approach based Reserve Path Adaptive Routing (RPAR) topology for QoS constraints (due to congestion) management is examined. In this work process, 2 Mbps value is set to the channel capacity of mobile hosts. DCF (Distributed Coordination Function) of IEEE 802.11 represented MAC layer protocol in this simulation model. Link failure in routing process will be identified by this DCF.

Within the range of 30 to 110 are being used to perform simulations. In every set of simulation we increased the number nodes by 10. 1100 meter X 1100 meter network area is considered in simulations where as simulation time is only for 60 seconds. The deviation of node mobility direction is not being considered because this simulation model is using Random Way Point mobility model. 200 meters among every two hop level nodes is the maximum communication coverage range. 10 to 50 m/s is range of the node mobility. Constant Bit Rate (CBR) is the traffic simulated. The parameters summary used in simulation model detailed in table 1.

Table 1: Simulation parameters

No. of Nodes	30 to 110, with increment of 10 nodes for each sequence
Area	1100 X 1100
MAC	DCF of 802.11
Radio range	200 mtrs
Simulation time	60000 milli seconds
Traffic source	CBR
Rate	0.25 kb/ms
Packet size	512 B
Mobility model	Random way point
Speed	10 to 50 m/s
Pause time	5000 milli seconds

5.1 Performance Analysis

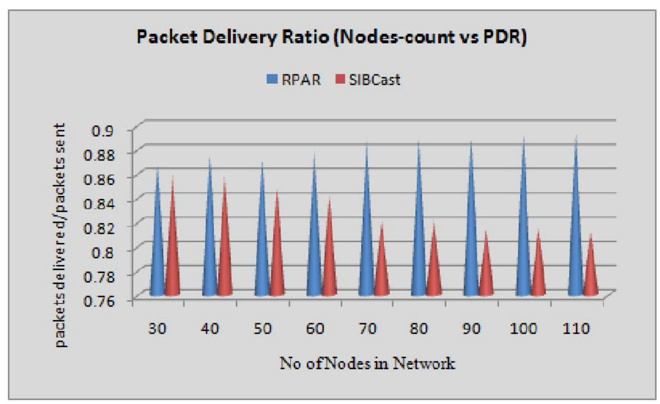
With the proposed RPAR protocol we have compared the Swarm Adaptive Hybrid Routing Topology [15]. As per the following conditions we have examined the performance of the RPAR.

Control overhead: Overall number of routing control packets normalization through the overall set of received data packets.

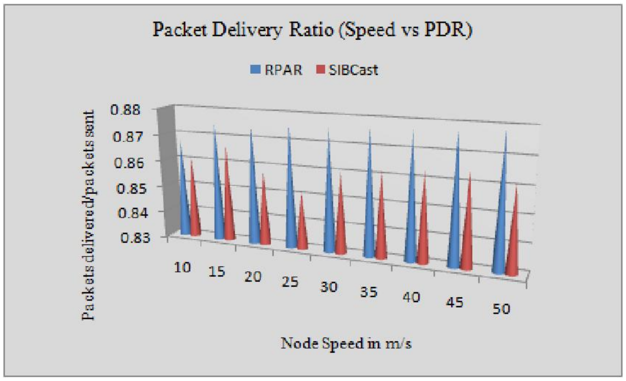
Average Packet Delivery Ratio: The number of packets routed and total number of packets delivered ratio. The observations of the simulation are as follows.

The ratio of packets delivered against to the number of packets sent is a key parameter to indicate the performance of any routing strategy. This is exemplified for SIBCAST [15] and RPAR (see figure 1). By contemplating this output it is adequate to confirm that RPAR deals with utmost inability of achieving PDR by SIBCAST. Quite appropriate catastrophe amount of PDR that is restored by the RPAR than SIBCAST is 1.5%. This is stable volume amongst the pause intervals. The minimal PDR hike inspected is 0.12% and the maximal is 3.04%.

RPAR is having minimal routing overhead than that SIBCAST as observed in Figure 2. This gain of the RPAR is due to the usage of of efficacious routing procedure with multiple substitute routes. The routing overhead ascertained in SIBCAST is almost 5.3% larger than routing overhead revealed in RPAR. The slightest and uppermost routing overhead in SIBCAST than RPAR anticipated as 4.59% and 8.97% correspondingly.

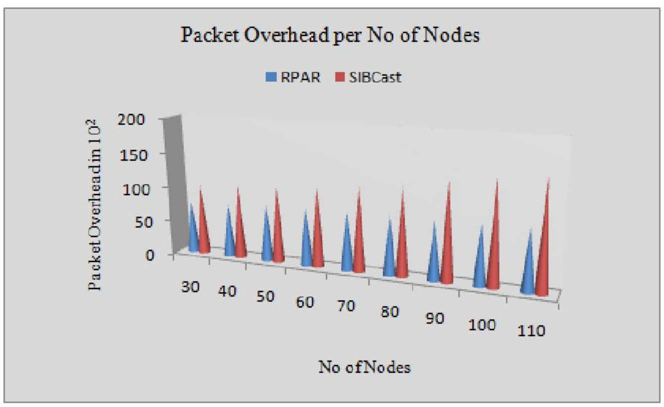


1(a) The Packet Delivery ratio observed against divergent number of nodes involved in routing

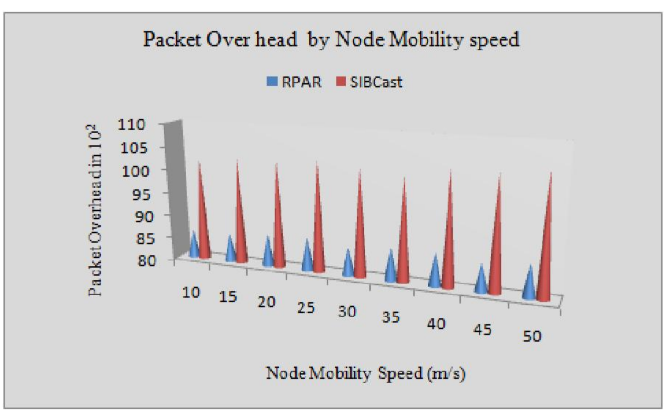


1(b) Packet Delivery Ratio Observed against divergent node mobility speed

Figure 1: Packet Delivery Ratio comparison between SIBCAST[15] and RPAR



2(a): Packet Overhead Observed against number of nodes involved in routing



2(b): Packet Overhead Observed due to Node Mobility Speed

Figure 2: Overhead comparison of RPAR with SIBCAST

6. CONCLUSION

Herewith in this paper for QoS obstacles arose because of congestion in Mobile Ad Hoc Networks we initiated Pharaonis approach based Reserve Path Adaptive Routing (RPAR) Topology. Previous work that we have exhibited is a routing topology SIBCAST [15] developed for establishment of core level process of route after proper search. To coordinate the endurance congestion with respect to the load at the time of route maintenance process, we initiated a novel routing with substitute routes model, and that yield very good results. After deciding the route based on the MAC Layer congestion and load indications the data packets will be routed through different paths. In order to highlight the congestion the load managing technique is executed in the system. As per the results we got in testing the proposed protocol is yielding better results than the SIBCAST core level protocol. It is producing the better results in stipulations of PDR by control overhead and low delay when there is an increase in the speed of the mobile and network size.

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S.JAFFAR M.Tech, M.I.E, M.I.S.T.E (Ph.D) Currently working as Associate Professor Head of ECE Department at MADINA ENGINEERING COLLEGE KADAPA YSR DISTRICT KADAPA , A.P

Dr.M.V.Subramanyam received his B.E degree in 1989, M. Tech degree in 1997 and PhD degree in 2007. Presently he is working as a 'Principal' and 'Professor' of 'Electronics and Communication Engineering' department of Santhi Ram Engineering College, Nandyal, Kurnool district, Andhra pradesh, India. He is having more than 23 years of teaching experience. His areas of interest are Adhoc Networks, Computer Networks, Advanced Communications, Signal Processing, Image processing, Embedded Systems and Microcontrollers. He has published more than 40 papers in national and international, conferences and international journals. He is a life member of ISTE, IEEE, IETE, IEI and KDTFM.