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A cluster Head Deployment for Node Balancing of data with Network Lifetime Maximization in Wireles Sensor Network

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Abstract:

The sensor nodes are to sense and transmit the data's to that of the base station, in which it leads to reduce the energy of the sensor node. So lifetime maximization of sensor is the major issue in most of the wireless sensor network where it can be operated in the environment, in which human's access and monitoring are practically infeasible. Clustering is the technique that can put in an order, where the system operation can attend the network scalability, low energy consumption, and also to increase the network lifetime maximization. To overcome this issue, many researchers have triggered many clustering algorithms. The clustering algorithm such as LEACH (Low Energy Adaptive Clustering Hierarchy), DEEC (Distributed Energy Efficient Clustering), EECS (Energy Efficient Clustering Scheme) are use to maximize the lifetime of a sensor. Hence, our proposed fuzzy logic based implementation offers an energy-efficient, less computational cost, reduce time complexity and to maximize the network lifetime solution for node deployment in large wireless sensor networks.

Keywords — **Wireless sensor network (WSN), Cluster node deployment, Lifetime, Balanced energy consumption, Fuzzy logic.**

I.INTRODUCTION

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN), are spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. 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.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. There are three cross layers planes added to those above five layers of OSI model i.e. power management plane, connection management plane, task management plane. These layers are used to manage the network connectivity and allows the nodes to work together to increase the overall efficiency of the network

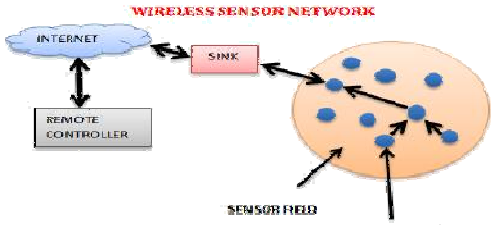


Fig. 1
WSN Architecture

A. Structure of Wireless Sensor Networks

Wireless Sensor networks follows most common architecture OSI model .Basically, there are five layers in sensor network. These are application layer, transport layer, network layer, data link layer and physical layer. There are three cross layers planes added to those above five layers of OSI model i.e. power management plane, connection management plane, task management plane. These layers are used to manage the network connectivity and allows the nodes to work together to increase the overall efficiency of the network.

B. Wireless Network

Wireless network can be configured in two ways (i.e.) Adhoc or infrastructure mode. Wireless device require WLAN cards & access points for communication. Wireless network requires equipment like wireless adapters and access points which is quite expensive.

C.Types of Wireless Network

- **Cellular Network**

It is a communication network where the last link is wireless. The network is distributed over land areas called cells .Each served by at least one fixed location transceiver known as a cell site or base station. This base station provides the cell with the network coverage which can be used for transmission of voice data and others.

- **Wireless Adhoc Network**

A wireless Adhoc network (WANET) is a decentralized type of wireless network. The network is adhoc because it does not rely on a pre-existing infrastructure such a routes in wired network or access points in managed wireless network. It is self-configuring, dynamic network in which modes free to move.

- **MANET**- Mobile Adhoc Network

A MANET is a type of adhoc network that can change location and configuration itself on the fly. Because MANET‟s are mobile they use wireless connection to connect to various networks. This can be standard Wi-Fi connection (or) another medium such as cellular (or) satellite transmission.

D.Types Of Wireless Sensor Networks

- **Terrestrial WSNs**

Terrestrial WSNs are capable of communicating base stations efficiently, and consist of hundreds to thousands of wireless sensor nodes deployed either in unstructured (ad hoc) or structured (Pre planned) manner. In an unstructured mode, the sensor nodes are randomly distributed within the target area that is dropped from a fixed plane. The Pre planned or structured mode considers optimal placement, grid placement, and 2D, 3D placement models. In this WSN, the battery power is limited; however, the battery is equipped with solar cells as a secondary power source. The Energy conservation of these WSNs is achieved by using low duty cycle operations, minimizing delays, and optimal routing, and so on. These networks consist of a number of sensor nodes and vehicles deployed under water. Autonomous underwater vehicles are used for gathering data from these sensor nodes. In an unstructured mode, the sensor nodes are randomly distributed within the target area that is dropped from a fixed plane. The Pre planned or structured

mode considers optimal placement, grid placement, and 2D, 3D placement models.

- **Underground WSNs**

The underground wireless sensor networks are more expensive than the terrestrial WSNs in terms of deployment, maintenance, and equipment cost considerations and careful planning. The WSNs networks consist of a number of sensor nodes that are hidden in the ground to monitor underground conditions. To relay information from the sensor nodes to the base station, additional sink nodes are located above the ground.

- **Under Water WSNs**

More than 70% of the earth is occupied with water. These networks consist of a number of sensor nodes and vehicles deployed under water. Autonomous underwater vehicles are used for gathering data from these sensor nodes. A challenge of underwater communication is a long propagation delay, and bandwidth and sensor failures.

- **Multimedia WSNs**

Multimedia wireless sensor networks have been proposed to enable tracking and monitoring of events in the form of multimedia, such as imaging, video, and audio. These networks consist of low-cost sensor nodes equipped with microphones and cameras. These nodes are interconnected with each other over a wireless connection for data compression, data retrieval and correlation.

- **Mobile WSNs**

These networks consist of a collection of sensor nodes that can be moved on their own and can be interacted with the physical environment. The mobile nodes have the ability to compute sense and communicate. The mobile wireless sensor networks are much more versatile than the static sensor networks. The advantages of MWSN over the static wireless sensor networks include better and improved coverage, better energy efficiency, superior channel capacity, and so on.

II. WHY ENERGY EFFICIENT

The necessary constraint challenges for wireless sensor network is energy efficient. Sensor nodes are generally battery-powered through batteries that should be either replaced or recharged once the batt. Sensor nodes usually use the batteries for power provide within the wireless sensor networks. These sensor nodes are usually deployed or put in within the geographical area so as to watch the surroundings and to gather the knowledge from the geographical surroundings. Once the sensor nodes are deployed they are typically unapproachable to the operator. The vital or the foremost necessary point while using sensor nodes is that battery power ought to be consumed less so as to make wireless sensor network more energy economical or energy efficient. When these sensor nodes usually send the gather data or reports to the sink or base station they often consume the battery energy, due to which consumption of energy of the network will increases. Therefore energy conservation and energy economical or efficient routing protocol ought to be taken into consideration to develop the dynamic and adaptive idea within the networking for wireless sensor network. Designing an energy economical or efficient routing protocol that decrease the energy consumption of information transmissions and prolong the network life is a very important issue while creating wireless sensor network as energy economical or efficient.

Fig. 3. DESIGN

A. Existing System

To gather streams of data in static wireless sensor networks, a novel graded node deployment strategy is

proposed that generates minimum traffic, just sufficient for coverage. Based on this node distribution, a distributed, nearly load balanced data gathering algorithm is developed to deliver packets to the sink node via minimum-hop paths that also in turn helps to limit the network traffic. An average case probabilistic analysis is done based on perfect matching of random bipartite graphs to establish a theoretical lower bound on the number of nodes to be deployed. Analysis and simulation studies show that the proposed model results huge enhancement in network lifetime that significantly overrides the cost due to over deployment. Hence, this technique offers an excellent cost-effective and energy-efficient solution for node deployment and routing in large wireless sensor networks to operate with prolonged lifetime.

- **Disadvantages:**

- The existing work does not consider the present state of the sensor nodes (e.g. residual energy, distance to sink, etc.).
- When the node with less residual energy becomes CH, it will die soon. And the distance to BS is also not considered.
- The nodes located far from BS become CH; the energy consumption is increased enormously.

IT does not suitable for large scale WSN where the distance between the sensor node and BS is high

B.Proposed System

Many researchers are involved in fuzzy based clustering technique. Because of the uncertainties occurring in the WSN environments, increasing number of clustering-based protocols make use of fuzzy logic for clustering in WSNs. Using the fuzzy input and output variables, uncertainties inherent in the WSN nature are handled effectively. And, it has low computational complexity and more flexibility than crisp logic. The fuzzy inference system can be employed to get a better combination of the applicable input parameters to obtain optimal output, which is the CH selection procedure in this context. The fuzzy logic controller consists of four parts which is shown in Fig 2.

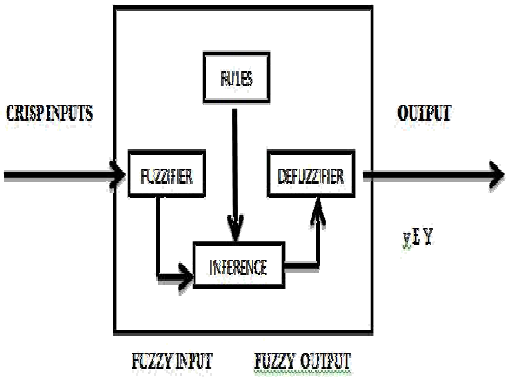


Fig.2 Working of Fuzzy

- Fuzzy rule base: It stores a set of IF-THEN rules.
- Fuzzy Inference Engine: The inference engine maps the input values with rule base table to produce fuzzified output rules
- Fuzzification module: translates crisp inputs into fuzzy values.
- Defuzzification: translates fuzzy outputs into crisp values

In our proposed work, a dynamic CH selection is done with the help of fuzzy logic. The fuzzy input parameters are residual energy and the distance to BS. The output parameter is the probability of becoming CH. Initially, the crisp inputs and mapped into appropriate fuzzy sets. The linguistic variables for the input variables and the respective values.Crisp inputs are transformed into fuzzy sets by applying the fuzzification functions then combined with if-then rules to get the fuzzy output. Defuzzification process transforms the fuzzy output probability

to a crisp value representing the probability of a node to become a cluster head. Once the probability of becoming CH is determined by fuzzy logic, BS broadcasts its probability to all nodes. The nodes receive the message and identify its probability. The nodes advertise the probability value to its neighbours within the communication range. When no higher probability message is received by a node, it elects itself as CH. The CH broadcasts its status to its neighbours. The nodes receiving the CH message, joins the cluster as cluster member. After the formation of clusters, cluster member sense the value and forwards to CH. CH receives the data and aggregates into a single packet. CH forwards the aggregated packet to BS via intermediate CHs.

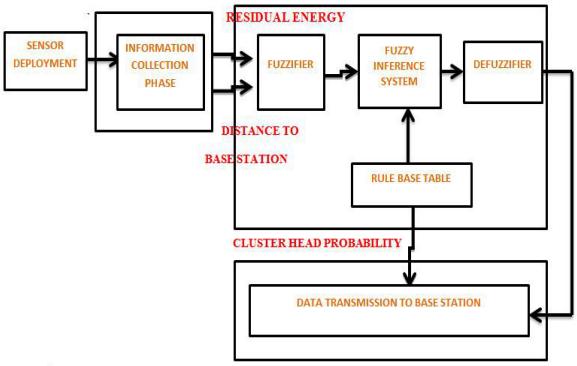


Fig. 3. DESIGN

The sensor nodes are randomly deployed in the sensing region. BS or sink is located far away from the deployed region. The sensor node consists of four units: sensor unit, power unit, processing unit and communication unit. The sensor unit is used to measure the physical parameters needs to be measured. The physical parameters can be temperature, pressure, humidity, vibration, acoustic signal, etc. The sensed value is processed by the processing unit and the communication unit is used to forward the data to BS. Power unit is the crucial unit in WSN.

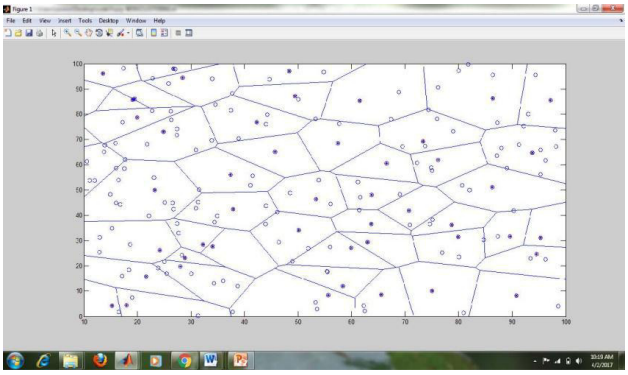
The sensor nodes are battery powered and needs to operate for longer time. It is very difficult or impossible to recharge or replace batteries in the sensor node. So, effective usage of available energy is the primary way to maximize the network lifetime. The sensor nodes are randomly deployed in the sensing region. BS or sink is located far away from the deployed region. The sensor node senses the physical parameter and forwards the data to BS directly or through intermediate sensor nodes. When the distance between the sensor node and BS is less, the node transmits the data directly to BS. In large scale WSN, the distance between the BS and sensor node is large. In those situations, data is forwarded in multi-hop fashion, i.e. data is transmitted through the intermediate nodes. The remote user can access the data from BS via internet. Various approaches have been developed to achieve energy efficiency in WSN. Clustering is the most popular energy efficient technique to reduce the overall energy consumption in the network . The network is partitioned into various clusters and a leader is selected among the nodes. The leader is called as Cluster Head (CH) and remaining nodes are termed as cluster members or cluster nodes. The cluster members sense the region and transmit the data to CH. The CH performs three operations: receives data from cluster members, aggregate the data and forward the data to sink. There are two types of communication in clustered WSN. They are intra-cluster communication and inter-cluster communication. The intra-cluster communication refers to the data transmission within a cluster, i.e. cluster members sends data to CH. The inter-cluster communication refers to the data transmission between several CHs. For transmitting data to sink, CH uses several CHs as intermediate nodes in multi-hop communication.

C. Advantages of Proposed System

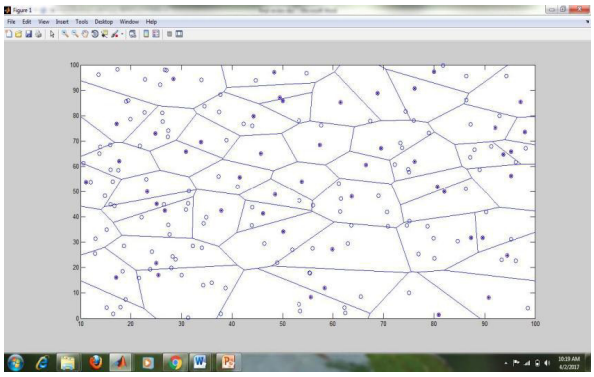
- Consists of high residual energy when compared to exiting system
- Maximize the network lifetime of sensor
- Less computational cost
- Reduce time complexity

IV.IMPLEMENTATION

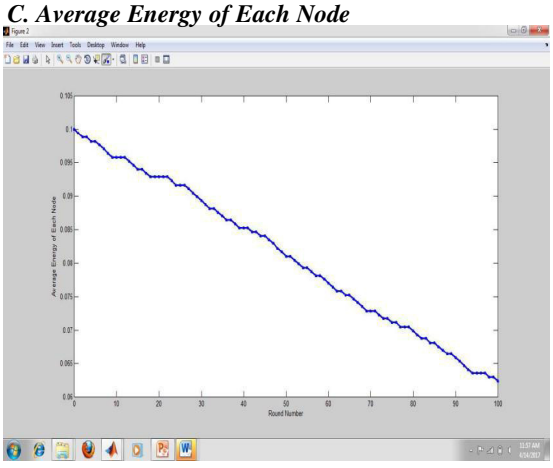
A. Random Deployment of Nodes



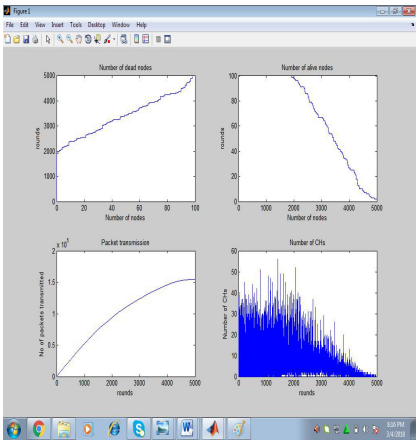
B. Changing of Cluster Head Selection



C. Average Energy of Each Node



D. Energy Consumption And Network Lifetime



V. CONCLUSION AND FUTURE WORK

A fuzzy logic based dynamic CH selection is done in WSN. The residual energy of the sensor node and the distance between sensor node and BS is used as fuzzy input parameters and the probability of becoming CHs is the output parameter. The proposed method is simulated and the proposed method is compared to LEACH. The experimental results show that the proposed method produces better results than LEACH. The proposed method is compared to LEACH in terms of energy consumption and network lifetime. The fuzzy based CH selection minimizes the energy consumption and maximizes the network lifetime significantly. The extensive experiments clears that network lifetime of the proposed method is increased by 55.72% and the energy consumption is reduced to 50% when compared to LEACH.

VI. REFERENCES

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