Improvement in Firefly Algorithm for Node Localization in Underwater Acoustic Networks

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Abstract- The underwater acoustic network is the type of network which is deployed under the deep sea to sense ocean conditions like pressure etc. The networks are deployed underwater for providing communication such that the important information can be easily transmitted across regions. Originally for the terrestrial wired and wireless channels, the communication techniques were designed. Thus, in order to make them appropriate for underwater channels, there is a need to modify these techniques. In the previous research, the fry fly algorithm is applied for the node localization. In the fire fly algorithm the optimal value is calculated for the node localization. In this research work, distance based technique is applied for the node localization. The proposed and existing algorithms are implemented in MATLAB. The simulation results show that proposed algorithm performs well in terms of certain parameters.

Keywords- Firefly, Localization, Underwater, Acoustic Networks

I. INTRODUCTION

A network that consists of various sensor nodes and base station for collecting data from surroundings is known as a wireless sensor network. The power, memory as well as computational capacity of sensor nodes in these networks is very less. There is a random distribution of the sensor nodes within these networks such that the surrounding conditions can be sensed and the important information can further be forwarded to be the base station of the network. To aggregate the data, the base station is deployed centrally within these wireless networks [1]. The environmental conditions are monitored from the sensor nodes deployed in these networks. The centrally localized base station can gather all such information. The computation power and storage capacity of the sensor nodes are very high. Thus, there is a need of very less amount of time to process such amount of information. An interface between the internal and external environments of these networks is provided through gateway. Here, the role of gateway is played by a base station. The data that is received from the base station by end users is accessed and then passed on to the server further. There are huge areas in which the sensor networks are deployed and to ensure that such huge amount of gathered data is passed on at single time duration, several base stations are deployed in these networks [2]. The networks are deployed underwater for providing communication such that the important information can be easily transmitted across regions. Due to the presence of limited bandwidth, higher multi-path, higher fading, huge time-variations as well as Doppler shifts, it is difficult to perform high-speed communication within underwater acoustic channels. Within the sea waters, the propagation of electromagnetic waves is very poor. Originally for the terrestrial wired and wireless channels, the communication techniques were designed. Thus, in order to make them appropriate for underwater channels, there is a need to modify these techniques [3]. Due to the dynamic nature of WSNs, one of the major issues that arise is known as node localization. For ensuring efficient data communication, the location of sensor nodes is shared through node localization mechanism. By proposing efficient solution to the node localization issue, the data aggregation issue is resolved. For performing several tasks like tracking of target, monitoring the environmental conditions, WSNs are deployed in various applications. To fulfill the various applications of WSN, an important requirement is node localization. Due to the dynamic nature of these networks, node localization is known to be the major issue. The task in which the coordinates of nodes are collected for identifying unknown nodes is known as node localization [4]. The distance approaches can be utilized to perform this technique along with the coverage area in which sensor nodes are deployed. For generating queries from sensor nodes for several events, forwarding data within the groups, and routing the data, the generation of queries is important within this technique. Anchor nodes are deployed within the network for localizing the position of sensor nodes. Thus, an estimated value is calculated to determine the localization distance amongst the sensor node and anchor [5]. Several optimization approaches are implemented on anchor nodes for estimating the exact position of sensor nodes. Ranging errors is the major issue of node localization in which the exact position estimation of unknown nodes is to be minimized. There is reduction of mean square error due to the identification of position of unknown nodes. For estimating the exact location of sensor nodes, there is a need to minimize the optimization issue using the fitness value known as mean square error. Several techniques that are proposed by different researchers are included within the node localization mechanism. There are centralized and decentralized mechanisms proposed within

the node localization mechanism. On the basis of the type of mechanism being centralized or decentralized, the class is assigned a particular algorithm [6]. The approach in which control messages are forwarded and the node location is sent as a response back is known as centralized type of localization mechanism. The approach in which the anchor nodes are deployed such that the nodes and anchor nodes are forwarded control messages to estimate the position is known as decentralized type of localization mechanism. There are numerous mechanisms proposed in this technique.

II. LITERATURE REVIEW

Ranjit Kaur, et.al, (2017), presented a study related to node localization which plays a very important role within wireless sensor networks. On the basis of distance, the location of sensor nodes is estimated within the localization approach. The value of estimated value is just an approximation and not real. The important information from base station is very difficult to be generated in case if the estimation of position of node is not correct. Because of huge sizes of the sensor networks, the complexity of node localization is very high also. An optimization issue caused here commonly is node localization. For node localization, a nature inspired optimization approach is proposed by author [7]. Comparisons are made amongst various optimization algorithms in order to identify appropriate mechanisms with respect to accuracy and computation time they provide.

S.R.Sujatha, et.al, (2017), proposed in this paper a novel dynamic weight based mechanism for node localization in WSN. Mainly, a hybrid approach is proposed here through which the improvements are achieved. When there is equality of the estimated and measured positions of nodes, the bit error rate is minimized. For gathering the accurate locations of nodes, the anchor nodes are utilized. For localization, DE algorithm is proposed by author here with whom the accuracy of localization is increased here [8]. With respect to accuracy and execution time, the proposed algorithm provides better simulation results.

Meng Joo Er, et.al, (2016), presented research related to node localization within WSNs. To provide highly accurate position of nodes, the density of network needs to high. The accuracy of node localization is directly affected due to the node density. There is minimization of number of hops of network when the density of nodes is minimized in the area. Thus, the accuracy of network is also minimized here. For providing node localization, node density based estimation approach is proposed [9]. The node density is calculated for anchor nodes and regions within sub-regions are divided on the basis of node density of anchor node. To estimate the position of nodes, the distance amongst the anchor node and sensor node is computed. In comparison to already existing approaches, the performance of proposed approach is shown to be better as per the simulation results.

Eva Tuba, et.al, (2016), presented that an important part of WSNs is the estimation of position of sensor nodes. A mechanism in which the location of unknown nodes can be estimated is known as node localization. In order to predict the location of sensor nodes, the distance amongst the anchor nodes as well as the sensor nodes is computed as per the RSSI approach. On the basis of firework swarm intelligence optimization algorithm, the node localization mechanism is proposed in this paper [10]. From several anchor nodes, the gathering of estimated data is done using this algorithm. In the form of input, this data is provided to the system. There are three different phases in which this algorithm performs. The location of each node is compared within the initial phase. Further, the best location is computed within the second step. Further, for node localization, the value of MSE is estimated within the final phase. It is seen through the comparisons that with respect to accuracy and execution time parameters, the performance of proposed algorithm is better that already existing approaches.

Chin-Shiuh Shieh, et.al, (2016), presented study related to node localization which is a major issue. The gathering of data from the network becomes difficult in case when the position as well as identification of sensor nodes is not estimated. The optimization issue faced within WSNs is node localization which is mainly caused due to the estimation of positions of nodes [11]. Several optimization algorithms that are proposed for node localization are compared within this research to evaluate the performances of each other in comparison to each other. The various optimization algorithms are compared with respect to accuracy as well as execution time. It is seen as per the simulation results that the firefly algorithm performance better in comparison to other algorithms.

Suman Bhowmik, et.al, (2016), presented the study related to node localization issue within WSNs. The aggregation of important data within the network is very difficult in case when there is no knowledge about the position or no identification of node. Because of the dynamic nature of network, the localization of node is another optimization issue. For node localization, an efficient technique to be applied is the received signal strength. On the basis of received signal strength, the position of node is estimated within RSSI technique. A fuzzy logic based node localization approach is proposed in this research work [12]. Using distance parameters, fuzzy rules are generated within the fuzzy logic approach. Amongst the anchor node and sensor nodes, the distance is computed. The position estimation is done using the calculated distance that follows the define rule. Within Omneet++, the simulation of proposed algorithm is done and the accuracy of node localization is also evaluated when proposed algorithm is applied.

III. RESEARCH METHODOLOGY

There is minimization of time required for node localization within the underwater acoustic networks on the basis of proposed technique. The fry fly Optimization is the algorithm utilized as the optimize solution using which difficult problems are solved. The development of fry fly is modeled by the bird flocks and schools of fish. It is considered as the evolutionary computation technique but in some manner it differs from other algorithms such as genetic algorithms. In the initial state, there is initialization of the swarm of particles in the fry fly that proceed with a random solution to the problem. In the given velocity around the search space particles moved. A potential solution is represented by the location of a particle at a given point in which the fitness function is used to evaluate fitness. The previous generations has been utilized in order to govern and generate subsequent generations. Therefore, in order to find out the optimal solution for the given problem, the particles moved around the search space to produce new generations. Until the generation limit reached or the optimal particle in the population cannot be improved this process continues

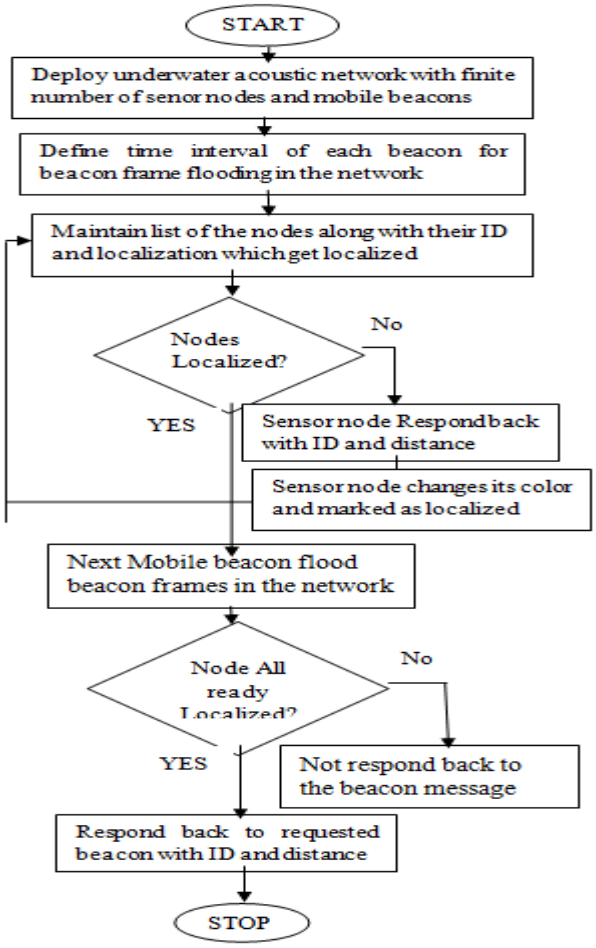

Fig.1: Flowchart of Proposed Work

IV. EXPERIMENTAL RESULTS

The proposed and existing algorithms are implemented in MATLAB and results are analyzed in terms of various parameters.

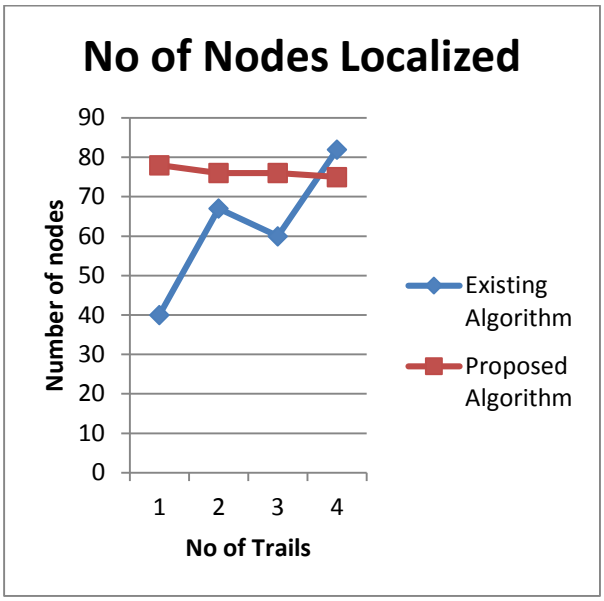

Fig.2: Number of nodes localization

As shown in figure 2, the number of nodes localized with the proposed and exiting technique is compared. It is analyzed that proposed technique performs well as compared to existing technique

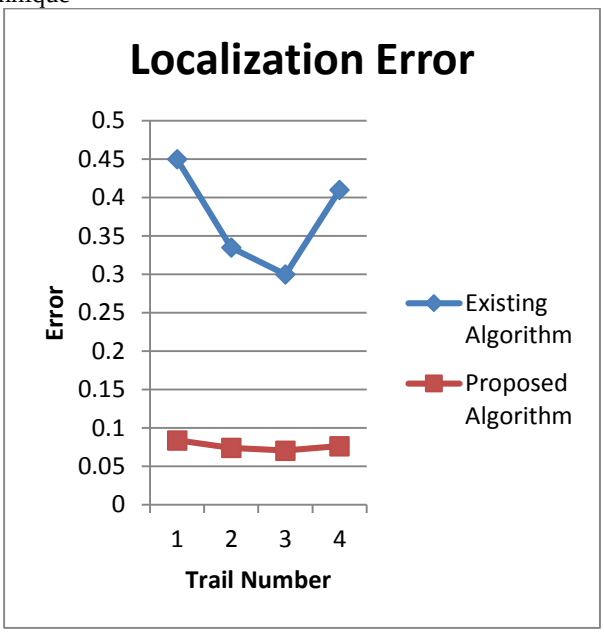

Fig.3: Localization Error

As show in figure 3, the existing and proposed techniques are compared in terms of localization. The localization error in the

proposed technique is less as compared to existing technique.

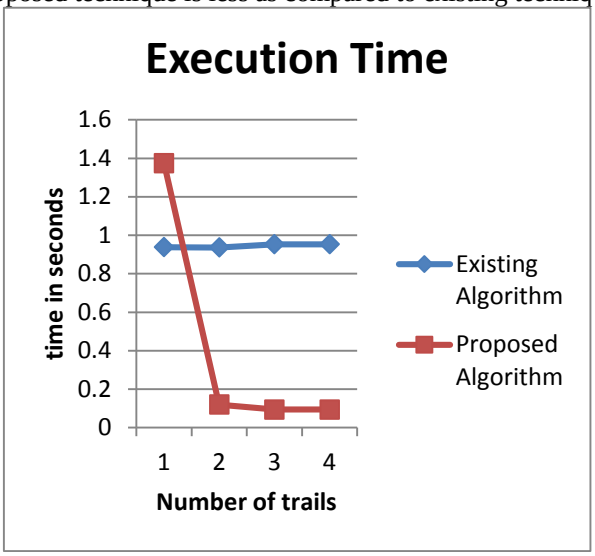

Fig.4: Execution Time

As shown in figure 4, the execution time of the proposed and existing technique is compared for the performance analysis. It is analyzed that execution of proposed technique is less as compared to existing technique.

V. CONCLUSION

Node localization is also one of the problems in WSN. It is the process of identifying the position coordinates of unknown nodes which can be achieved by using the distance information, and radius of wireless communications. Node localization is required to report the origin of events, assist group querying of sensors, routing and to answer questions on the network coverage. The fry fly algorithm is the optimization for the node localization. The fry fly algorithm need large number of iterations for the node localization. In this research work, distance based technique is applied for the node localization. The proposed algorithm is implemented in MATLAB and results are analyzed in terms of certain number of parameters.

VI. REFERENCES

[1]. Avinash Kaur, Sonu Agrawa, "Location detection in wireless sensor network using classical optimization methodology," 2012, IJCST, vol. 3, pp.108-115.

[2]. Asma Mesmoudi, Mohammed Feham, Nabila Labraoui, "Wireless sensor networks localization algorithms: a comprehensive survey", 2013, International Journal of Computer Networks & Communications (IJCNC) vol.5, pp. 112-120.

[3]. Z. Mary Livinsa, Dr. S. Jayashri, "Performance analysis of diverse environment based on RSSI localization algorithms in wsns", 2013, Proceedings of 2013 IEEE conference on Information and Communication Technologies, vol.3, pp.627-628.

[4]. A. Nasipuri and K. Li, "A directionality based location discovery scheme for wireless sensor networks," 2002, In Proceedings of ACM WSNA, vol. 4, pp.105-111

[5]. D. Niculescu and B. Nath, Ad Hoc Positioning System (APS) using AoA," 2013, In Proceedings of IEEE INFOCOM '03, vol. 3, pp. 1734-1743

[6]. M. Broxton, J. Lifton and J. Paradiso, "Localizing a Sensor Network via Collaborative Processing of Global Stimuli," 2005, IEEE Workshop on Wireless Sensor Networks, vol.5, pp. 321-332.

[7]. Ranjit Kaur, Sankalap Arora, "Nature Inspired Range Based Wireless Sensor Node Localization Algorithms," 2017, Springer, vol.4, pp7-17

[8]. S.R.Sujatha, Dr.M.Siddappa, "Node Localization Method for Wireless Sensor Networks Based on Hybrid Optimization of Particle Swarm Optimization and Differential Evolution," 2017, IOSR-JCE, vol.19, pp.7-12

[9]. Meng Joo Er, Shi Zhang, Baihai Zhang, Chiang-Ju Chien, and Feifan Wang, " A novel localization approach towards anchor to node in wireless sensor networks," 2016, IEEE, vol.4, pp.143-148

[10]. Eva Tuba, Milan Tuba, Marko Beko, "Node Localization in Ad Hoc Wireless Sensor Networks Using Fireworks Algorithm," 2016, IEEE, vol.3, pp. 130-137

[11]. Chin-Shiuh Shieh, Van-Oanh Sai, Yuh-Chung Lin, Tsair-Fwu Lee* , Trong-The Nguyen and Quang-Duy Le, "Improved Node Localization for WSN using Heuristic Optimization Approaches," 2016, IEEE International Conference on Networking and Network Applications, vol.3, pp.95-98

[12]. Suman Bhowmik, Rajib Kar, Chandan Giri, "Fuzzy Node Localization in Wireless Sensor Network," 2016, IEEE WiSPNET 2016 conference, vol.8, pp.1112-1116