IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 18, Issue 4, Ver. I (Jul.-Aug. 2016), PP 11-17
www.iosrjournals.org

Implementation of an efficient algorithm to enhance connectivity and lifetime in wireless sensor networks

Channakrishnaraju[1], Dr. M.Siddappa [2]
[1](*Research Scholar, Sri Siddhartha Academy of Higher Education [SSAHE], Tumkur, India)*
[2](*Professor & Head, Dept. of Computer Science & Engg. Sri Siddhartha Institute of Technology, Tumkur, India)*

Abstract: *Wireless sensor network is a rapidly growing area for research and commercial development. Wireless Sensor Network (WSN) is a major and very interesting technology, which consists of small battery powered sensor nodes with limited power resources. The sensor nodes are inaccessible to the user once they are deployed. Replacing the battery is not possible every time. K-means algorithm will provide better results in terms of network lifetime enhancement and connectivity. A new cost function has been defined in K- means algorithm to minimize the intra-cluster distance by dynamically updating cluster head to enhance connectivity of the network. The connectivity and energy consumption are the key issues in wireless sensor network are reviewed in this paper. The proposed k means algorithm provide optimum network lifetime and connectivity. The three performance metrics Energy Consumption, Network Lifetime and End to End delays are considered for comparison between existing system and proposed system. Proposed system shows better results than existing one. Energy consumption of nodes is 16 Joules in existing system, whereas in proposed system is 12 Joules. Lifetime of Network has been increased by 83% in existing system, whereas 96% in proposed system. End-to-end delay in existing system is 3.7 sec and for proposed system is 2.7 sec.*
Keywords: *Cluster, Connectivity, K-Means algorithm, Lifetime, Wireless sensor network*

I. Introduction

A wireless sensor network consists of a number of wireless sensor nodes. Wireless sensor networks are a rapidly growing area for research and commercial development. Wireless Sensor Network (WSN) is a self-organized network of tiny computing and a communication device (nodes) has been widely used in several un-attended and dangerous environments. Recent advances in hardware miniaturization, communication technologies, and low-cost mass production have facilitated the emergence of wireless sensor networks (WSNs).The nodes does wireless communication and often self-organize after being deployed in an adhoc fashion. Such systems can revolutionize the way we live and work. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring. A promising WSN application is long-term surveillance in hostile or distant environments. Network structure, Data aggregation, Data compression, routing protocol, Scheduling activity in this paper we are considering problem of enhance the connectivity and network lifetime of WSN using K means Algorithm. K-means algorithm will provide optimum network lifetime enhancement and a new cost function has been defined in K- means algorithm to minimize the intra-cluster distance by dynamically updating cluster head to enhance connectivity of the network. The connectivity and energy consumption issues in wireless sensor network are reviewed in this paper. The proposed k means algorithm provide optimum network lifetime and connectivity.

In this paper section II presents the previous work done by various researchers. Section III has the comparison of existing system to proposed system in system analysis and Section IV present in brief about system implementation. Section V has simulation information and results. Section VI contains the conclusion of the work presented.

II. Related Work

WSN lifetime problem include network structure [1], sensor activity scheduling [2, 3] data aggregation [4, 5, 6], data compression [7], and routing protocol [8, 9, 10].Wireless Sensor Network (WSN) comprises of tiny sensor nodes with very limited initial energy and are deployed in sensing area of particular intersect to fetch necessary environment data and sending it back to end user via base station. One of the major issues in WSN is energy efficient coverage in which any loss of data due to lack of energy or power in sensor node. Such situation may occur due to over burden on nodes when unbalanced cluster are formed leading to extra communication overhead [11]. Wireless sensor networks are used to perform sensor measurements under a variety of conditions. In settings with sparse distribution of sensor nodes, multi-hop routing is traditionally used to forward information from a source node to a destination node. A problem with this approach is that loss of connectivity of nodes in the path between source and destination may lead to a partitioning of the network [12]. Coverage and connectivity both are important in wireless sensor network (WSN). [13] The impact of sensing model of nodes on the network coverage is investigated. Also, the dependency of the connectivity and coverage on the shadow fading parameters. It has been observed that shadowing effect reduces the network coverage while it enhances connectivity in a multi-hop wireless network. The data collected from individual nodes is aggregated at a base station. Secure data aggregation process can also enhance the robustness and accuracy of information. Iterative filtering algorithm is one of the algorithms to perform secure data aggregation and also provides security to the entire network. Iterative filtering simultaneously aggregation data from multiple sources and provide trust assessment of these sources, in the form of corresponding weight factor assigned to data provided by each source[14].The sensor nodes will be divided into small groups, which are called as clusters. Each cluster will be having a cluster head which will monitor the remaining nodes. Nodes in a cluster do not communicate with the base station directly. They sense the data and send it to the cluster head. The cluster head will aggregate this, remove the redundant data and transmit it to the base station. So the energy consumption and number of messages transmitted to the base station will be reduced and number of active nodes in the communication is also reduced. Firefly algorithm seems to be a favorable optimization tool phenomenon due to the effect of the attractiveness function, which is a unique to firefly behavior [15]

III. System Analysis

Jumper firefly algorithm is one of the Meta heuristic algorithms which are used to solve optimization problems. Firefly algorithm is such a population-based algorithm so that their group behavior and interaction result in a swarm intelligence that is used to find the best fittest firefly. The probability of obtaining eligible and suitable solutions is qualified population is high. Mahdi Bidar and Hamidreza Rashidy Kanan[16] developed a new algorithm called Jumper firefly algorithm based on firefly algorithm that to improve the performance of the agents in determining more appropriate solutions by modifying them. For this process, they have used a Status Table, which records and observes all the details of the fireflies behavior .This status table helps to indicate the agents that have to be changed in their situations by jumping into new situations. Firefly algorithm seems to be a favorable optimization tool phenomenon due to the effect of the attractiveness function, which is a unique to the firefly behavior. Firefly not only includes the self-improving process with the current space, but it also includes the improvement among its own space from the previous stages. The above system having some demerits such as the existing iterative filtering algorithms consider simple cheating behavior by adversaries, none of them take into account sophisticated malicious scenarios such as collusion attack. Adversaries/Hacker May hack the data by injecting false data into the original. Existing researches did not combine data confidentiality, data integrity and false data detection together well.

The proposed system k-Means is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed a priority.

The main idea is to define k centroid, one for each cluster. These centroids should be placed in a cunning way because of different location causes different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest centroid. When no point is pending, the first step is completed and an early group age is done. At this point it is necessary to re-calculate k new centroid as bar centers of the clusters resulting from the previous step. After obtaining these k new centroid, a new binding has to be done between the same data set points and the nearest new centroid. A loop has been generated. As a result of this loop, one may notice that the k centroid change their location step by step until no more changes are done. In other words centroid do not move any more.

The k Means algorithm can be run multiple times to reduce this effect. K Means is a simple algorithm that has been adapted to many problem domains and it is a good candidate to work for a randomly generated data points. One of the most popular heuristics for solving the k-Means problem is based on a simple iterative scheme for finding a locally minimal solution. This algorithm is often called the k-Means algorithm. This algorithms has merits over the previous algorithm such as K-means is relatively scalable and efficient in processing large data sets ,The computational complexity of the algorithm is O(nkt) ,More accurate and faster converge, Reliability and trustworthiness of the data received from each sensor node and Secured than the existing systems.

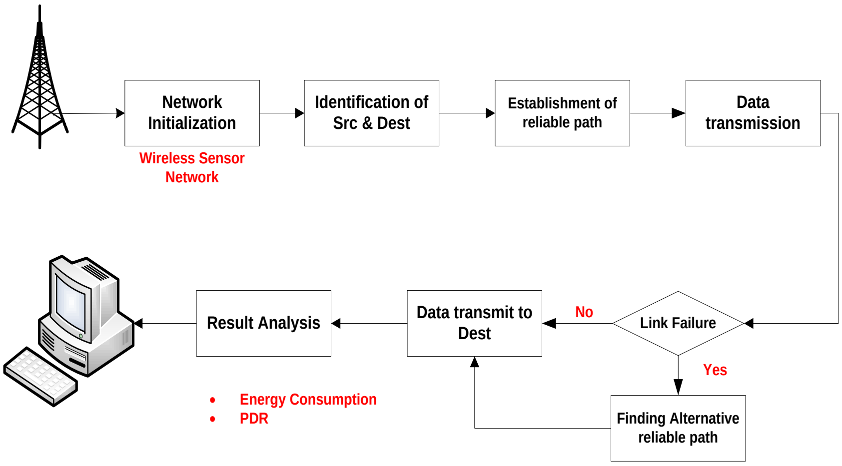

Fig 3.1 -Proposed architecture

The proposed architecture is as shown in the Fig 3.1 and it consists of:
Network Initialization: Here Network can be initialized with some number of nodes say(N =20), along with the area of 100*100, node can be characterized using xloc and yloc with initial node properties, here initial energy of the node is 100j, and also nodes can be identified using Unique identity number. **Source and Destination Selection**: After Network initialization next step is to select source and destination for transferring information from source to destination. And these nodes can be selected from users dynamically.

Reliable Path Selection: In this phase Reliable Minimum Energy Cost Routing (RMECR) for networks with hop-by-hop (HBH) retransmissions providing link layer reliability, and networks with E2E retransmissions providing E2E reliability. It considers the impact of limited number of transmission attempts on the energy cost of routes in HBH systems and also here it consider the impact of acknowledgment packets on energy cost of routes in both HBH and E2E systems. Finally considers energy consumption of processing elements of transceivers. As mentioned earlier, underestimating the energy consumption of transceivers can severely harm reliability and energy-efficiency of routes. A detailed consideration towards various aspects of the energy consumption of nodes makes our work realistic and thus closer to practical implementations our objective is to find reliable routes which minimize the energy cost for E2E packet traversal.
Data Transmission: After finding reliable routing using Reliable Minimum Energy Cost Routing next step is to transfer data, data of maximum 1000kb can be transferred to the destination. If any link failure occurs while transmitting data it finds alternate reliable path by using RMEC routing.5.
Alternate path: When link failure occurs in middle of data transmission then by using RMEC routing another most reliable path is selected and by using that path data is transferred to desired destination.
Receiving data : After successfully receiving data to the destination point that data is analyzed in next step.
Result analysis: In this step, analysis of the total energy consumption by the total process of data transformation from source to destination and check the packet delivery ratio.

Algorithm for k-means

1: Arbitrary choose k objects from D as in initial cluster center
2: Repeat
3: Reassign each object to the most similar cluster based on the Mean value of the objects in the cluster
4: Update the cluster means
5: Until no change

Algorithm for Caesar Cipher

1: First translate all the characters to numbers, 'a'=0, 'b'=1, 'c'=2' .... z'=25.
2: Represent the Caesar cipher encryption function, e(x), e(x)=(x + k) (mod 26) Where x is the character we are encrypting, Where k is the key (the shift) applied to each letter
3: After applying this function the result is a number which must then be translated back Into a letter. The decryption function is:
$e(x) = (x - k) \pmod{26}$

IV. System Implementation

The system is having four models such as Network Initialization, Cluster head, Channel allocation and Data aggregation

Network Initialization: In the network initialization the nodes 'n' are deployed randomly in the networks. Consider a network consisting of a fixed base station (BS) and a large number of wireless sensor nodes, which are homogeneous in functionalities and capabilities

Cluster head:

The cluster head formation is based on the distance between the nodes to the base stations using k Means algorithm. A cluster head is formed to a cluster or a group of nodes for the easier communication between the nodes and base station. All the data that needs to be passed to the base station will be sent to the cluster head and then to the base station. Distance from the each node is calculated first to make the cluster head to the particular cluster.

Channel Allocation In this phase a channel is allocated between the cluster head and its nodes inside the cluster. Load balancing of each node and residual energy of each node is checked afterwards route is established between node and cluster head .'j' numbers of channel are allocated for the 'j' number of nodes in a cluster .

Data Aggregation:

It has two phases. One is to aggregate the data from nodes to the cluster head. Another one is aggregating data from cluster heads to the base station. Data is encrypted at the nodes before sending it to the cluster head. This encrypted data is transferred to the base station. In the base station data is decrypted. And while transferring data energy consumed by the each node is calculated.

V. Simulation

The series of experiments are conducted for 15,20 and 25 number of nodes using mat lab to estimate Energy Consumption, Network Lifetime and end-to-end delay of WSN. The simulation platform is MATLAB 7.6.0 on top of Windows XP.

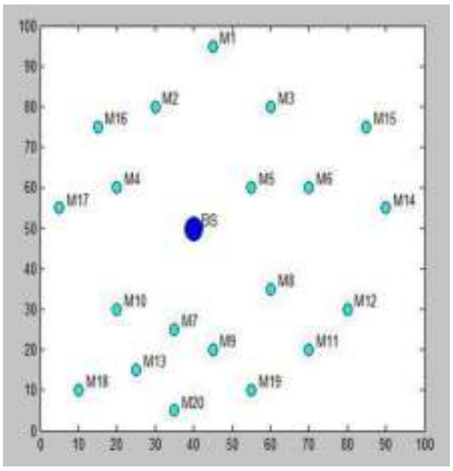

Fig 5.1 Network Initialization

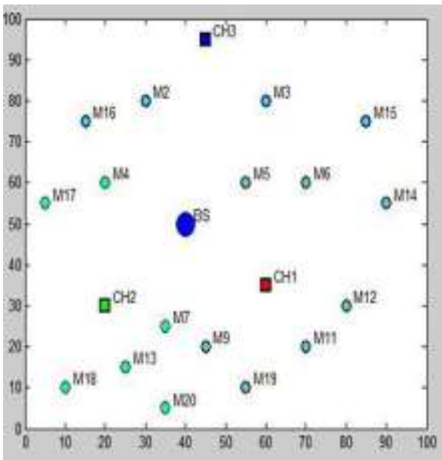

Fig 5.2 Formation of Cluster Head

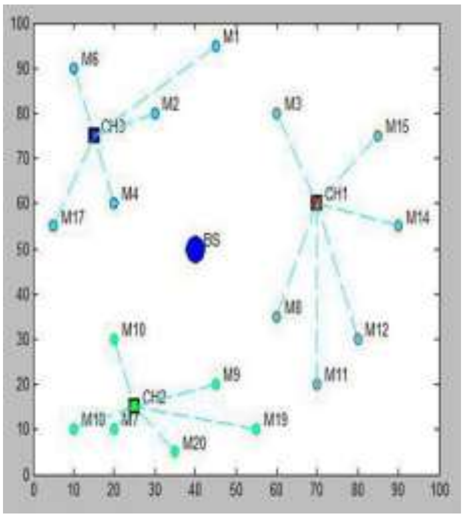

Fig 5.3 Channel Allocation

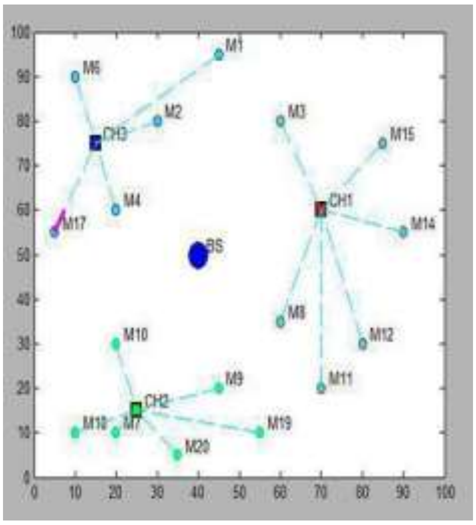

Fig 5.4 Data transferring

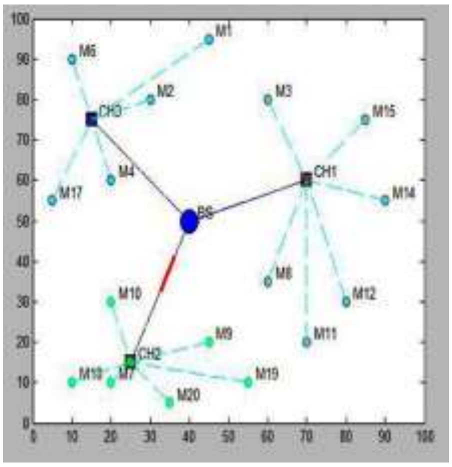

Fig 5.6 Data Aggregation

Proposed graphs:

1. Energy Consumption

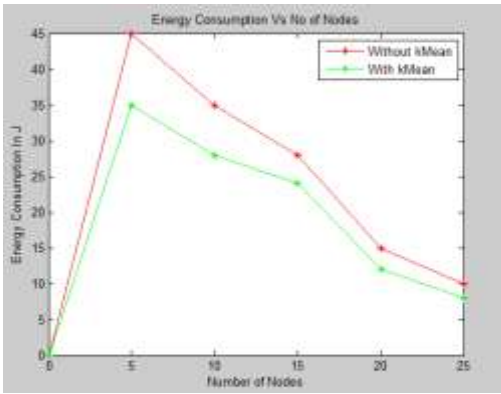

Fig 5.7 Energy Consumption between existing and proposed

This graph shows that the proposed algorithm K mean which is being represented in green color consumes the less energy with respect to the existing algorithm Jumper Firefly which represented in a red color.

2. Lifetime

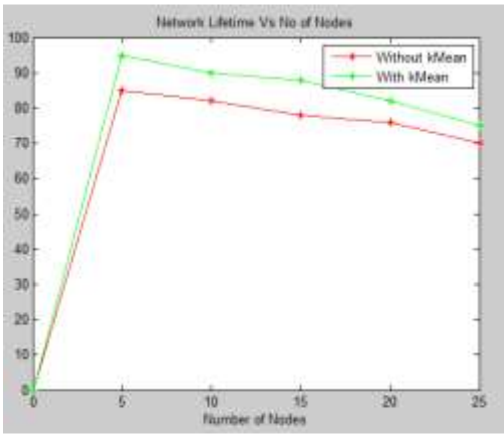

Fig 5.8 Network Lifetime

This graph shows that the proposed algorithm K mean which is being represented in green color has the more lifetime with respect to the existing algorithm Jumper Firefly which represented in a red color.

3. Node Delay

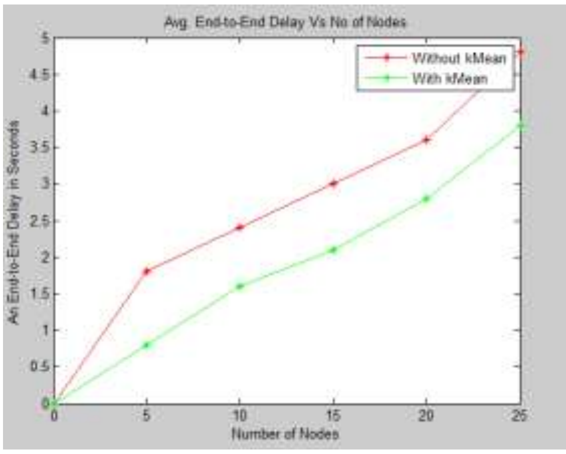

Fig 5.9 End-to-End delay

This graph shows that the proposed algorithm K mean which is being represented in green color has the more lifetime with respect to the existing algorithm Jumper Firefly which represented in a red color.

This Work concentrate on three performance matrices for comparison between existing system and proposed system; they are Energy Consumption, Network Lifetime and end-to-end delay. Proposed system shows better results than the existing system. Energy consumption of nodes is 16 Joules in existing system, whereas in proposed system is 12 Joules. Lifetime of Network has been increased by 83% in existing system, whereas 96% in proposed system. End-to-end delay in existing system is 3.7 sec and for proposed system is 2.7 sec

VI. Conclusions

In wireless sensor networks energy consumption is a major parameter that can be achieved by cluster formation using appropriate algorithms. Here we have used k means to reach our requirements. Hence target algorithms provide the improvements in the network performance parameters in terms of network lifetime and node connectivity. One of the major advantages of k-means is, it can applied to the randomly generated sensor nodes. As soon as new node is entered cluster head will be dynamically updated which leads to the decrease in distance between leaf nodes and cluster head by which network connectivity is enhanced. For the security of the data encryption and decryption will be done while sending and receiving the data respectively. For this we are making use of *Caesar* cipher algorithm. The calculations and simulations are provided to illustrate the efficiency of the proposed protocols. In future, the work is extended to ZIP and Unzip functions in order to decrease the size of the data while transmitting data from Cluster Head to Base Station. As data transfer is in wireless sensor media it may cause damage to the information sent through sensor nodes to the base station. Design of an efficient cryptographic method to enhance the security in the network during transfer the data between the nodes.

References

[1]. I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", Computer Networks 38 (4) (2002) 393–422.

[2]. M.Cardei, D.Z. Du," Improving wireless sensor network lifetime through power aware organization", Wireless Networks 11 (3) (2005) 333–340.

[3]. Meenakshi Bansal, Iqbal Singh, Parvinder S. Sandhu," Coverage and Connectivity Problem in Sensor Networks" "World Academy of Science, Engineering and Technology 73, 2011

[4]. Z. He, B.S. Lee, X.S. Wang, "Aggregation in sensor networks with a user-provided quality of service goal", Information Sciences 178 (9) (2008) 2128–2149.

[5]. Chalermek Intanagonwiwat, Ramesh Govindan, and Deborah Estrin, Directed diffusion: "a scalable and robust communication paradigm for sensor networks", MobiCom '00: Proceedings of the Sixth Annual International Conference on Mobile Computing and Networking, ACM, 2000, pp. 56–67

[6]. L.Krishnamachari, D. Estrin, S. Wicker,"The impact of data aggregation in wireless sensor networks" 22nd International Conference on Distributed Computing Systems Workshop, 2002, pp. 575–578, 2002.

[7]. F. Marcelloni, M. Vecchio, "Enabling energy-efficient and lossy-aware data compression in wireless sensor networks by multi-objective evolutionary optimization", Information Sciences 180 (10) (2010) 1924–1941.

[8]. W.R. Heinzelman, A. Chandrakasan, H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks" 33rd Annual Hawaii International Conference on System Sciences, 2000, pp.1–10.

[9]. C.Ok, S. Lee, P. Mitra, S. Kumara," Distributed routing in wireless sensor networks using energy welfare metric", Information Sciences 180 (9) (2010).

[10]. P.S. Sausen, M.A. Spohn, A. Perkusich, "Broadcast routing in wireless sensor networks with dynamic power management and multi-coverage backbones",Information Sciences 180 (5) (2010) 653–663.

[11]. Ajit Singh Negi, Neha Garg and Akhand Pratap Singh," Role of Clustering in Achieving Energy Efficient Coverage in Wireless Sensor Network: A Short Review" Department of Computer Science and Engineering and Information Technology, GEU, Dehradun, Uttarkhand, India, 2015.

[12]. Albert Krohn, Michael Beig, Christian Decker, Till Riedel and Tobias Zimmer and David Garc´es Varona "Increasing Connectivity in Wireless Sensor Network using Cooperative Transmission" Telecooperation Office (TecO), Universit¨at Karlsruhe Germany.

[13]. Ashraf Hossain and Rashmita Mishra "Sensing and Link Model for Wireless Sensor Network: Coverage and Connectivity Analysis" BPPIMT, Kolkata, India

[14]. K.Suriya, R.Dahanagopal "An efficient Approach for Secure Data Technique for Wsn In The Presence Of Security Attacks", IJARTET 2015

[15]. N.V.S.N Sarma, Mahesh Gopi, "Energy Efficient Clustering using Jumper Firefly Algorithm in Wireless Sensor Network", International Journal of Engineering Trends and Technology (IJETT) – Volume 10 Number 11 - Apr 2014.

[16]. M. Bidar and H. R. Kanan, "Jumper firefly algorithm," International Conference on Computer and Knowledge Engineering (ICCKE2013), pp. 267-271, Oct-Nov 2013.

Author Profile

Mr. Channakrishnaraju has 19 years of teaching experience for UG and PG courses in computer Science and Engg and presently working as Associate Professor in the department of computer Science and Engg at Sri Siddhartha Institute of Technology, Tumkur. He Obtained B.E from Bangalore University in the year 1995, and PG in software systems in the year 2000. His research interests are in the areas Wireless sensor networks and Artificial Intelligence. Currently pursuing Doctoral degree in computer science &Engg (wireless sensor networks) from Sri Siddhartha Academy of Higher Education,[SSAHE], Tumkur, under the guidance of Dr.M.Siddappa Professor and Head department of Computer Science and Engineering, Sri Siddhartha Institute of Technology, Tumkur. He published 19 Technical Papers in National, International Conference and journals.

M.Siddappa received B.E degree in Computer Science & Engineering from University of Mysore, Mysore, Karnataka, India in 1989, M.Tech from University of Mysore in 1993 and doctoral degree from Dr. MGR Educational Research Institute Chennai under supervision of Dr.A.S.Manjunatha, CEO, Manvish e-Tech Pvt. Ltd., Bangalore. He worked as project associate in IISc, Bangalore under Dr. M. P Srinivasan and Dr. V.Rajaraman (1991–93). He has teaching experience of 25years and research of 10years.. He is a member of IEEE and Life member of ISTE. He is working in the field of data structure and algorithms, Artificial Intelligence, Image processing and Computer networking. He worked as Assistant Professor in Department of Computer Science & Engineering from 1996 to 2003 in Sri Siddhartha Institute of Technology, Tumkur. Presently, he is working as Professor and Head, Department of Computer Science & Engineering from 1999 in Sri Siddhartha Institute of Technology, Tumkur. He has published nearly 65papersin national and international journals. He is having citation index as 85 with j-index 4 and i10-index 1. He has received **"Best Engineering teacher award"** from ISTE for the year 2011.