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A Review on Distributed Topology Control Techniques for Energy Efficient Cluster based Protocols for WSN

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***Abstract:** In current environment there are various application where WSN is used. These area may be critical fields as well. Because WSN is very easy to set and very cost efficient network. Each node in the sensor network has specific number of nodes. Each node can transmit and receive the signal. Because each node has battery as energy source, so there is a high chances of energy depletion early. So various researches has been done in current time to have efficient protocols which can utilize energy is time efficient manner. This will protect the node from being dead and also enhance the life time of the node. Various cluster based protocols are there which can sib divide the network area into smaller parts and each part can have specific number of sensor nodes deployed randomly. Based on residual energy one node will be selected as cluster head. All sensor node will collect the data and sends that data to the cluster head. And then cluster head to the base station.*
***Keywords:** WSN, CLUSTER, ENERGY EFFICIENT*

I. INTRODUCTION

Wireless Sensor Networks (WSN) is the innovation that comprises of expansive number of small sensor hubs disseminated in a specially appointed way. Sensors are by and large spread over a land range in profoundly thick way. These sensor hubs are of ease and low power which can perform different capacities.

In wireless sensor node the sensor nodes are being put into the sensor field. The distribution is dependent on the factor depends upon this issue that which application they will be using. The sensor nodes in the network can be distributed randomly, regular. These sensor nodes can be dropped from the aircraft for random distribution. But if it is to be put in regular way they grid like structure is builded and nodes are being distributed at regular distance in the grid. The sensor node in the area can be mobile in nature. Each sensor node sole objective is to collect the information from its physical environment and send that information to the base station. Each sensor node has limited computing, memory and energy resources. Under those resources the node will send the data to its neighbor and then to the cluster head. In whole communication the node never communicates to all the nodes in the network.

The base station is the central node who will collect whole data. This node has large processing power and large storage. This base station will collect the data from all the sensor nodes and process whole data for further use. Later on after processing the base station sends the data to the remote computer through internet or satellite[2].

Nowadays, agriculture has changed. There requires various techniques which can control the efficiency and quality of the production and also to reduce the environment impact of the agriculture production. The wireless sensor network is primarily used in precision agriculture. The precision agriculture deals with the application the required quantity of water, fertilizer, pesticides etc at the required time in order to enhance improve quality and productivity, while ensuring zero damage to the environment. A wireless sensor nodes cluster together to form a network with each node having the capability to process. The nodes are arranged in an ad hoc fashion and communicate wirelessly. India primarily being an agricultural country faces many problems concerning agriculture such as crop productivity and quality resulting in shortcomings in quantity that can be exported and utilizing the agricultural lands for other sources such as building construction and tourist spot. The agriculture in India requires more attention to be paid to the farming activity and farmers, more research regarding latest agriculture tools and testing the quality of various innovative ideas. So, here we study the application of Precision Farming (PF) that aims to improve the revenue by utilizing more precise information recorded using technologies available for sensing and communicating[3].

A. Wireless Sensor Network Architecture

Architecture of the wireless sensor network is a physical placement of various components. And the source node communicates to the base station either directly of by keeping one node in between. So that the information using relay node can arrive at the

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destination. This way the communication of the node can be taken place. There are various routing protocols through which information can be transmitted to the base station.

1) Flat sensor networks
2) Hierarchical sensor networks

Flat Sensor Networks In the flat type of topology each sensor node has similar role to play. It has to take the data from its environment and send to the base station. Either directly ir by keeping another node in between. This way the data can be transmitted to the base station. So some time node can also act as relay node.

Hierarchical sensor networks

In this type of network topology the node collects the data from its environment and send to the cluster head lies in upper hierarchy. As cluster head collects and aggregates the whole data and after the time threshold send that data to the node lies in the upper hierarchy. This upper hierarchy is second level cluster head or the base station. So that data can be transmitted with regular interval. This way whole data will be transmitted to the base station. This base station collects the data and process the data for further purpose. This way the data can be further transmitted to the remote station using internet[5].

B. Wireless Sensor Network Design Objectives

Most sensor systems are application based. There are diverse number of application lies in the field of networks. This type of network has wide and diverse number of applications. like

1) Little node size: Each node has small size. This small size enables the node to be placed in any type of topology. Due to the smaller size the network can be put into various numbers in the network. So that these nodes can be used for both transmissions and receiving of the data.
2) Low node cost: Each node has smaller cost to incur. So this network is of lower cost. So these nodes can be distributed in large number in those areas. Where there is very harsh environment. Low cost also provides the advantage in terms of distribution in large area.
3) Low power utilization: Because this network consists of various small sized nodes. Each node can work for both transmission and receiving of the data. These nodes are power backed up. This power can be either direct current or alternate current. Normally the nodes are battery operated. That means these nodes uses the battery power for small interval of time. After the elapse of the time the battery has to be changed so that new life can be given to the node.
4) Adaptability: This type of network can be used due to its versatility in any type of application. So that system configuration can be used in any field.
5) Dependability: this sensor nodes part of the sensor network has being highly reliable source of information and will provide the reliable information from source area.
6) Self-configurability: this type of network is so cost effective that the nodes in the network can configure them self automatically. Because initially the node are place randomly and then later on these nodes are configured and localized according to the requirements.
7) Flexibility: This type of network has higher amount of flexibility. Because it is automatically adjustable network where various nodes can adjust them self. According to the requirements. This type of network has the ability to configure the network according to the requirements.
8) Channel usage: Since this network has lower capacity nodes. These nodes only collects the data and transfer that data to the cluster head and then to the base station. So lower level of band width will be used for transfer of the data.
9) Adaptation to non-critical failure: This type of network is highly adaptable to the newer level of failures. Because at the occasion of any failure the system requirements can be established and the current coverage of the system requirements can be established.
10) Security: In this type of network there is a automatic configuration of the network resources. So that system automatically configure and there will be less chances of the system failure[4].

C. Challenges To WSN

The unique network characteristics, design issues, application specific requirements, sensor network architecture and physical conditions of targeted region etc. lead to many challenges for a wireless sensor network, which involves the many crucial aspects. Network lifetime and performance metrics are get significantly affected by these challenges.

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1) Limited Battery Power sensor nodes in the network has limited battery power. Due to small battery power these nodes can communicates to its environment for limited period of time. So certain amount of efficiency is required for transmitting the data from one node to other node.
2) Limited Hardware Resources: Sensor node has limited hardware resources like processing components, memory element and other type of transmitter and receivers. Which make it less functional in terms of both transmission and receipt. So for transmission to the base station there requires intermediate node as relay due to less transmission power.
3) Massive and Random Deployment: A sensor network area consists of various number of sensor nodes. These sensor nodes are lying in randomly or regular way in the network area. Once they will be positioned in the network area they will be localized in the area. Once localized they will starts transmission and receipt in the network area. There requires the routing protocol which will make it to transmit the data from source node to the destination by considering other node as intermediate node.
4) Dynamic and Unreliable Environment: Wireless sensor network is highly dynamic and unreliable which can change very frequently. Due to the dynamic nature there topology often get changed. Which will make it difficult to identify the routing path on fixed basis. Due to dynamic nature the error pronability is more compared to fixed topology.
5) Diverse Applications: Sensor network has various types of applications which make it suitable network. It provide wide range of application with wide no. of topologies. Single protocol may not be suitable for all types of applications.
6) Self-Configurability: In WSN the sensor nodes are being delayed in random way. These nodes are even so random can be thrown from the aircraft. Later on sensor nodes configure themselves by using various localization techniques.
7) Security: WSN is such network which can be placed in the network area for various types of applications. These sensor nodes working way is suited for all types of applications. Even they are used for various such applications which requires higher level of security. So that any unauthorized access will not be taken place. Also no malicious node can be the part of the network.
8) QoS Support: WSN is the network having the ability of connecting the different devices to each other. They will be communicating to each other by having various quality parameters intact. These quality parameters are like throughput and energy saving and cost saving[3].

II. LITERATURE SURVEY

Gino Alvarado et al.(2017): Wireless sensor networks systems have a lot of problems like security, energy consumption, heterogeneity and other disadvantages that need be solved. In this paper we look the best energy model protocol choice for a random topology and deployment in a sensor network, considering cluster establishment phase and stable data transmission, regarding different types of energy consumption, distances, and interference. the first one Low-Energy Adaptive Clustering Hierarchy protocol (LEACH) a protocol that use randomized rotation of cluster heads in the network and this protocol consider all the parameters that will be tested. The second protocol will be the Optimal number of cluster heads (ONCH) algorithm according to this algorithm the best way to obtain safe energy in a better way is optimizing the number of clusters heads in the network considering the number of nodes, radio, different routing coefficients and energy consumption.

Muhammad Aslam et.al.(2016): The author proposed Two-Hop Centralized Energy Efficient Clustering (THCEEC) and Advanced heterogeneity-aware Centralized Energy Efficient Clustering (ACEEC) routing protocols which are derived from Centralized Energy Efficient Clustering (CEEC) routing protocol for three level heterogeneous WSNs to enhance stability period of nodes and network lifetime of WSN. Applying it, WSN became energy efficient and achieve stable elections.

Ben Liu et.al. (2016): This algorithm uses sink side least-square algorithm, which reduces the communication traffic between sink and the monitoring center , on the side of monitoring center, the incident identification accuracy improved in D-S evidence recognition framework, by using the triangular fuzzy membership function for obtaining basic probability assignment value. It Reduces communication traffic between sink and source and identification accuracy is improved in D-S evidence theory recognition framework.

S. G. Santhi et.al.(2015): proposed an algorithm DCHM used for secure and accurate data fusion as well as Accuracy of data fusion results is also improved. It performs well in improving security and accuracy of data fusion by update reputation and trust systems.

Mohammadreza Soltani et.al .(2014): In this research, kalman filters based on data fusion used to reduce the number of active sensor node in large network, in this Only those sensor considered which are inside of the gate validation region, Reduction of network resources, less network load, secure communication. The application is suitable for those applications which requires moving type of node. This moving node is such that each moving node cover the large area. All the sensor nodes collect the data from the environment and send to the cluster head and then to the base station. All the sensor nodes collects the data at regular

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interval and collect data at constant rate. At the mobile node these data will be fused and from fused data the noise is removed and denoised data will be forwarded to the base station.

Jin-gang-cao et. al. (2013): in this research paper they have used the technique called as ACOE algorithm based. This algorithm has improve the various research parameters like network traffic, reduction in delay and also increase the life time of the node in the network. Structure of the mobile agent consists of three issues one is identification number second is the executing code third is data space and fourth is migration route. it calculates as follows:

$$min \sum_{i,j \in V} w(i,j) * eij, i \neq j$$

where e is the connectivity status of wireless sensor nodes, (i,j) and its value is "0" or "1 ", where "1" denotes v(i) and v(j) are connection, and "0" expresses they are disconnection. this calculates minimum distance in network.

Rui tan et.al. (2012): the research defines fundamental limits of coverage based on data fusion models that process noisy measurement of sensor that measured by probabilistic disc model. Result of research allows analysis of existing disc space model and provides key into designing and analyze of WSN adopted data fusion algorithm. It define mobile agent within the coverage area of the network and for better signal coverage and to count total consumption by sensor.

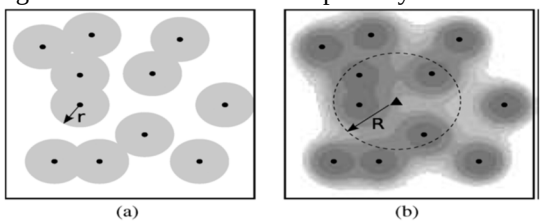


Fig. 1(a)disc space model, (b)probabilistic disc space[12]

to study the coverage of large-scale WSNs.

III. COMPARATIVE ANALYSIS

Topic	Author(year)	Conclusion	Future work	Result
Data fusion utilization for optimizing large scale in wsn.	Mohammadreza soltani.(2016)	In this paper, kalman filters based on data fusion used to reduce the number of active sensor node in very large network. only those sensor measures are considered which are inside of the gate validation region.	There is need to consider mobile agent to measure efficient node with high energy level.	Reduction of network resources ,less network load, secure communication.
Optimization of Hierarchical Data Fusion in Wireless Sensor Networks	Ben-liu(2016)	On sink side least-square algorithm with a limited window, which reduces the communication traffic between sink nodes and the monitoring center; on the side of monitoring center, the incident identification accuracy is improved in D-S evidence theory recognition framework, by using the triangular fuzzy membership function to obtain the basic probability assignment (BPA) value.	There is need to be cover large area coverage.	reduces the communication traffic between sink nodes and the monitoring center, , the incident identification accuracy is improved in D-S evidence theory recognition framework.

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Adaptive Energy-Efficient Clustering Path Planning Routing Protocols for Heterogeneous Wireless Sensor Networks	Muhammad Aslam(2016)	This paper proposed Two-Hop Centralized Energy Efficient Clustering (THCEEC) and Advanced heterogeneity-aware Centralized Energy Efficient Clustering (ACEEC) routing protocols which are derived from Centralized Energy Efficient Cluster-ing (CEEC) routing protocol for three level heterogeneous WSNs to enhance the stability and network lifetime of WSN.	in future, develop implementations of the proposed protocols for real applications to study and optimize them in real-life scenarios.	energy efficient, stable election protocol.
Mobile base station and clustering to maximize network lifetime in WSN.	Oday jerew(2016)	This paper use breath first search and clustering-based heuristic algorithm for finding a trajectory of the mobile BS to balance the energy consumption among sensor nodes. The algorithm allows the BS to visit all cluster heads within a specified delay.	There is need to be cover large area coverage.	No packet loss, balance energy consumption,mo re secure because base station is moving.
Energy efficient scheme for wireless sensor networks with multiple mobile base station.	Sashidhar rao gandham(2016)	MAC protocol which provide channel access to all nodes.use linear program to determine position of base station.	Future work is to implement this algorithm by enlarging cluster.	Secure network, less energy require to transfer packets.
Novel Cluster based data fusion algorithm for wsn	Ullah munir(2015)	This algo conduces to uniform cluster head distribution and rational cluster formation consequently achieve better performance on both energy efficient and lifetime of wsn.	. Scale of network is restricted if CH communicate with BS directly, so that we will introduce the inter-cluster-head multi-hope communication in our future work. extending it to adapt the network with mobile nodes and make it more applicable.	better performance on both energy efficient and lifetime of wsn.
Clustering based	S.G. Santhi(2015)	In this paper DCHM used for	objective of future	secure and

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Data Collection using Data Fusion in Wireless Sensor Networks		secure and accurate data fusions as well as Accuracy of data fusion results is also improved. this model performs well in improving the security and accuracy of data fusion by update the reputation and trust systems.	work is to retrieve the collective information from the sink and use DSR (Destination Source Routing) protocol for reducing the data loss.	accurate data fusion
A Novel Routing Algorithm for Hierarchical wsn	Huang-lu(2012)	novel power efficient routing algorithm for hierar-chically cluster compared with simple directed diffusion and non-clustering routing algorithm, proposed routing algorithm prolongs the system lifetime for large scale multi-hop transmission WSNs.	future plan includes the improvements for better comparison results, such as changing the position of the BS, and changing the probability of becoming CHs from all sensor nodes.	results show that, for large scale WSNs, our proposed algorithm performs better than the existing routing algorithms in terms of network lifetime.
Mobile agent tree route for data fusion in wsn.	Yuzhi-wu, lianglun cheng.(2012)	In this paper, MST is used to combine sensor node energy level to layout the routing.consider data fusion energy and transmission energy and adapt to adjust mobile agent amount and data fusion	There is also a need increase the area for large coverage link.	Decrease energy consumption ,increase network efficiency,it find minimum possible total cost.
Data fusion routing algorithm in wsn based upon mobile agent .	Jin-gang-cao(2013)	This paper allow ACOE algorithm to find beter route.this algo reduce the impact of invalid nodes in wsn.	There is also an issue need to be considered and to be further researched such as security of communication between the sensor nodes and reliability of links.	Reduce transmission delay,network traffic ,prolong the network lifetime.
Exploting data fusion to improve the coverage of wsn.	Rui-tan(2013)	In this paper fundamental limits of coverage based on data fusion models that jointly process noisy measurement of sensor i.e; measured by probabilistic disc model.	There should also have to consider mobile agent within the coverage area for better signal coverage and to count total consumption by sensor.	The result allow analysis of existing disc space model and provides key into designing and analyze of wsn adopted data fusion algorithm.

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IV. CONCLUSION

Various researches are being held by the researchers for making protocol level efficiencies. Most reliable technique for energy efficiency is heirarical routing protocol. All the research papers used the multilevel cluster topologies. It includes sub dividing the network into small sections. Each section is called as cluster. Various number of sensor nodes are being deployed in the cluster. Sensor nodes will senses the data and send to the cluster head. And then to the base station. This way energy efficiency is achieved. Further the work can be made more efficient by using various another levels of cluster efficiencies. Topological issues are major issues for energy saving. Mobile base station or even multiple base will helps in sending and receiving signals more efficiently. Because base station is energy harvested. They have more resources compared to the other network. To improve the performance, most existing algorithms control the topology in the distributed manner in the sense that every node in the network executes the algorithm at least once.

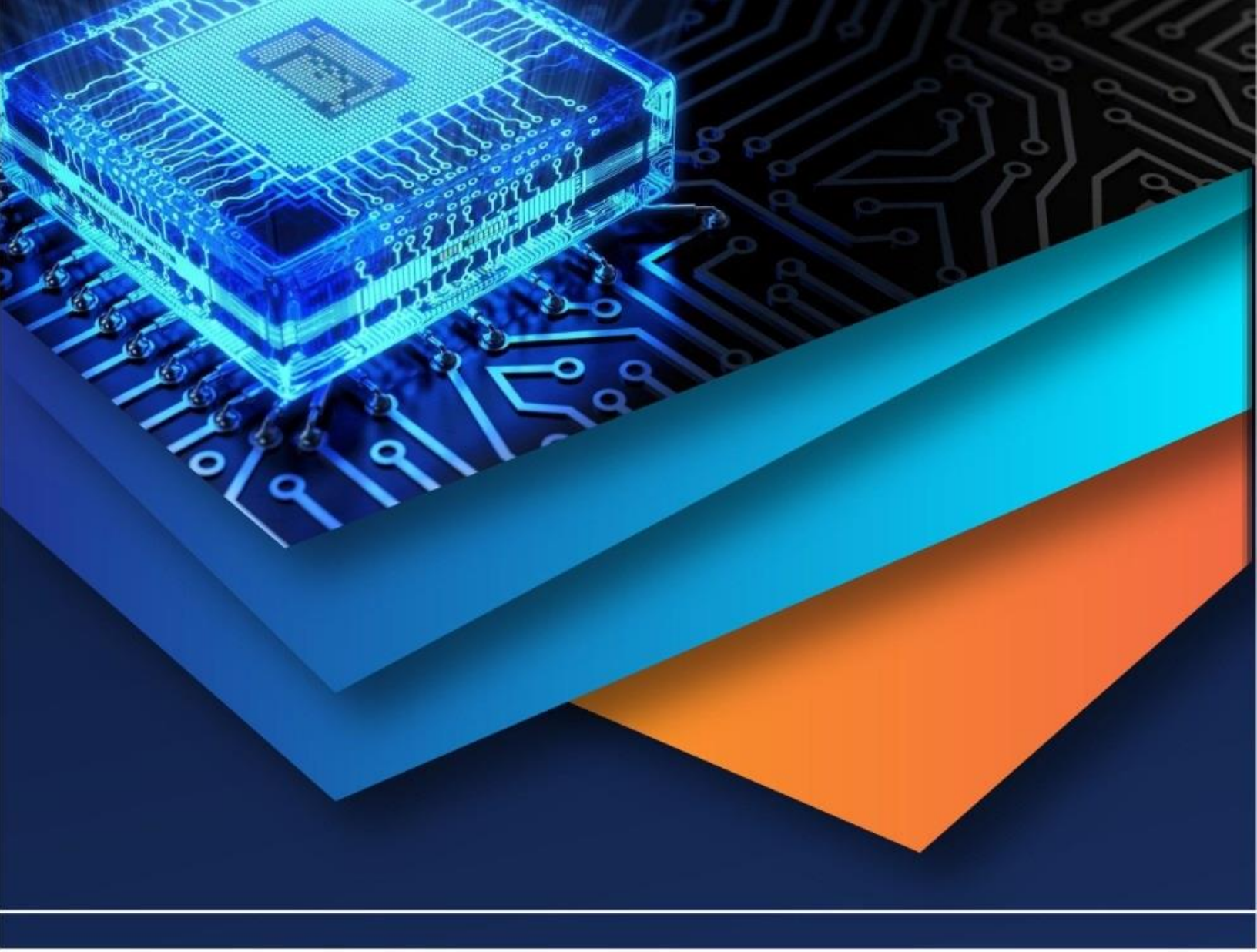
V. FUTURE WORK

Current researches are being help in subdividing the total network area into smaller parts each part named as cluster and sensor nodes will senses the data and then sends that data to the cluster head. And then the base station. This topologies can be improved by having multiple base stations. And also base stations are moving in nature. So that less energy should be wasted while transmission and reception of the signal.

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