Energy Aware Nature Inspired Algorithm for better energy utilization for Wireless Sensor Network

Pooja Sahni, Sukhdeep Kaur, Jaswinder Singh, Ripple Sahni

Abstract -Wireless sensor nodes are dead very early because of less battery power availability. If any single node dead in the network then the workload shifted on the other nodes. By this scenario battery consumption increase of other nodes from the regular routine, and the whole sensor network down very soon. Every single node in a sensor network interconnected with each other without the help of the radio waves technology. Each sensor nodes associated with a battery that provides sufficient power to complete the whole tasks, like to sense data, receive data, transmit data etc. Tasks are huge but the battery lifetime is limited, this is a major problem in the sensor network. This paper represented a newly develop Algorithm to better utilization of nodes battery power and make the sensor network more stable by increasing the lifetime of the sensor nodes. EANIA results proved that this approach is more energy aware and more secure.

Index Term: Cluster Head, Energy Efficient, Network Lifetime, Sensor Network.

1. INTRODUCTION

In WSN many sensor nodes are preinstalled, every mote sense information in a wireless environment. Sensor technology is very useful and leading technology in recent days, every field of science and technology use sensors to collect the information to deliver better facilities to people with higher security. Example: security at the sensitive areas, for safety in a crowded area, ready for rescue in advance from nature damage (expend the ability of human remote interactive data). Single sensor node not as powerful and accurate, so all nodes combined in one network for getting an accurate result. A large amount of sensed data combined and forward to the base station. In 1970, sensor network launched with a single signal in a hierarchical structure, all nodes coordinate with each other by using point to point communication. Low power sensor nodes start to operate independently in next-generation. All nodes cooperate with each other and transmit the data to other nodes for processing. In the 1990s, architecture improved of motes and the new improvement launched with the installation of the controller unit, and bus connectivity.

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Pooja Sahni, Sukhdeep Kaur, Jaswinder Singh, Ripple Sahni- Chandigarh Engineering College, Landran, Mohali, Punjab, India

In the fourth generation, the motes network is in progress, defined by self-organization and multi-hop network.
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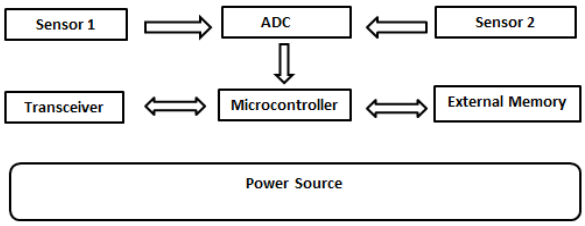

Fig 1: Wireless sensor network Architecture

IEEE 802.15.4 is reserved standard for a wireless sensor network, Zig-bee and LOW6PAN protocols are defined under this standard. This technologyuses DSSS(direct sequence spread spectrum) radio with 256-kilobits/ sec data rate. In wireless motes, when power consumption rate goes high all Sensor nodes will start entering into idle mode and the network goes down. Longer lifetime and stable network is the requirement of the modern motes network because it is not possible to physically visit and recharge batteries after some time slot. The solution of this problem is to develop some advanced method that fulfills all requirements and function of motes with less power consumption.
In this paper: Section 1 is the Introduction, which provides the detail of the sensor network, Section 2 provides detail of the already proposed techniques, and discusses various Nature-inspired algorithms and, Section 3gives detail explanation of proposed work, Section 4 represents Simulation Results, and finally Conclusion.

2. LITERATURE SURVEY

Numbers of Researchers contribute their work to improve network stability by improving nodes lifetime, some of the researchers work given below:
Heinzeleman in 2000 [1] proposed the first time LEACH algorithm. Every node in LEACH becomes CH (cluster) head. CH compress information arrived from the other nodes and forward it to the base station. This protocol uses TDMA/CDMA and MAC technique to reduce the inter-cluster collisions. Cell LEACH [3], in this approach the geographical area is divided into cell formation and each cell

has its own Cell Head. Simply one cluster head always presents in each cell. Clustering fixed but CH and Cell Head select randomly. In TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol) [4], all nodes are organized in a hierarchical structure and certain nodes become Cluster Head. When cluster head selected user sets attributes and these attributes accepted by CH (Hard Threshold (HT) and Soft Threshold (ST) values) and distributes to his all members. In SEP [5]protocol only higher energy nodes become cluster head. All nodes are divided according to their initial energy like higher energy nodes and lower energy nodes. Lower energy nodes have very less probability to become cluster head.

Asgarali Bouyer et al. in 2015[2] represented the hybrid model of Fuzzy C Mean approach and LEACH method. This model proposed that if the distance of the lower energy node is larger to BS than lower chance to become a cluster head. CH selected according to a fuzzy probability vector. This model, offer more energy balanced network than Leach algorithm.

Paola G. Vinueza Naranjo et al. [6] in 2017 published paper on advanced approach Prolong-Stable-Election-Protocol (P-SEP). This model represented the new CH selection policy before the failure of the first node. P-SEP make motes network more stable with higher information deliver rates.

K. Vijayan et al. [7] in 2016proposed CAERP model combination of the cluster formation and of the routing algorithm. It stands for Cluster Arrangement Energy Efficient Routing Protocol. The proposed CAERP was operated in four modes: first Dynamic Clustering, second CH Selection, third Effective Routing, and last one Secured Data Communication.

The base station nearest cluster head hasa smaller cluster size than those farther from the base station, so during inter-cluster data communication, they can preserve some energy. The effectiveness of this approach is compared with Q-LEACH protocol.

A. Nature Inspired Algorithms [9, 12, 13]

GA is a type of evolutionary algorithms, developed by Holland and his colleagues in 1960s and 1970s, used in the field of engineering, bio-informatics, phylogenetics, computer science, economics, physics,etc., to find an estimated solution to optimization and search problem. In a motesnetwork, its performance defines as to predefined cluster formation, which helps to reduce overall minimum communication cost. GA methodology based on inheritance, mutation, selection, and cross-over. The main disadvantage of this approach is very difficult to operate a dynamic data set.

Genetic Programming is an Evolutionary Algorithm, developed by Koza in 1992 its methodology inspired by biological evolution. It used to find a computer program that performs the task defined by the user in a muchbetter way. Many instruction Set work in this approach and the fitness function parameter is considered to check how well a programperformsuser-definedtask.

ACO is a nature-inspired Swarm intelligence technique, introduced by Dorgio in 1997, useful to find a better path through the graph. In ACO's simulated environment Ants record their position and their solution quality. A number of ants coordinate for reaching to the destination(food). The shortest path is followed in this approach between the source and destination to make data transmission better. The basic disadvantage of this approach is local search is not sufficient, and consume a large amount of energy if more numbers of the paths are available.

ABC developed by Parabola in 2005, in which three types of bees are considered in methodology. Employer bee, onlooker bee, and scout bee. In the first phase, bees exploit the source by local search in the neighborhood of the solution selected in employee bee section using deterministic selection and probabilistic selection in the onlooker section. In the scout bee section which is an analogy of abandoning exhausted food source in the foraging process, an old result which is not beneficial anymore replace with a new better solution. The main disadvantages of this approach are lack of use of secondary information, the population of solution increase the computational cost.

3. PROPOSED WORK

Many researchers and practitioners have worked on the analysis of remote motes technology and energy optimization. It is not possible to upgrade the nodes by physically approach after some times, so a better solution is to make whole process energy aware and that increase the nodes lifetime by better utilization of battery power. This work presented nature inspired based improved techniques tomake the network more stable by better utilization of battery power. Energy Aware Nature Inspired Approach (EANIA) approach,is present in this paper by using River formation Dynamic (RFD) soft computing method.In proposed approach cluster head selected on the basis of the initial energy, because cluster head handlemaximum load of the clusternodes and if any lower energy node selected as a cluster head then it will die very soon and the coverage area will be reduced.In proposed technique EANIA, secondary cluster head always present in every cluster so that if primary cluster head goes down then secondary cluster head take place of primary CH and save the time wastage required for selected new CH. Security is a major problem, wicked nodes make the network unstable.

This proposed technique avoids energy consuming assaults with dynamic energy optimization and key exchange to distinguish the fake nodes from the network and preserve the energy and overall performance.

4. RESULTS

Wireless sensor nodes are varying in the simulation environment and then the following mentioned results are collected. The simulated results are proved that the proposed new

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technique is more energy efficient, increase lifetime of the sensor network, and more secure. Fig. 2 represent that the proposed algorithm performs better (consumed less energy) as compared to the classical approach.

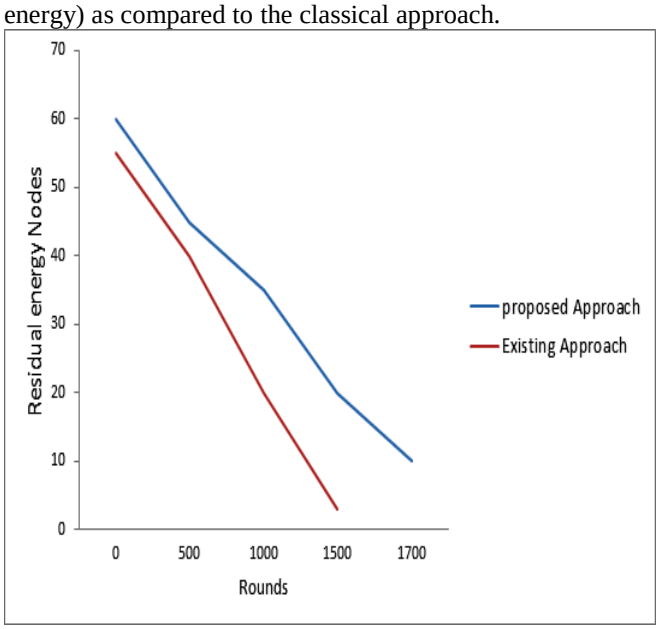

Fig2: Residual energy of nodes

Malicious nodes hamper the network and constrained its power very soon, due to this reasonthe sensornetwork never perform an operation for a long time. It is very necessary that the newly developed algorithm provides the save environment for sensor nodes but it does not meanthat the whole network goes down just because to fulfill the network security requirement. The proposed technique is more beneficial to detect the malicious nodesand save the ideal nodes. EANIA is a very advancedalgorithm with both facilities of increasing network lifetime and providesanadditional security feature.Figure 3, represents that the proposed approach is more secured as compared to the classical approach.

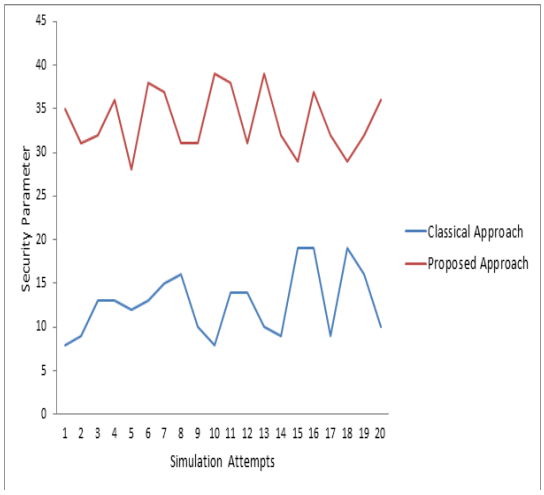

Fig 3: Proposed and classical Approach comparison on Security Parameter

5. CONCLUSION

This paper report the various routing protocols and nature-inspiredalgorithm, these are very helpful to better utilize the energy of the wireless sensor nodes. There are many techniques are available to improve the energyefficiency of the network.Nature-inspiredapproaches are better performance and not too complex. EANIAapproach is very effective in term of sensor network lifetime increasing, security, and overall performance. In future work, applying routingprotocolswithnature-inspiredoptimization technique to make more energy efficient cluster formation hybrid model.

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Dr. Pooja Sahni is working as Professor in Chandigarh Engineering College, Mohali, India. She has more than 15 years of teaching experience, more than 11 national and 16 international journal research papers to his credit and filed five patents. Her area of interest is Wireless Communication

"Dr. Sukhdeep Kaur is working as Professor in Chandigarh Engineering College, Mohali, India. She did PhD. from Thapar Institute of Engineering and Technology, Punjab, India in the yest 2016. She has more than 18 years of teaching experience, more than 15 national and 20 international journal research papers to her credit. Her area of interest are Wireless Communication and Antenna design."

Mr. Jaswinder Singh received his Master Degree (M. Tech.) in Electronics and Communication Engineering from PTU Jalandhar. His areas of interest are Wireless Communication and VANET Security.

Ripple Sahni is working as Assistant Professor in Chandigarh Group Of College, Mohali, India. She has more than 12 years of experience. Her area of interest is Wireless Communication.