List of Symbols and Abbreviations

Content	Full Form
WSN	Wireless Sensor Network
MAC	Medium Access Control
LEACH	Low energy adaptive clustering hierarchal
HEED	Hybrid Energy Efficient Distributed
TEEN	Threshold Sensitive Energy Efficient Sensor Network Protocol
APTEEN	Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network
SEAD	Scalable Energy Efficient Asynchronous Dissemination
IDSQ	Information Driven Sensor Query (IDSQ)
CHR	Cluster-Head Relay Routing
SAR	Sequential Assignment Routing
SPEED	Real Time Routing Protocol for Sensor Networks

ABSTRACT

The positioning of wireless nodes has been an active research area over the last decade. Many network positioning algorithms have been proposed to solve this problem. The vast majority assume that a fixed set of nodes (called seeds) have a mechanism to position themselves at all times (using GPS or other means). The other nodes estimate their positions based on positional information exchanged between nodes using wireless communication. The monetary cost of a GPS unit is decreasing so systems where most nodes are equipped with a GPS unit is foreseeable A problem with this assumption is that the task of self-positioning via a GPS unit is expensive in terms of energy consumption which results in faster battery decay. In this paper, we assume that every node is capable of self-positioning but activates that module selectively. This allows for balancing the energy costs of self-positioning among all nodes and results in reduced positional error. We investigate several different strategies for governing the self-positioning module and report on their performance

Wireless sensor networks consist of small battery powered devices with limited energy resources. Once deployed, the small sensor nodes are usually inaccessible to the user, and the Replacement of the energy source is not feasible. Hence, energy efficiency is a key design issue that needs to be enhanced in order to improve the life span of the network. Several network layer protocols have been proposed to improve the effective lifetime of a network with a limited Energy supply. In this article we propose a centralized routing protocol called Base-Station Controlled Dynamic Clustering Protocol (BCDCP), which distributes the energy dissipation evenly among all sensor nodes to improve network lifetime and average energy savings. the performance of BCDCP is then compared to clustering-based schemes such as Low- Energy Adaptive Clustering Hierarchy (LEACH), LEACH centralized (LEACH-C), and Power-Efficient Gathering in Sensor Information Systems (PEGASIS). Simulation results show that BCDCP reduces overall energy consumption and improves network lifetime over its comparatives

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ANIL YADAV

CERTIFICATE

It is certified that the work contained in this thesis entitled " **WIRELESS SENSOR NETWORK AND ENERGY CONSTRAINED NODES** ",by **ANIL YADAV** (1140447011) for the award of Master of Technology from Babu Banarasi Das University has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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Date 21 May 2016

WIRELESS SENSOR NETWORK AND ENERGY CONSTRAINED NODES

A Thesis Submitted

in Partial Fulfillment of the Requirements

for the Degree of

MASTER OF TECHNOLOGY

In

Computer Science & Engineering

COMPUTER NETWORK

by

Raj Narayan Patel

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Under the Supervision of

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Cover Letter

Dear HR Executive,

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Thanks & Regards.

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LIST OF FIGURE TABALE

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- **Partial fulfillment of** - Mini project of MCA 4^{th} Sem.
- **Role** - Developer
- **Description** - The Hotel Management System is proposed to be a web based platform using which a particular user can reserve their rooms in a particular hotel. Customer can order for home food delivery form a hotel. This project has two parts User and Admin. Admin can manage their all employee information
- **Skills** - JAVA, JSP, JAVASCRIPT, HTML

(Java Web Applications)

- **Project** - UNWANTAGE FILTERING MESSAGE
- **Partial fulfillment of** - **Main** project of MCA 6^{th} Sem.

- **Ro** - Developer

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CHAPTER 1
INTRODUCTION

1.1 Wireless Sensor Network

Wireless Sensor Network (WSN) is a group of Sensor Nodes (SNs) that work in the uncontrolled areas, organized into a cooperative network. It is composed of a huge number of sensor nodes which can monitor the environment by collecting, processing as well as transmitting collected data to the remote sink node through direct or multi hop transmission.Wireless Sensor Network (WSN) is a collection of large number of sensor nodes deployed in a particular region. The positioning of wireless nodes has been an active research area over the last decade. Many network positioning algorithms have been proposed to solve this problem. The problem of positioning, or the estimation of the geographical positions of wireless nodes in ad hoc and sensor networks. The position information is used in many parts of the network infrastructure, including topology maintenance, medium access control (MAC) protocols and routing protocols like geographic routings, event localization, target tracking and sensed data mapping. Node positions in the global co-ordinate system. For this they have to assume that a fixed set of nodes (called seed nodes) have some mechanism to position themselves at all times. One such mechanism is GPS. The other nodes estimate their positions based on positional information of other nodes obtained using wireless communication. This is sometimes called *network positioning.* Recent advances in MEMS based sensor technology, low-power analog and digital electronics, and low-power RF design have enabled the development of relatively inexpensive and low-power wireless micro sensors. These sensors are not as reliable or as accurate as their expensive macro sensor counterparts, but their size and cost enable applications to network hundreds or thousands of these micro sensors in order to achieve high quality, fault tolerant sensing networks. Reliable environment monitoring is important in a variety of commercial and military applications For example, for a security system, acoustic, seismic, and video sensors can be used to form an ad hoc network to detect intrusions. Micro sensors can also be used to monitor machines for fault detection and diagnosis. Micro sensor networks can contain hundreds or thousands of sensing nodes. It is desirable to make these nodes as cheap and energy-efficient as possible and rely on their large numbers to obtain high quality results. Network protocols must be designed to achieve fault tolerance in the presence of individual node failure while minimizing energy consumption. In addition the data being sensed by the nodes in the network must be transmitted to a control center or base station, where the end-user can access the data. Are many possible models for these micro sensor networks in this work, we consider micro sensor networks where: The base station Fixed and located far from the sensors. All nodes in the network are homogeneous and energy constrained. Thus communication between the sensor nodes and the base station is expensive, and there are no “high energy” nodes through which communication can proceed This is the framework for MIT’s -AMPS project, which focuses on innovative energy optimized solutions at all levels of the system hierarchy, from the physical layer and communication protocols up to the application layer and efficient DSP design for micro sensor nodes. Sensor networks contain too much data for an end-user to process. Therefore automated methods of combining or aggregating the data into a small set of meaningful information is required. In addition to helping avoid information overload, data aggregation also known as data fusion, can combine several unreliable data measurements to produce a more accurate signal by enhancing the common signal and reducing the uncorrelated noise The classification Proceedings of the 33rd Hawaii International Conference on System Sciences - 2000 0-7695-0493-0/00 $10.00 (c) 2000 IEEE 1 performed on the aggregated data might be performed by a human operator or automatically. Both the method of performing data aggregation and the classification algorithm are application-specific In many WSN applications, the deployment of sensor nodes is performed in an Ad-hoc fashion without careful planning and engineering. Once deployed, the sensor nodes must be able to autonomously organize themselves into a wireless communication network. The Sensor nodes are battery-powered and are expected to operate without the attendance for a relatively long period of time. In most cases it is very difficult and even impossible to change or recharge batteries for the sensor nodes. WSNs are characterized with denser levels of sensor node deployment, higher unreliability of sensor nodes, severe power computation and memory constraints. Thus, the unique characteristics and constraints present many new challenges for the development and application of Wireless Sensor Networks

For example, acoustic signals are often combined using a beam forming algorithm to reduce several signals into a single signal that contains the relevant information of all the individual signals. Large energy gains can be achieved by performing the data fusion or classification algorithm locally, thereby requiring much less data to be transmitted to the base station. For example, flooding is a technique in which a given node broadcast data and control packets that it has received from the rest of the nodes in the network. This process repeats until the destination node is reached. This technique does not take into account about the energy constraint imposed by WSNs. The sensor nodes are organized in a random manner as in Figure 1.1.

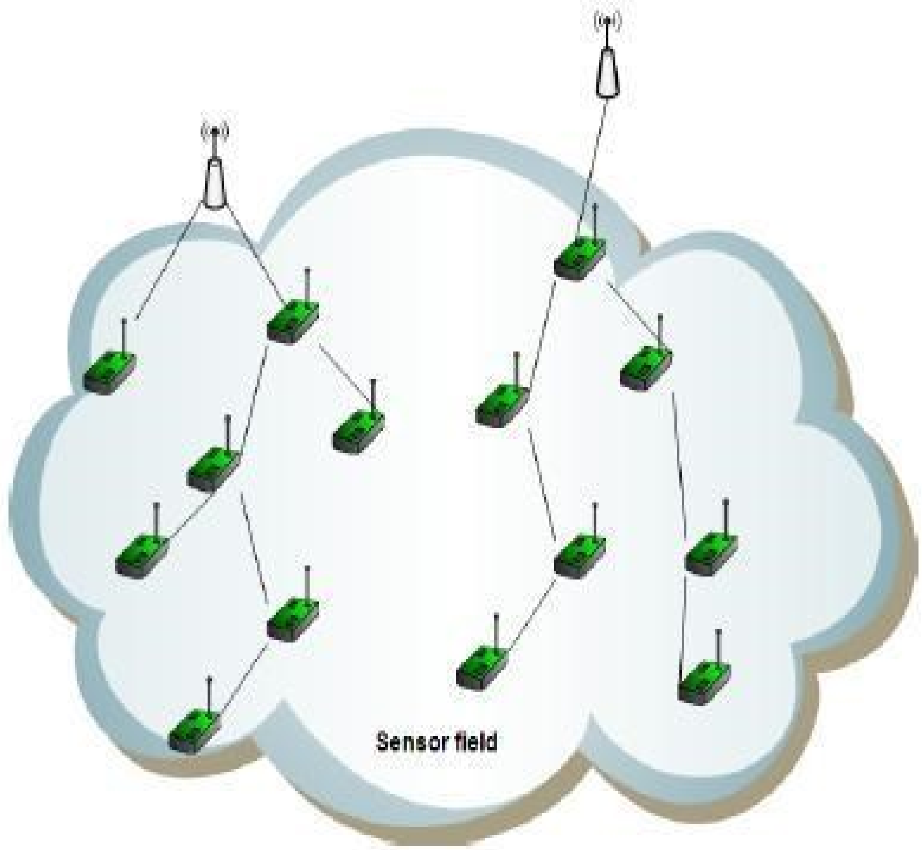

Figure 1.1 Architecture of Wireless Sensor Networks [1]

When data routing is used in WSNs, it lead to problems such as implosion and overlap Flooding is a blind technique an which has duplicated .packets that are kept to circulate in the Network and hence sensors will receive those duplicated packets, causing an implosion problem Also, when two sensors sense the same region and broadcast their sensed data, at the same time their neighbors will receive duplicated packets. To overcome this flooding another technique known as gossiping can be applied. In gossiping technique, when receiving a packet a sensor would select randomly one of its neighbor and send the packet to it. The same process repeats until all sensors receive this packet. Using gossiping, a given sensor would receive only one copy of a packet being sent. While gossiping tackles the implosion problem, there is a significant delay for a packet to reach all sensors in a network Furthermore, these inconveniences are highlighted when the number of nodes the network increases. The emerging field of wireless sensor network combines the sensing, computation and communication into a single tiny device. Through advanced mesh networking protocols these devices form a sea of connectivity. As water flows to fill every room of a submerged ship, the mesh networking connectivity will seek out and exploit any possible communication path by hopping data from node to node in search of its destination. With the capabilities of single device, the composition of hundreds of devices offers new technological possibilities Smart environments represent the next evolutionary development step in building utilities industries, home, shipboard, transportation and system's automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The challenges in the hierarchy of detecting the relevant quantities monitoring and collecting the data, assessing and evaluating the information formulating meaningful user displays, and performing decision-making and alarm functions are enormous. The network increases. The he emerging field of wireless sensor network combines the Sensing computation and communication into a single tiny device through advanced mesh networking protocols, these devices form a sea of connectivity. As water flows to fill every room of a submerged ship, the mesh networking connectivity will seek out and exploit any possible communication path by hopping data from node to node in search of its destination .with the capabilities of single device, the composition of hundreds of devices offers a new technological possibilities. Smart environments represent the next evolutionary development step in building utilities industries home shipboard transportation and system

1.2 Issues in WSN

The major issues that affect the design and performance of a wireless sensor network are as follows:

1.2.1 Hardware and Operating System for WSN

Wireless Sensor Networks are composed of hundreds of thousands of tiny devices called nodes. A sensor node is often abbreviated as a node. A sensor is a device which senses the information and passes the same on to a mote. The sensors are used to measure the changes in the physical environment like pressure, humidity, sound, vibration and changes in the health parameters of the person like blood pressure, stress and heartbeat. A mote consists of processor, memory, battery, A/D converter for connecting to a sensor and a radio transmitter for forming an ad hoc network. A Mote and Sensor together form a Sensor Node. The structure of a sensor node is shown in Figure 1.2. There can be different sensors for different purposes mounted on a Mote.

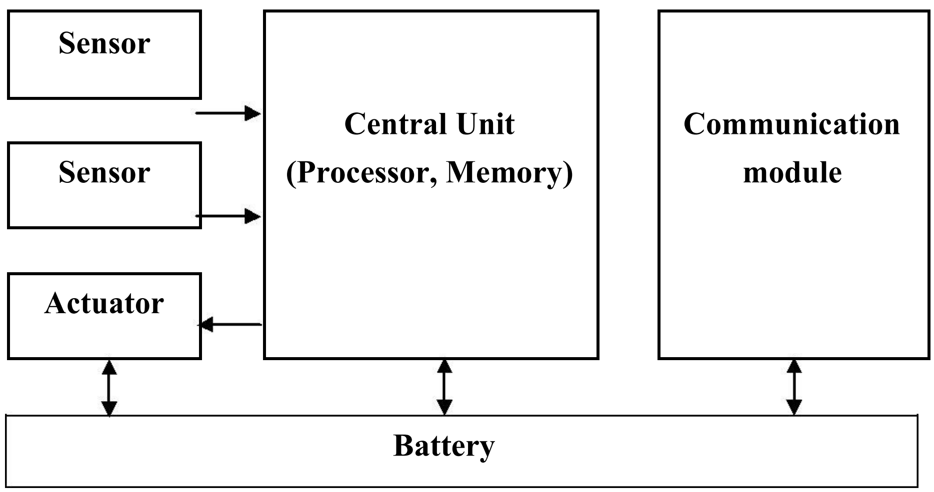

Figure 1.2 Structure of Sensor Node [2]

The nodes used in sensor networks are small and have significant energy constraints. The hardware design issues of sensor nodes are quite different from other applications and they are Radio Range of nodes should be high (1-5 kilometers). Radio range is critical for ensuring network connectivity and data collection in a network, as the environment being monitored may not have an installed infrastructure for communication. In many networks the nodes may not establish connection for many days or may go out of range after establishing connection. Use of Memory Chips like flash memory is recommended for sensor networks as they are non-volatile and inexpensive. Energy Consumption of the sensing device should be minimized and sensor nodes should be energy efficient since their limited energy resource determines their lifetime. To conserve power, the node should shut off the radio power supply when not in use. Battery type is important since it can affect the design of sensor nodes. A Battery Protection Circuit to avoid overcharge or discharge problems can be added to the sensor nodes. Sensor Networks consist of hundreds of thousands of nodes. It is preferred only if the node is cheap.

1.3.1 Wireless Communication Characteristics

The performance of wireless sensor networks depends on the quality of wireless communication. But, wireless communication in sensor networks is known for its unpredictable nature .Main design issues for communication in WSNs are: Low Energy Consumption in sensor networks is needed to enable long operating lifetime by facilitating low duty cycle operation and local signal processing. Distributed Sensing effectively acts against various environmental obstacles and care should be taken that the signal strength, consequently the effective radio range is not affected by various factors like reflection, scattering and dispersions. Multiple Networking may be adapted among the sensor nodes to reduce communication link range. The density of the sensor nodes should be high. Communication Systems should include error control subsystems to detect errors and to correct them.

1.3.2 Medium Access Control (MAC)

Communication is the major source of energy consumption in WSNs. The medium access Control protocols directly control the radio of the nodes in the network. The medium access Control protocols should be designed for regulating energy consumption which in turn increases the lifetime of the network. The various design issues of the Medium Access Control (MAC) protocols suitable for sensor network environment are The MAC layer provides fine-grained control of the transceiver and allows on and off switching of the radio. The design of the MAC protocol should have this switching mechanism to decide when and how frequently the on and off mechanism should be done. This helps in conserving energy.

A MAC protocol should avoid collisions from interfering nodes over emitting overhearing control packet overhead and idle listening. When a receiver node receives more than one packet at the same time, these packets are referred as "Collided Packets"

Which are to be sent again thereby increasing energy consumption. When a destination node is not ready to receive messages then it is said to be over-emitting Overhearing occurs if a node picks up packets that were destined for some other node. The Sending and the receiving of less useful packets results in Control Overhead An Idle Listening is an important factor as the nodes often hear the channel for possible reception of the data which is not sent. Scalability Adaptability and Decentralization are the other important criteria in designing a MAC protocol the sensor network should adapt to the changes in the network size, node density and topology. Also some nodes may die overtime, some may join and some nodes may move to different locations. A good MAC protocol should accommodate these changes to the network. A MAC protocol should have minimum latency and high throughput when the sensor networks are deployed in critical applications. A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst Thus, a node which has more data gets more time to access the medium. There should be uniformity in reporting the events by a MAC protocol. Since the nodes are deployed randomly, nodes from highly dense area may face high contention among themselves when reporting events resulting in high packet loss consequently the sink detects fewer events from such areas. Also the nodes which are nearer to the sink transmit more packets than the nodes which are away from the sink. The MAC protocols should take care of the well-known problem of Information asymmetry which arises if a node is not aware of packet transmissions that are two hops away The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection, processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S-Mac (Sensor MAC) Time MAC and Wise-MAC

1.3.3 Deployment

Deployment means setting up an operational sensor network in a real world environment. Deployment of sensor network is a labor intensive and cumbersome activity as it does not have influence over the quality of wireless communication Sensor Nodes can be deployed either by placing one after another in a sensor field or by dropping it from a plane. The following are the deployment issues which has to be taken into account when the sensor nodes are deployed in the real world, Node death due to energy depletion is either caused by normal battery discharge or due to short circuits arises. This is a common problem which may lead to wrong sensor readings. Also sink nodes act as gateways and they store and forward the data collected. Hence, problems affecting sink nodes should be detected to minimize data loss. Deployment of sensor networks result in the network congestion due to many concurrent transmission attempts made by several sensor nodes. Concurrent transmission attempts occur due to an inappropriate design of the MAC layer or by repeated network floods. Another issue is the physical length of a link.Two nodes may be very close to each other but still they may not be able to communicate due to the physical interference in the real world while nodes which are far away may communicate with each other. Low data yield is another common problem in the real world deployment of sensor nodes. Low data yield refers to the insufficient amount of information delivered by the network. Self-Configuration of the sensor networks without human intervention is needed due to random deployment of sensor nodes.

1.3.4 Localization

The Sensor localization is the fundamental and crucial issue for network management and operation. In many of the real world scenarios the sensors are deployed without knowing their positions in advance and also there is no supporting infrastructure available to locate and manage them once they are deployed. Determining the physical location of the sensors after they have been deployed is known as the problem of localization the location discovery or localization algorithm for a sensor network should satisfy the following requirements the localization algorithm should be distributed since a centralized approach requires high computation at selective nodes for estimating the position of nodes in the whole environment. This increases signaling bandwidth and also puts extra load on nodes close to the center node. Knowledge of the node location can be used for implementing energy efficient message routing protocols in sensor networks the localization algorithms should be robust enough to localize the failures and loss of nodes it should be tolerant to error in physical measurements. The precision of the localization increases with the number of beacons a beacon is a node which is aware of its location but the main problem with increased beacons is that they are more expensive than other sensor nodes. Once the unknown stationary nodes have been localized using beacon nodes then the beacons become useless. The techniques that depend on measuring the ranging information from signal strength and time of arrival requires specialized hardware which is typically not available on the sensor nodes.

1.3.5 Calibration

Calibration is the process of adjusting the raw sensor readings obtained from the sensors into corrected a values by comparing it with some standard values Manual calibration of sensors is a sensor network is at the time consuming and difficult task due to the failure of sensor nodes and random noise which makes manual calibration of the sensors is too expensive. Various Calibration issues in sensor networks are as follows;

- A sensor network consists of large number of sensors typically with no calibration interface.
- Access to individual sensors in the field can be limited.
- The reference values might not be readily available.
- Different applications require different calibration.
- It requires calibration in a complex dynamic environment with many observables like ageing, decaying, damages etc.
- Other objectives of calibration include accuracy resiliency against the random errors ability to be applied in various scenarios and to address a variety of error models

1.3.6 Network Layer

Over the past few years sensor networks are being built for specific applications and routing is important for sending the data from sensor nodes to the Base Station (BS).The various issues at the Network Layer includes Energy efficiency is a very important criterion. The network layer needs to find various methods for discovering energy efficient routes and for relaying the data from the sensor nodes to the base station so that the lifetime of a network can be optimized. Routing Protocols should incorporate multipath design technique. Multi-path is referred to those protocols which set up multiple paths so that a path among them can be used when the primary path fails. Path repair is desired in routing protocols whenever a path break is detected. Fault tolerance is another desirable property for routing protocols. Routing protocols should be able to find a new path at the network layer even if some nodes fail or blocked due to some environmental interferences.

- The sensor networks collect information from the physical environment and are highly data centric In the network layer in order to maximize the energy savings a flexible platform for performing routing and data management has to be provided

- The data traffic that is the generated will have a significant. Redundancy among individual sensor nodes. Since multiple sensors may generate same data within the vicinity of a phenomenon. The routing protocol should exploit such redundancy to improve energy and bandwidth utilization.

1.3.7 Transport Layer

The End to End reliable communication is provided at the Transport layer The various design issues for Transport layer protocols are.

- In transport layer the messages are fragmented into several segments at the transmitter and reassembled at the receiver. Therefore a transport protocol should ensure orderly transmission of the fragmented segments.
- Limited bandwidth results in congestion which impacts normal data exchange and may also lead to packet loss.
- Bit error rate also results in packet loss and also wastes energy. A transport protocol should be reliable for delivering data to potentially large group of sensors under extreme conditions.
- The End to End communication may suffer due to the various reasons such as the placement of nodes is not predetermined and external obstacles may cause poor communication performance between the two nodes If this type of the Problem is encountered then end to end communication will suffer. Another problem is failure of nodes due to battery depletion.
- In the sensor networks, the loss of data, when it flows from source to sink is generally tolerable. But the data that flows from sink to source is sensitive to message loss.

1.3.8 C Data Aggregation and Data Dissemination

The Data Aggregation is defined as the process of aggregating the data from multiple sensors to eliminate redundant transmission and then providing fused information to the base station. Some design issues in the data aggregation are.

The sensor networks are inherently unreliable and certain information may be unavailable or expensive to obtain. It is also difficult to obtain complete and up-to date information of the neighboring sensor nodes to gather information. Making some of the nodes to transmit the data directly to the base station or to have less transmission of data to the base station to minimize energy. Eliminating transmission of the redundant data using meta- data negotiations improving clustering techniques for data aggregation to conserve energy of the sensors. Improving In-Network aggregation techniques to enhance energy efficiency.in-Network aggregation means sending partially aggregated values rather than raw values, thereby reducing the energy consumption. The Data dissemination is a process by which data and the queries for the data are routed in the sensor network. The Data dissemination is a two-step process. In the first step, if a node is interested in some events like temperature or humidity, Network. In the second step, the nodes that have the requested data will send the data back to the source node after receiving the request. The main difference between the data aggregation and the data dissemination is that, in data dissemination all the nodes including the base station can request for the data and in data aggregation all the aggregated data is transmitted to the base station periodically In addition, during the data aggregation the data can be transmitted periodically, while in data dissemination the data is always transmitted on demand.

1.3.9 Quality of Service

The Quality of service (QoS) is the level of service provided by the sensor networks to its users. Quality of Service for sensor networks is the optimum number of sensors sending information towards information-collecting sinks or a base station. The sensor networks are getting implemented in more number of applications which includes the mission critical applications such as the military applications and the nuclear plant monitoring applications QoS is being given considerable review as the events occurring in these situations are of utmost importance. The QoS routing algorithms for wired networks cannot be directly applied to Wireless Sensor Networks. The performance of the most wired routing algorithms relies on the availability of the precise state information. The nodes in the sensor network may join, leave, and rejoin, and links may break at any time Hence maintaining and re-establishing the paths dynamically is a problem in Wireless Sensor Networks and it is not a big issue in wired networks Many times routing in the sensor networks need to sacrifice the energy efficiency to meet delivery requirements Even though multichip reduce the amount of energy consumed for data collection, the overhead associated with it may slow down the packet delivery. Also redundant data makes routing a complex task for data aggregation thereby affecting the Quality of Service in WSN Buffering in routing is advantageous as it helps to receive many packets before forwarding them. But multichip routing requires buffering of huge amount of data This limitation in buffer size will increase the delay. The packets that occur while travelling on different routes and even on the same route make it difficult to meet QoS requirements. The QoS designed for WSN should be able to support scalability. Adding or removing of the nodes should not affect the QoS of the Wireless Sensor Networks.

1.3.10 Security

In many applications security in the sensor networks is an important factor as the performance and the low energy consumption. Security in a sensor network is challenging as WSN is not only being deployed in battlefield applications but also for surveillance, building monitoring and burglar alarms and in critical systems such as airports and hospitals. Since the sensor networks are still a developing technology Researchers and developers agree that their efforts should be concentrated in developing and integrating security from the initial phases of sensor application developments. By doing so, a stronger and complete protection against illegal activities can be provided and at the same time stability of the systems can also be maintained. Following are the basic security requirements to which every WSN application should adhere to: The Confidentiality is needed to ensure sensitive information which is to be well protected and not revealed to unauthorized third parties during the communication process confidentiality is required in sensor networks to protect information

1.4. Mobility Based Protocols

Mobility brings new challenges to routing protocols in WSNs. The sink mobility requires energy efficient protocols to guarantee the data delivery originated from source sensors towards mobile sinks.

1.4.1 Data MULES Based Protocol

Data MULE based Protocol was proposed to address the need of guaranteeing cost effective connectivity in a sparse network while reducing the energy consumption of the sensors [28]. It is a three-tier architecture based on mobile entities called Mobile Ubiquitous LAN Extensions (MULE).

1.4.2 Scalable Energy-Efficient Asynchronous Dissemination (SEAD)

SEAD is a self-organizing protocol, which was proposed to trade-off between minimizing the forwarding delay to a mobile sink and the energy savings. SEAD considers data dissemination in which a source sensor reports its sensed data to multiple mobile sinks and consists of three main components namely the dissemination tree (d-tree) construction, data dissemination and maintaining linkages to mobile sinks.

1.4.3 Dynamic Proxy Tree Based Data Dissemination

A dynamic proxy tree based data dissemination framework [29] is proposed for maintaining a tree connecting a source sensor to multiple sinks that are interested in the source. This helps the source to disseminate its data directly to those mobile sinks. In this framework, a network is composed of stationary sensors and several mobile hosts called sinks. The sensors are used to detect and continuously monitor some mobile targets while the mobile sinks are used to collect data from specific sensors called sources, which may detect the target and periodically generate detected data or aggregate detected data from a subset of sensors. Because of the target mobility, a source may change and a new sensor closer to the target may become a source. Each source is represented by a stationary source proxy and each sink is represented by a stationary sink proxy. The source and sink proxies are temporary in the sense that they change as the source sensors change and the sinks move. A source will have a new source proxy only when the distance between the source and its current proxy exceeds a certain threshold. Likewise, a sink will have a new sink proxy only when the distance between the sink and its current proxy exceeds a certain threshold. The design of such proxies reduces the cost of pushing data and querying data from the source and the sink proxies.

1.5 Multipath Based Protocols

1.5.1 Disjoint Paths

Sensor disjoint multipath routing [30,31] is a multipath protocol. In the sensor-disjoint path routing, the primary path is the best available, whereas, the alternate paths are less desirable as they have longer latency. The disjoint makes those alternate paths independent from the primary path. Thus, if a failure occurs on the primary path, it remains local and does not affect any of those alternate paths. The sink can determine which of its neighbors can provide it with the highest quality data characterized by the lowest loss or lowest delay after the network is flooded with some low-rate samples Although disjoint paths are more resilient to sensor failures, they can be potentially longer than the primary path and thus having less energy efficiency.

1.5.2 Braided Paths

Braided multipath [31] is a partially disjoint path from primary one after relaxing the disjointedness constraint. To construct the braided multipath, first primary path is computed. Then the best path from a source sensor to the sink is computed. Those best alternate are called as idealized braided multipath. Moreover, the links of each of the alternate paths lie either on or geographically close to the primary path. Therefore, the energy consumption on the primary and alternate paths seems to be comparable as opposed to the scenario of mutually ternate and primary paths.

1.5.3 Heterogeneity Based Protocols

In heterogeneity sensor network architecture, there are two types of sensors namely line powered sensors which have no energy constraint and the battery powered sensors having limited lifetime and hence should use their available energy efficiently by minimizing their potential of data communication and computation. In this section the uses of heterogeneity in WSNs to extend network lifetime and a few routing protocols are presented.

1.5.4 Information Driven Sensor Query (IDSQ)

IDSQ [32] addresses the problem of heterogeneous WSNs of maximizing information gain minimizing detection latency and energy consumption for target localization and tracking through dynamic sensor querying and data routing. To improve tracking accuracy and reduce detection latency, communication between sensors is necessary. In order to conserve power only a subset of the sensors need to be active when there are interesting events to report in some parts of the network. The choice of a subset of active sensors that have the most useful information is balanced by the communication cost needed between those sensors. Useful information can be sought based on predicting the space and time the interesting events would take place. In IDSQ protocol, first step is to select a sensor as leader from the cluster of sensors. This leader will be responsible for selecting the optimal sensors based on some information utility measure.

1.5.5 Cluster-Head Relay Routing (CHR)

CHR routing protocol [33] uses two types of sensors to form a heterogeneous network with a single sink, a large number of low-end sensors, denoted by L-sensors, and a small number of powerful high-end sensors, denoted by H-sensors. Both types of sensors are static and aware of their locations using some location service. Moreover, those L- and H-sensors are uniformly and randomly distributed in the sensor field. The CHR protocol partitions the heterogeneous network into groups of sensors (or clusters), each being composed of L-sensors and led by an H-sensor. Within a cluster, the L-sensors are in charge of sensing the underlying environment and forwarding data packets originated by other L sensors towards their cluster head in a multi hop fashion. The H-sensors, on the other hand are responsible for data fusion within their own clusters and forwarding aggregated data packets originated from other cluster heads towards the sink in a multi hop fashion using only cluster head L-sensors use short-range data transmission to their neighboring H-sensors within the same cluster and the H-sensors perform long-range data communication to other neighboring H-sensors and the sink.

1.5.6 QoS-based Protocols

In addition to minimizing energy consumption, it is also important to consider the quality of service (QoS) requirements in terms of delay, reliability, and fault tolerance in routing in WSNs. In this section, a sample of QoS based routing protocols that help to find a balance between energy consumption and QoS requirements is reviewed

1.5.7 Sequential Assignment Routing (SAR)

SAR is the routing protocols for WSNs that introduces the notion of QoS in the routing decisions. It is a table-driven multi-path approach striving to achieve energy efficiency and fault tolerance. The routing decision in SAR is dependent on three factors such as the energy resources, QoS on each path, and the priority level of each packet (34, 35). The SAR protocol create trees rooted at one-hop neighbors of the sink by taking QoS metric energy resource on each path and priority level of each packet into consideration. By using created trees, multiple paths from sink to sensors are formed. One of these paths is selected according to the energy resources and QoS on the path. Failure Recovery is done by enforcing routing table consistency between upstream and downstream nodes on each path.Any local failure causes an automatic path restoration procedure locally. The objective of SAR algorithm is to minimize the average weighted QoS metric throughout the lifetime of the network. If topology changes due to node failures, a path re-computation is needed.as a preventive measure, a periodic re computation of paths is triggered by the base-station to account for any changes in the topology. A handshake procedure based on a local path restoration scheme between neighboring nodes is used to recover from a failure. The failure recovery is done by enforcing routing table consistency between upstream and the downstream nodes on each path. Simulation results showed that the SAR offers less power consumption than the minimum-energy metric algorithm which focuses only on the energy consumption of each packet without considering its priority. Although this ensures fault-tolerance and easy recovery, the protocol suffers from the overhead of maintaining the tables and states at each sensor node especially when the number of nodes is huge.

1.5.8 Real Time Routing Protocol for Sensor Networks (SPEED)

SPEED [36] is another QoS routing protocol for sensor networks that provides soft real time end-to-end guarantees. The protocol requires each node to maintain information about its neighbors and uses geographic forwarding to find the paths. In addition, SPEED strive to ensure a certain speed for each packet in the network so that each application can estimate the end-to-end delay for the packets by dividing the distance to the sink to the speed of the packet before making the admission decision. Moreover, SPEED can provide the congestion avoidance when the network is congested. The routing module in SPEED is called as stateless geographic non-deterministic forwarding. The beacon exchange mechanism collects information about the nodes and their location. Delay estimation at each node is basically made by calculating the elapsed time when an acknowledgement is received from a neighbor as a response to a transmitted data packet by looking at the delay values SNGF selects the node which meets the speed requirement

CHAPTER 2

PROBLEM STATEMENT

2.1 Objective

The objective of this work is to investigate strategies that balance the use of the GPS unit with the need to conserve energy. There have been several network routing protocols are analyzed and it can be examined in the context of wireless sensor networks that: There are two such possible routing protocols, namely direct communication with the base station and minimum-energy multi-hop routing using our sensor network and radio models. In multi-hop we found that conventional clustering approach (LEACH, HEED, APTEEN ,EECHWSN etc.) to routing are used and they have many drawbacks of using such an approach when the nodes are all energy-constrained. While using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of messages. The devices are mobile so the position of a sensor can change over time. The model describes the environment, wireless communication and mobility of the devices. The dynamics of the system of devices are captured in discrete time steps. In each time step a node can communicate, perform some computation, and change its location. We will assume that every node is capable of self-positioning but activates that module selectively. This allows for balancing the energy costs of self-positioning among all nodes and results in reduced positional error.

2.1.1 Routing protocols in WSN

The Routing [1] in wireless sensor networks have certain issues such that there is no infrastructure, wireless links are unreliable, sensor nodes may fail and routing protocols have to meet strict energy saving requirements. To minimize the energy consumption the routing techniques proposed in the literature for WSNs employ some well-known routing tactics as well as tactics special to WSNs, e.g., the data aggregation and in-network processing, clustering, different node role assignment and data-centric methods. Almost all the routing protocols can be classified according to the network structure as flat hierarchical or location-based. In flat networks, all nodes play the same role while hierarchical protocols aim at clustering the nodes so that cluster heads can do some aggregation and reduction of data in order to save the energy. The location-based protocols utilize the position information to relay the data to the desired regions rather than the whole network. Furthermore, these protocols can be classified into multi path based, query-based, negotiation-based QoS-based and coherent based depending on the protocol operation. The sample of routing protocols in each of the categories in preceding sub-sections is reviewed. While using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes direct communication will require a large amount of transmit power from each node. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of message.

There are many protocol use in wireless sensor network.

2.2 Hierarchal based protocol

- LEACH
- HEED
- TEEN
- APTEEN
- EEHCWSN

2.2.1 Low energy adaptive clustering hierarchal (LEACH)

LEACH [22] is the first and the most popular energy-efficient hierarchical clustering algorithm for WSNs that was proposed for reducing power consumption. In LEACH, the clustering task is rotated among the nodes, based on the duration. Direct communication is used by each Cluster Head (CH) to forward the data to the Base Station (BS). It uses clusters to prolong the life of the wireless sensor network. LEACH is based on an aggregation (or fusion) technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual sensors LEACH divides the network into several clusters of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, in order to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and dying quickly. The operation of LEACH is divided into rounds having two phases each namely.

- A setup phase to organize the network into clusters, CH advertisement and transmission schedule creation.
- A steady-state phase for data aggregation, compression and transmission to the sink

LEACH is completely distributed and it requires no global knowledge of network it reduces energy consumption by

(a) Minimizing the communication cost between the sensors and their cluster heads
(b) Turning off non-head nodes as much as possible.

2.2.2 Hybrid Energy-Efficient Distributed Clustering (HEED)

HEED [24] extends the basic scheme of LEACH by using residual energy and node degree or density as a metric for the cluster selection to achieve power balancing. It operates in multi-hop networks, using an adaptive transmission power in the inter clustering communication. HEED was proposed with four primary goals namely prolonging network lifetime by distributing energy consumption, terminating the clustering process within a constant number of iterations, minimizing control overhead and producing well-distributed CHs and compact clusters.

2.2.3 Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN)

TEEN [25,26] is a hierarchical clustering protocol, which groups sensors into clusters with each led by a CH. The sensors within a cluster report their sensed data to their CH. The CH sends aggregated data to higher level CH until the data reaches the sink. Thus, the sensor network architecture in TEEN is based on a hierarchical grouping where the closer nodes form clusters. This process goes on to the second level until the base station (sink) is reached. TEEN is useful for applications where the users can control a trade-off between the energy efficiency, data accuracy, and response time dynamically

2.2.4 Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network Protocol (APTEEN)

APTEEN is an improvement to TEEN to overcome its shortcomings and it aims at both capturing periodic data collections and reacting to time-critical events. Thus, APTEEN is a hybrid clustering-based routing protocol that allows the sensor to send their sensed data periodically and react to any sudden change in the value of the sensed attribute by reporting the corresponding values to their CHs. The architecture of APTEEN is same as in TEEN, which uses the concept of hierarchical clustering for energy efficient communication between source sensors and the sink. APTEEN supports three different query types namely

- Historical query, to analyze past data values
- One-time query, to take a snapshot view of the network and

Persistent queries, to monitor an event for a period of time. APTEEN guarantees lower energy dissipation and keeps the larger number of Sensors alive.

2.2.5 Energy Efficient Homogenous Clustering Algorithm for Wireless Sensor Networks

Singh et al [27] proposed homogeneous clustering algorithm for Wireless Sensor Network that saves power and prolongs the network life. The life span of the network is increased by ensuring a homogeneous distribution of nodes in the clusters. A new cluster head is selected on the basis of the residual energy of existing cluster heads, holdback value, and nearest hop distance of the node. The homogeneous algorithm makes sure that each node is either a cluster head or a member of one of the clusters in the wireless sensor network. In the proposed clustering algorithm the cluster members are uniformly distributed and thus, the life of the network is more extended. Further, in the proposed protocol, only cluster heads broadcast cluster formation message and not the every node. Hence, it prolongs the life of the sensor networks. The emphasis of this approach is to increase the life span of the network by ensuring a homogeneous distribution of nodes in the clusters so that there is not too much receiving and transmitting overhead on a Cluster Head.

CHAPTER 3
LITERATURE SURVEY

3.1 Previous Work through the Literature Survey

2000: B. Karp, H. T. Kung, GPSR: greedy perimeter stateless routing for wireless networks: This work deals with position information that is used in many parts of the network infrastructure, including topology maintenance, medium access control (MAC) protocols and routing protocols like geographic routing [1], event localization, target tracking and sensed data mapping. Many algorithms have been proposed to solve this problem in different scenarios.

2003:W. Navidi, T. Camp, Stationary distributions for the random waypoint mobility model: The positions of the nodes change over time. The random waypoint mobility model is used to describe node movement. Under this model each node selects a destination point from the space and moves along a line towards it. In each time step the node moves a random distance chosen uniformly from the interval [0,δ] on this line When the node reaches the destination it selects a new destination point for the next time step. This model has been used extensively in this literature of Navidi et. al. **2004:**L. Hu, D. Evans, and Localization for mobile sensor networks: Several very good positioning algorithms have been proposed over the last decade. The seminal paper by Hu and Evans [14] proposed an algorithm called MCL that produced good positional accuracy in sensor networks with mobile nodes. This kicked offa series of work that all increased the positional accuracy, often without significant increase in computation or communication costs. All of these algorithms utilized the available location information very efficiently to greatly reduce positional error. **2009**: I. Constandache, S. Gaonkar, M. Sayler, R.R. Choudhury, L. Cox, Enloc: Energy efficient localization for mobile phones:Constandache et al [4] uses heuristics and mobility predictions to maximize the positional accuracy for a given energy budget. **2010 :** R. Zviedris, A. Elsts, G. Strazdins, A. Mednis, L. Selavo Lynxnet: wild animal monitoring using sensor networks: They have reported that the extra hardware modules attached to sensors to enable self-positioning often consume significant energy and results in faster battery draining for seed nodes [2]. In recent years the monetary cost and size of self-positioning hardware has decreased enough that equipping all sensors with these modules is becoming less prohibitive.

2010 : J. Paek, J. Kim, R. Govindan, Energy-efficient rate-adaptive GPS-based positioning for smartphones: Peak et al [5] store historical information about where GPS is not known to work well (e.g. urban areas) and use Bluetooth and a duty-cycled accelerometer to compute location uncertainty.

2010: R. Jurdak, P. Corker, D. Dharma, G. Salagnac, Adaptive GPS duty cycling and radio ranging for energy-efficient localization:
Jurdak et al [10]covered two important respects: first, it investigate the effect of duty cycling on far more sophisticated (and range-free) algorithms compared to them, and second, it do not use predictive mobility models.

3.1.1 Medium Access control

Communication is the major source of energy consumption in WSNs. The medium access Control protocols directly control the radio of the nodes in the network. The medium access Control protocols should be designed for regulating energy consumption which in turn increases the lifetime of the network. The various design issues of the Medium Access Control (MAC) protocols suitable for sensor network environment are.

The MAC layer provides fine-grained control of the transceiver and allows on and off switching of the radio. The design of the MAC protocol should have this switching mechanism to decide when and how frequently the on and off mechanism should be done.This helps in conserving energy. A MAC protocol should avoid collisions from interfering nodes, over-emitting, overhearing, control packet overhead and idle listening. When a receiver node receives more than one packet at the same time these packets are referred as The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S Mac (Sensor MAC)
Time-MAC and Wise-MAC
A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst. Thus, a node which has more data gets more time to access the medium “Collided Packets”, which are to be sent again thereby increasing energy consumption. When a destination node is not ready to receive

messages then it is said to be over-emitting. Overhearing occurs if a node picks up packets that were destined for some other node. The Sending and the receiving of less useful packets results in Control Overhead. An Idle Listening is an important factor as the nodes often hear the channel for possible reception of the data which is not sent. Scalability Adaptability and Decentralization are the other important criteria in designing a MAC protocol. The sensor network should adapt to the changes in the network size node density and topology. Also some nodes may die overtime, some may join and some nodes may move to different locations. A good MAC protocol should accommodate these changes to the network. A MAC protocol should have minimum latency and high throughput when the sensor networks are deployed in critical applications .A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst. Thus, a node which has more data gets more time to access the medium. There should be uniformity in reporting the events by a MAC protocol. Since the nodes are deployed randomly, nodes from highly dense area may face high contention among themselves when reporting events resulting in high packet loss consequently the sink detects fewer events from such areas. Also the nodes which are nearer to the sink transmit more packets than the nodes which are away from the sink The MAC protocols should take care of the well-known problem of Information asymmetry Which arises if a node is not aware of packet transmissions that are two hops away The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection, processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S-Mac (Sensor MAC), Time-MAC and Wise-MAC

3.1.2 Drawbacks in the existing system analysis

Above works has assumed that every node is capable of self-positioning but governs the use of that module by activation and deactivation to conserve battery capacity. While they come up with several simple, intuitive strategies for activation it is far from clear how these strategies perform. We analyzed that several different activation strategies for duty cycling the self-positioning module using simulations and report their performance Specifically we they show that effective duty cycling strategies not only save energy but can reduce the mean positional error. There is a trade-off between battery power consumed in self-positioning and the positional error achieved. Higher numbers of seeds decrease the positional error and increase the energy consumption, and vice versa.

CHAPTER 4

PROBLEM FORMULATION

We will discuss a conventional clustering approach to routing and the drawbacks of using such an approach when the nodes are all energy-constrained. Using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. This will quickly drain the battery of the nodes and reduce the system lifetime. However, the only receptions in this protocol occur at the base station, so if either the base station is close to the nodes, or the energy required to receive data is large, this may be an acceptable (and possibly optimal) method of communication. The second conventional approach we consider is a "minimum-energy routing protocol. There are several power-aware routing protocols discussed in the literature. In these protocols, nodes route data destined ultimately for the base station through intermediate nodes. Thus nodes act as routers for other nodes' data in addition to sensing the environment. These protocols differ in the way the routes are chosen. Some of these protocols [6, 10, 14], only consider the energy of the transmitter and neglect the energy dissipation of the receivers in determining the routes. In this case, the intermediate nodes are chosen such that the transmit amplifier energy (e.g., ET xamp(k; d) = amp k d2 is minimized; thus node A would transmit to node C through node B if and only if: ET xamp(k; d = dAB) + ET xamp(k; d = dBC) < ET xamp(k; d = dAC) (3) or d 2 AB + d 2 BC < d2 AC (4) However, for this minimum-transmission-energy (MTE) routing protocol, rather than just one (high-energy) transmit of the data, each data message must go through n (low energy) transmits and n receives. Depending on the relative costs of the transmit amplifier and the radio electronics, the total energy expended in the system might actually be greater using MTE routing than direct transmission to the base station. To illustrate this point, consider the linear network shown in Figure 2, where the distance between the nodes is r. If we consider the energy expended transmitting a single k-bit message from a node located a distance nr from Base Station r n nodes. Simple linear network. the base station using the direct communication approach and Equations 1 and 2, we have: Edirect = ET x(k; d = n r) = Eelec k + amp k (nr)2 = k(Eelec + ampn2r 2) (5) In MTE routing, each node sends a message to the closest node on the way to the base station. Thus the node located a distance nr from the base station would require n transmits a distance r and n 1 receives. EMTE = n ET x(k; d = r)+(n 1) ERx(k) = n(Eelec k + amp k r 2)+(n 1) Eelec k = k((2n 1)Eelec + ampnr2) (6) Therefore, direct communication requires less energy thMT routing if: Edirect < EMTE Eelec + ampn2r 2 < (2n 1)Eelec + ampnr2 Eelec amp > r 2n 2 (7) Using Equaion.

4.1 Algorithm

4.1.1 Euclidean distance algorithm.

Finding the closet pair of point

We now consider the problem of finding the closet .pair of points in a set q of n greater than 2 points are" closest" refers to the usual Euclidean distance .Distance the distance between point p1=(x1,y1) and p2=(x2,y2) is root of ($(x1-x2)^2+(y1-y2)^2)^{1/2}$ two point is the set q be continue In which case the distance between there is zero. This problem has application is

```
Euclid (a,b)
    if b==0
    return a
else  return EUCLID(b, a mod b)
```

An example of the running of EUCLID, consider the computation of gcd (30 , 21).

Euclid (30,21) = Euclid (21,9)
= Euclid (9, 3)
= Euclid (3,0)
= 3.

For the examples of the Euclidean algorithm are used to traffic control systems a system for controlling air or sea traffic might need to identity the two closet vehicles in order to potential collisions.

CHAPTER 5
METHODOLOGY

6.1 Solution Methodology

The devices are represented by a set of n nodes= {u1,...,un}and a two-dimensional Euclidean space R where a transmitted message can be received by another node. This work uses the unit disk model of communication where the communication. The positions of the nodes change over time. The random waypoint mobility model is used to describe node movement. Under this model each node selects a destination point from the space R a line towards it. In each time step the node moves a random distance chosen uniformly from the interval. The nodes in the system under consideration are mobile so their position is always changing which necessitates periodic position estimation. It is assumed that each node in the system is equipped with a GPS unit that can be activated and deactivated at the discretion of the node. When a GPS unit at a node i is activate dit provides the node with its position pt (i) but consumes a large amount of energy. When a GPS unit is deactivated a nodes relies on a network positioning algorithm to estimate its position. The objective of this work is to investigate strategies that balance the use of the GPS unit with the need to conserve energy .A GPS activation strategy is a component of a positioning algorithm and determines when a node's. GPS unit is active. If a GPS unit is active a node knows its position. Three activation strategies have been formulated for this work: fixed, random and error. The activation strategy is integrated formulated for this work: fixed, random and error.

5.1.1 System Architecture

- Define maximum no. of nodes, n
- Display y axis of field length (meters)
- N=20
- Define maximum field length where nodes are placed
- M=100
- generate x and y position of nodes
- Display neighboring node id for each node.

- Display current x and y position for nodes at each step.
- Initial position of nodes:
- id x position y position
- 1 81 66
- 2 91 4
- 3 13 85
- 4 91 93
- 5 63 68
- 6 10 76
- 7 28 74
- 8 55 39
- 9 96 66
- 10 96 17
- 11 16 71
- 12 97 3
- 13 96 28
- 14 49 5
- 15 80 10
- 16 14 82
- 17 42 69
- 18 92 32
- 19 79 95
- 20 96 3

5.1.2 Show Neighbor nodes

- node 1has neighbor node 1 4 5 9 19
- node 2has neighbor node 2 10 12 13 15 18 20
- node 3has neighbor node 3 6 7 11 16
- node 4has neighbor node 1 4 9 19
- node 5has neighbor node 1 5 17

- node 6has neighbor node 3 6 7 11 16
- node 7has neighbor node 3 6 7 11 16 17
- node 8has neighbor node 8
- node 9has neighbor node 1 4 9
- node 10has neighbor node 2 10 12 13 15 18 20
- node 11has neighbor node 3 6 7 11 16 17
- node 12has neighbor node 2 10 12 13 15 18 20
- node 13has neighbor node 2 10 12 13 15 18 20
- node 14has neighbor node 14
- node 15has neighbor node 2 10 12 13 15 18 20
- node 16has neighbor node 3 6 7 11 16
- node 17has neighbor node 5 7 11 17
- node 18has neighbor node 2 10 12 13 15 18 20
- node 19has neighbor node 1 4 19
- node 20has neighbor node 2 10 12 13 15 18 20

5.1.3 Show Node Current Position

- X position Y position
- 79.0399 66.7841
- 89.5388 4.9155
- 13.7209 83.5791
- 92.9085 90.2813
- 63.6694 65.3563
- 11.0050 74.3021
- 29.2039 74.8094
- 57.1188 40.4856
- 94.6405 64.7399
- 95.9737 15.9417
- 15.6578 72.2514

- 94.9313 1.3513
- 95.2052 30.1452
- 48.0546 6.6502
- 80.9776 9.4152
- 11.7105 80.2852
- 44.4311 67.1138
- 91.7399 30.2732
- 77.3767 94.8570
- 95.6350 -0.1469

5.1.4 Calculate Node Distance

- **0 63 67 27 15 68 50 34 16 54 64 67 40 68 57 69 35 39 28 69**
- **63 0 109 85 66 105 92 48 60 13 100 6 26 42 10 108 77 25 91 8**
- **67 109 0 79 53 10 18 61 83 106 11 116 97 84 100 4 35 94 65 117**
- **27 85 79 0 38 83 66 61 26 74 79 89 60 95 82 82 54 60 16 90**
- **15 66 53 38 0 53 36 26 31 59 49 71 47 61 59 54 19 45 33 73**
- **68 105 10 83 53 0 18 57 84 103 5 111 95 77 95 6 34 92 69 113**
- **50 92 18 66 36 18 0 44 66 89 14 99 80 71 83 18 17 77 52 100**
- **34 48 61 61 26 57 44 0 45 46 52 54 39 35 39 60 29 36 58 56**
- **16 60 83 26 31 84 66 45 0 49 79 63 35 74 57 84 50 35 35 65**
- **54 13 106 74 59 103 89 46 49 0 98 15 14 49 16 106 73 15 81 16**
- **64 100 11 79 49 5 14 52 79 98 0 106 90 73 91 9 29 87 66 108**

- **67 6 116 89 71 111 99 54 63 15 106 0 29 47 16 115 83 29 95 2**
- **40 26 97 60 47 95 80 39 35 14 90 29 0 53 25 97 63 3 67 30**
- **68 42 84 95 61 77 71 35 74 49 73 47 53 0 33 82 61 50 93 48**
- **57 10 100 82 59 95 83 39 57 16 91 16 25 33 0 99 68 23 86 18**
- **69 108 4 82 54 6 18 60 84 106 9 115 97 82 99 0 35 94 67 116**
- **35 77 35 54 19 34 17 29 50 73 29 83 63 61 68 35 0 60 43 85**
- **39 25 94 60 45 92 77 36 35 15 87 29 3 50 23 94 60 0 66 31**
- **28 91 65 16 33 69 52 58 35 81 66 95 67 93 86 67 43 66 0 97**
- **69 8 117 90 73 113 100 56 65 16 108 2 30 48 18 116 85 31 97 0**

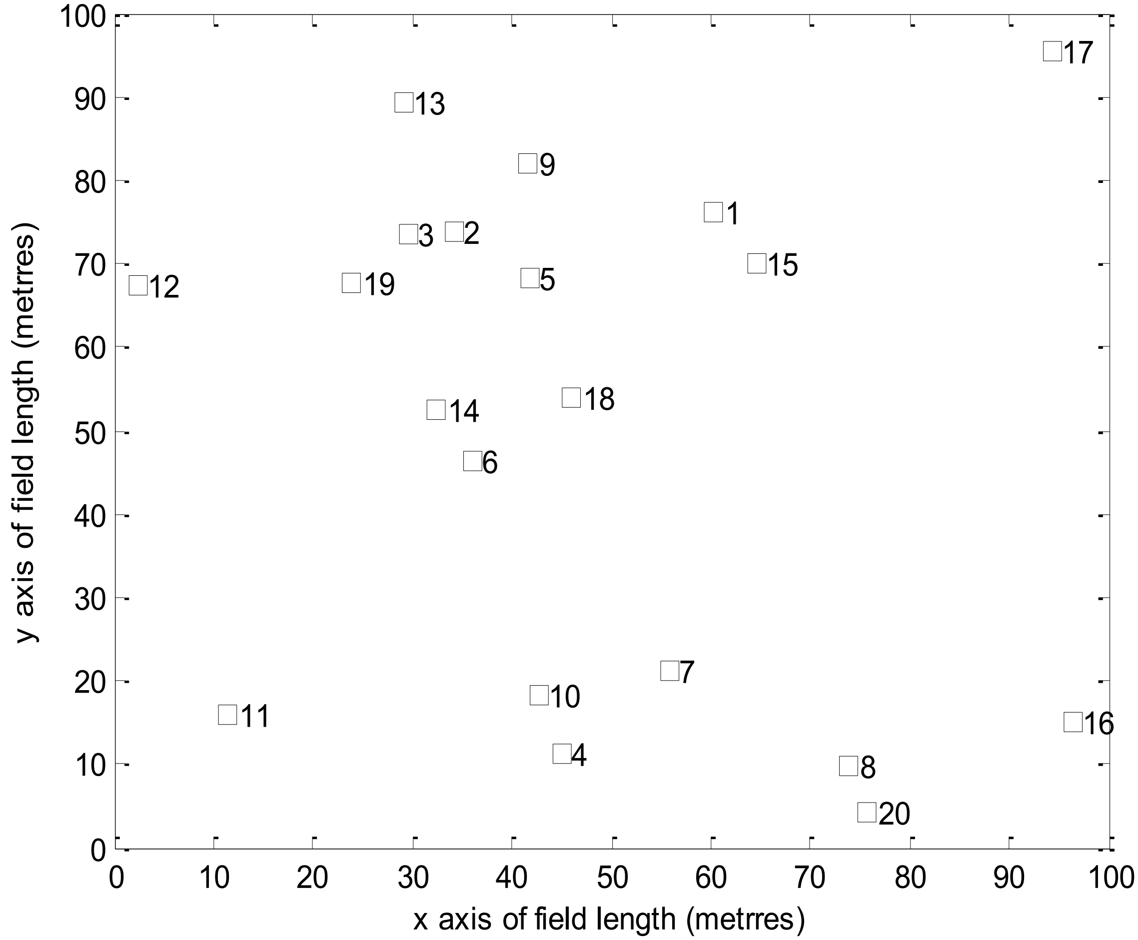

Fig Old Position

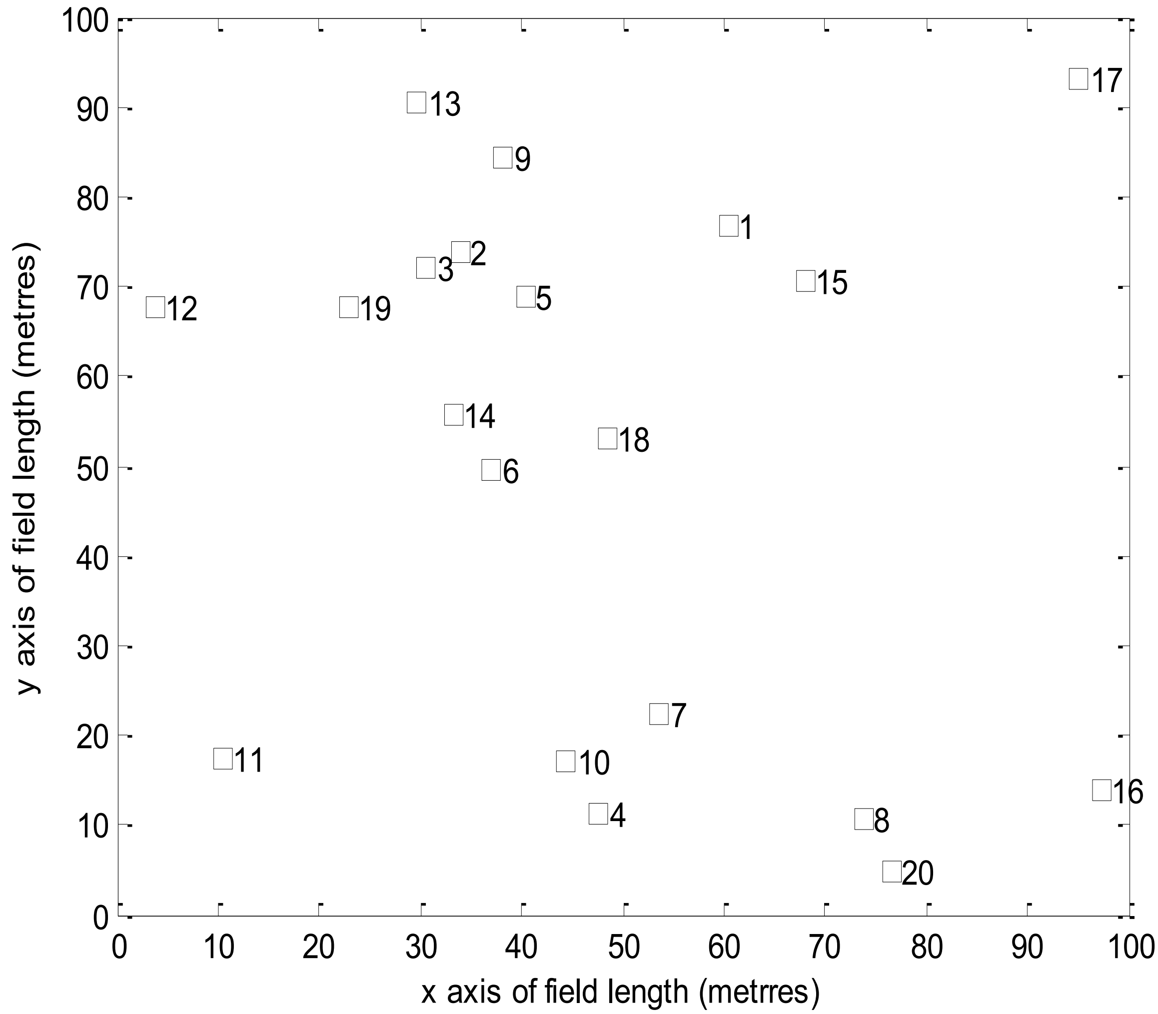

Fig Old position

CHAPTER 6

RESULT

6.1 show result

When an n>2 point (node) are deploy at the time then the two node are point are same position but distance are zero then the individual sensor are dying quickly and avid the battery depletion and save the energy of battery.

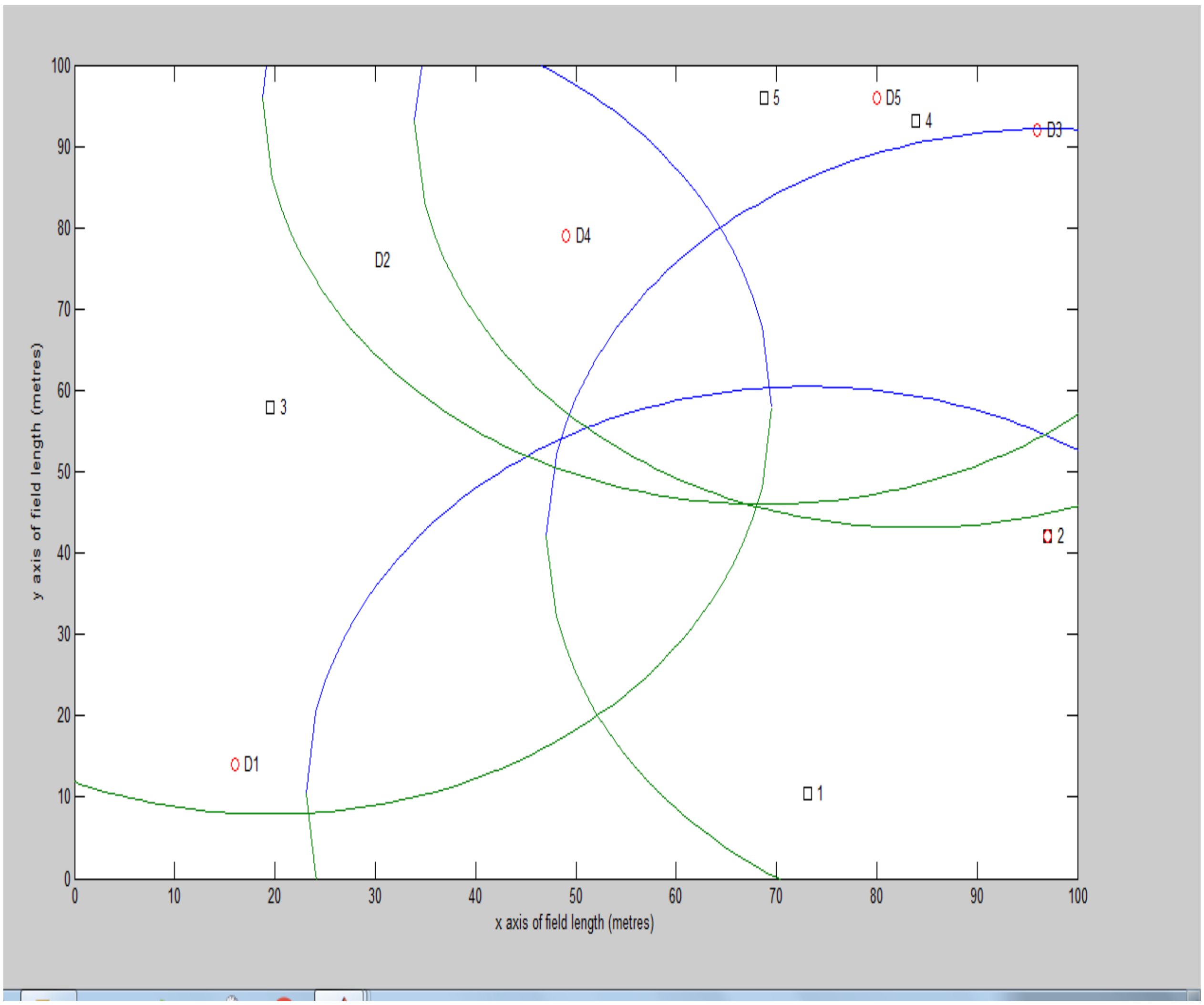

Fig- result

A computer simulation using mat lab that implements the model described below will be extended to evaluate the GPS activation strategies.

- The purpose of the evaluation of the strategies is to compare the performance of the three strategies in terms of positional error and energy usage.
- The expected positional error will be considered as performance measurement for reporting the quality of a positioning algorithm.
- The differences in energy consumption between the strategies due to computation will be compared to the requirements of a GPS unit.
- The simulation will be conducted on a system of $n = 80$ nodes that reside in a field of size 1000×1000 meters. The initial location for each is completely random.
- The communication range of each node will be $r = 100$ meters. The simulation is executed for 1000 time steps.
- Energy consumption will be measured by the mean number of GPS activations per time step. The mean number of GPS activations per time step used for all activation strategies. The values will be determined based on the mean number of GPS activations for a given error threshold b. The positional error over time will be related to node speed δ so a range of activations will be determined different node speeds.
- In the event the positional error exceeds the threshold and the node has the largest positional error when compared to its first and second neighbor nodes, the GPS unit at the node is activated. The GPS unit is deactivated at the beginning of each time step.
- The basis for this strategy is to improve positional error in regions with high positional error and limit the number of activations in a local region of the network.

CHAPTER 7

Conclusion and Future Scope

Above works has assumed that. Every node is capable of self-positioning but governs the use of that module by activation and deactivation to conserve battery capacity. While they come up with several simple intuitive strategies for activation, it is far from clear how these strategies perform Weanalysed that several different activation strategies for duty cycling the self-positioning module using simulations and report their performance. Specifically we they show that effective duty cycling strategies not only save energy but can reduce the mean positional error. There is a trade-off between battery power consumed in self-positioning and the positional error achieved. Higher numbers of seeds decrease the positional error and increase the energy consumption, and vice versa.

In the event the positional error exceeds the threshold and the node has the largest positional error when compared to its first and second neighbor nodes, the GPS unit at the node is activated. The GPS unit is deactivated at the beginning of each time step. The basis for this strategy is to improve positional error in regions with high positional error and limit the number of activations in a local region of the network. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of messages. The devices are mobile so the position of a sensor can change over time. The model describes the environment, wireless communication and mobility of the devices. The dynamics of the system of devices are captured in discrete time steps. In each time step a node can communicate, perform some computation, and change its location. We will assume that every node is capable of self-positioning but activates that module selectively. This allows for balancing the energy costs of self-positioning among all nodes and results in reduced positional error.

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CHAPTER 1

INTRODUCTION

1.1 Wireless Sensor Network

Wireless Sensor Network (WSN) is a group of Sensor Nodes (SNs) that work in the uncontrolled areas, organized into a cooperative network. It is composed of a huge number of sensor nodes which can monitor the environment by collecting, processing as well as transmitting collected data to the remote sink node through direct or multi hop transmission.Wireless Sensor Network (WSN) is a collection of large number of sensor nodes deployed in a particular region. The positioning of wireless nodes has been an active research area over the last decade. Many network positioning algorithms have been proposed to solve this problem. The problem of positioning, or the estimation of the geographical positions of wireless nodes in ad hoc and sensor networks. The position information is used in many parts of the network infrastructure, including topology maintenance, medium access control (MAC) protocols and routing protocols like geographic routings, event localization, target tracking and sensed data mapping. Node positions in the global co-ordinate system. For this they have to assume that a fixed set of nodes (called seed nodes) have some mechanism to position themselves at all times. One such mechanism is GPS. The other nodes estimate their positions based on positional information of other nodes obtained using wireless communication. This is sometimes called *network positioning.* Recent advances in MEMS based sensor technology, low-power analog and digital electronics, and low-power RF design have enabled the development of relatively inexpensive and low-power wireless micro sensors. These sensors are not as reliable or as accurate as their expensive macro sensor counterparts, but their size and cost enable applications to network hundreds or thousands of these micro sensors in order to achieve high quality, fault tolerant sensing networks. Reliable environment monitoring is important in a variety of commercial and military applications For example, for a security system, acoustic, seismic, and video sensors can be used to form an ad hoc network to detect intrusions. Micro sensors can also be used to monitor machines for fault detection and diagnosis. Micro sensor networks can contain hundreds or thousands of sensing nodes. It is desirable to make these nodes as cheap and energy-efficient as possible and rely on their large numbers to obtain high quality results. Network protocols must be designed to achieve fault tolerance in the presence of individual node failure while minimizing energy consumption. In addition the data being sensed by the nodes in the network must be transmitted to a control center or base station, where the end-user can access the data. Are many possible models for these micro sensor networks in this work, we consider micro sensor networks where: The base station Fixed and located far from the sensors. All nodes in the network are homogeneous and energy constrained. Thus communication between the sensor nodes and the base station is expensive, and there are no "high energy" nodes through which communication can proceed This is the framework for MIT's -AMPS project, which focuses on innovative energy optimized solutions at all levels of the system hierarchy, from the physical layer and communication protocols up to the application layer and efficient DSP design for micro sensor nodes. Sensor networks contain too much data for an end-user to process. Therefore automated methods of combining or aggregating the data into a small set of meaningful information is required. In addition to helping avoid information overload, data aggregation also known as data fusion, can combine several unreliable data measurements to produce a more accurate signal by enhancing the common signal and reducing the uncorrelated noise The classification Proceedings of the 33rd Hawaii International Conference on System Sciences - 2000 0-7695-0493-0/00 $10.00 (c) 2000 IEEE 1 performed on the aggregated data might be performed by a human operator or automatically. Both the method of performing data aggregation and the classification algorithm are application-specific In many WSN applications, the deployment of sensor nodes is performed in an Ad-hoc fashion without careful planning and engineering. Once deployed, the sensor nodes must be able to autonomously organize themselves into a wireless communication network. The Sensor nodes are battery-powered and are expected to operate without the attendance for a relatively long period of time. In most cases it is very difficult and even impossible to change or recharge batteries for the sensor nodes. WSNs are characterized with denser levels of sensor node deployment, higher unreliability of sensor nodes, severe power computation and memory constraints. Thus, the unique characteristics and constraints present many new challenges for the development and application of Wireless Sensor Networks

For example, acoustic signals are often combined using a beam forming algorithm to reduce several signals into a single signal that contains the relevant information of all the individual signals. Large energy gains can be achieved by performing the data fusion or classification algorithm locally, thereby requiring much less data to be transmitted to the base station. For example, flooding is a technique in which a given node broadcast data and control packets that it has received from the rest of the nodes in the network. This process repeats until the destination node is reached. This technique does not take into account about the energy constraint imposed by WSNs. The sensor nodes are organized in a random manner as in Figure 1.1.

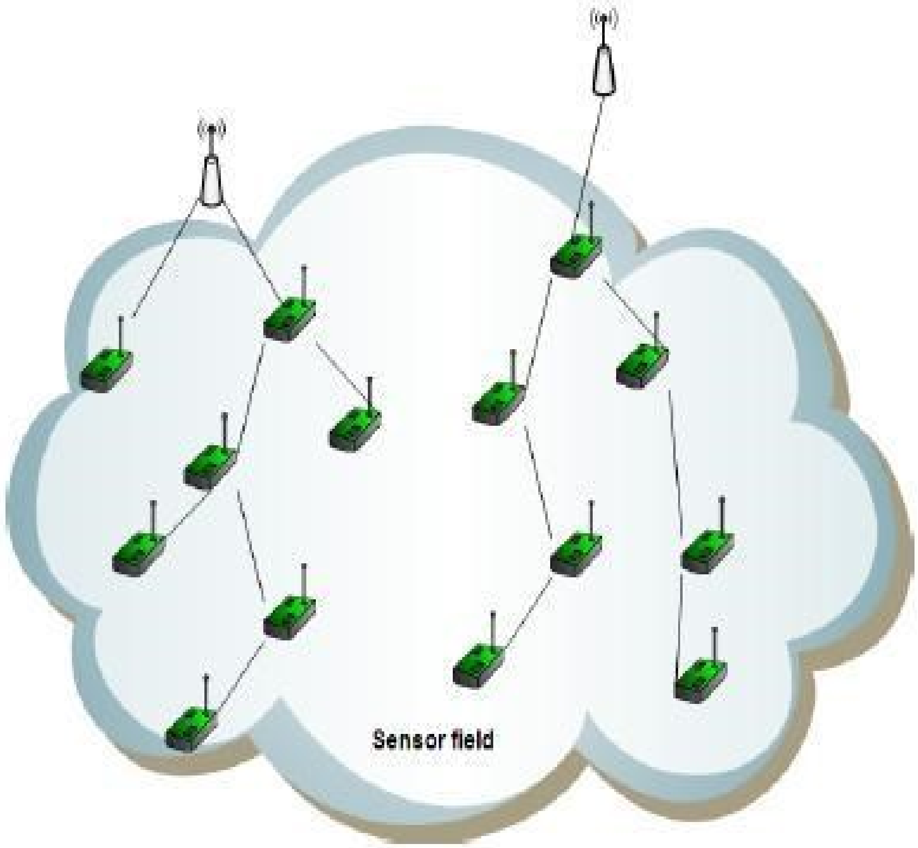

Figure 1.1 Architecture of Wireless Sensor Networks [1]

When data routing is used in WSNs, it lead to problems such as implosion and overlap Flooding is a blind technique an which has duplicated .packets that are kept to circulate in the Network and hence sensors will receive those duplicated packets, causing an implosion problem Also, when two sensors sense the same region and broadcast their sensed data, at the same time their neighbors will receive duplicated packets. To overcome this flooding another technique known as gossiping can be applied. In gossiping technique, when receiving a packet a sensor would select randomly one of its neighbor and send the packet to it. The same process repeats until all sensors receive this packet. Using gossiping, a given sensor would receive only one copy of a packet being sent. While gossiping tackles the implosion problem, there is a significant delay for a packet to reach all sensors in a network Furthermore, these inconveniences are highlighted when the number of nodes the network increases. The emerging field of wireless sensor network combines the sensing, computation and communication into a single tiny device. Through advanced mesh networking protocols these devices form a sea of connectivity. As water flows to fill every room of a submerged ship, the mesh networking connectivity will seek out and exploit any possible communication path by hopping data from node to node in search of its destination. With the capabilities of single device, the composition of hundreds of devices offers new technological possibilities Smart environments represent the next evolutionary development step in building utilities industries, home, shipboard, transportation and system's automation. Like any sentient organism, the smart environment relies first and foremost on sensory data from the real world. Sensory data comes from multiple sensors of different modalities in distributed locations. The challenges in the hierarchy of detecting the relevant quantities monitoring and collecting the data, assessing and evaluating the information formulating meaningful user displays, and performing decision-making and alarm functions are enormous. The network increases. The he emerging field of wireless sensor network combines the Sensing computation and communication into a single tiny device through advanced mesh networking protocols, these devices form a sea of connectivity. As water flows to fill every room of a submerged ship, the mesh networking connectivity will seek out and exploit any possible communication path by hopping data from node to node in search of its destination .with the capabilities of single device, the composition of hundreds of devices offers a new technological possibilities. Smart environments represent the next evolutionary development step in building utilities industries home shipboard transportation and system

1.2 Issues in WSN

The major issues that affect the design and performance of a wireless sensor network are as follows:

1.2.1 Hardware and Operating System for WSN

Wireless Sensor Networks are composed of hundreds of thousands of tiny devices called nodes. A sensor node is often abbreviated as a node. A sensor is a device which senses the information and passes the same on to a mote. The sensors are used to measure the changes in the physical environment like pressure, humidity, sound, vibration and changes in the health parameters of the person like blood pressure, stress and heartbeat. A mote consists of processor, memory, battery, A/D converter for connecting to a sensor and a radio transmitter for forming an ad hoc network. A Mote and Sensor together form a Sensor Node. The structure of a sensor node is shown in Figure 1.2. There can be different sensors for different purposes mounted on a Mote.

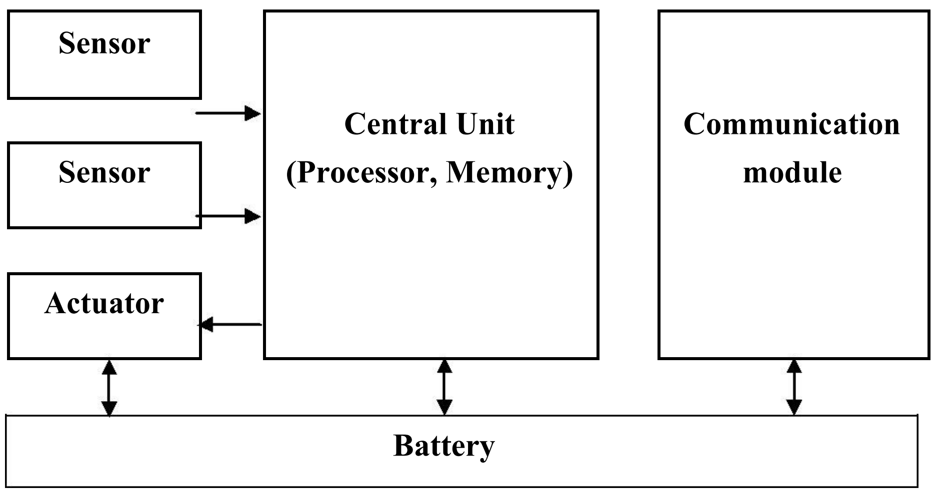

Figure 1.2 Structure of Sensor Node [2]

The nodes used in sensor networks are small and have significant energy constraints. The hardware design issues of sensor nodes are quite different from other applications and they are Radio Range of nodes should be high (1-5 kilometers). Radio range is critical for ensuring network connectivity and data collection in a network, as the environment being monitored may not have an installed infrastructure for communication. In many networks the nodes may not establish connection for many days or may go out of range after establishing connection. Use of Memory Chips like flash memory is recommended for sensor networks as they are non-volatile and inexpensive. Energy Consumption of the sensing device should be minimized and sensor nodes should be energy efficient since their limited energy resource determines their lifetime. To conserve power, the node should shut off the radio power supply when not in use. Battery type is important since it can affect the design of sensor nodes. A Battery Protection Circuit to avoid overcharge or discharge problems can be added to the sensor nodes. Sensor Networks consist of hundreds of thousands of nodes. It is preferred only if the node is cheap.

1.3.1 Wireless Communication Characteristics

The performance of wireless sensor networks depends on the quality of wireless communication. But, wireless communication in sensor networks is known for its unpredictable nature .Main design issues for communication in WSNs are: Low Energy Consumption in sensor networks is needed to enable long operating lifetime by facilitating low duty cycle operation and local signal processing. Distributed Sensing effectively acts against various environmental obstacles and care should be taken that the signal strength, consequently the effective radio range is not affected by various factors like reflection, scattering and dispersions. Multiple Networking may be adapted among the sensor nodes to reduce communication link range. The density of the sensor nodes should be high. Communication Systems should include error control subsystems to detect errors and to correct them.

1.3.2 Medium Access Control (MAC)

Communication is the major source of energy consumption in WSNs. The medium access Control protocols directly control the radio of the nodes in the network. The medium access Control protocols should be designed for regulating energy consumption which in turn increases the lifetime of the network. The various design issues of the Medium Access Control (MAC) protocols suitable for sensor network environment are The MAC layer provides fine-grained control of the transceiver and allows on and off switching of the radio. The design of the MAC protocol should have this switching mechanism to decide when and how frequently the on and off mechanism should be done. This helps in conserving energy.

A MAC protocol should avoid collisions from interfering nodes over emitting overhearing control packet overhead and idle listening. When a receiver node receives more than one packet at the same time, these packets are referred as “Collided Packets”

Which are to be sent again thereby increasing energy consumption. When a destination node is not ready to receive messages then it is said to be over-emitting Overhearing occurs if a node picks up packets that were destined for some other node. The Sending and the receiving of less useful packets results in Control Overhead An Idle Listening is an important factor as the nodes often hear the channel for possible reception of the data which is not sent. Scalability Adaptability and Decentralization are the other important criteria in designing a MAC protocol the sensor network should adapt to the changes in the network size, node density and topology. Also some nodes may die overtime, some may join and some nodes may move to different locations. A good MAC protocol should accommodate these changes to the network. A MAC protocol should have minimum latency and high throughput when the sensor networks are deployed in critical applications. A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst Thus, a node which has more data gets more time to access the medium. There should be uniformity in reporting the events by a MAC protocol. Since the nodes are deployed randomly, nodes from highly dense area may face high contention among themselves when reporting events resulting in high packet loss consequently the sink detects fewer events from such areas. Also the nodes which are nearer to the sink transmit more packets than the nodes which are away from the sink. The MAC protocols should take care of the well-known problem of Information asymmetry which arises if a node is not aware of packet transmissions that are two hops away The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection, processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S-Mac (Sensor MAC) Time MAC and Wise-MAC

1.3.3 Deployment

Deployment means setting up an operational sensor network in a real world environment. Deployment of sensor network is a labor intensive and cumbersome activity as it does not have influence over the quality of wireless communication Sensor Nodes can be deployed either by placing one after another in a sensor field or by dropping it from a plane. The following are the deployment issues which has to be taken into account when the sensor nodes are deployed in the real world, Node death due to energy depletion is either caused by normal battery discharge or due to short circuits arises. This is a common problem which may lead to wrong sensor readings. Also sink nodes act as gateways and they store and forward the data collected. Hence, problems affecting sink nodes should be detected to minimize data loss. Deployment of sensor networks result in the network congestion due to many concurrent transmission attempts made by several sensor nodes. Concurrent transmission attempts occur due to an inappropriate design of the MAC layer or by repeated network floods. Another issue is the physical length of a link.Two nodes may be very close to each other but still they may not be able to communicate due to the physical interference in the real world while nodes which are far away may communicate with each other. Low data yield is another common problem in the real world deployment of sensor nodes. Low data yield refers to the insufficient amount of information delivered by the network. Self-Configuration of the sensor networks without human intervention is needed due to random deployment of sensor nodes.

1.3.4 Localization

The Sensor localization is the fundamental and crucial issue for network management and operation. In many of the real world scenarios the sensors are deployed without knowing their positions in advance and also there is no supporting infrastructure available to locate and manage them once they are deployed. Determining the physical location of the sensors after they have been deployed is known as the problem of localization the location discovery or localization algorithm for a sensor network should satisfy the following requirements the localization algorithm should be distributed since a centralized approach requires high computation at selective nodes for estimating the position of nodes in the whole environment. This increases signaling bandwidth and also puts extra load on nodes close to the center node. Knowledge of the node location can be used for implementing energy efficient message routing protocols in sensor networks the localization algorithms should be robust enough to localize the failures and loss of nodes it should be tolerant to error in physical measurements. The precision of the localization increases with the number of beacons a beacon is a node which is aware of its location but the main problem with increased beacons is that they are more expensive than other sensor nodes. Once the unknown stationary nodes have been localized using beacon nodes then the beacons become useless. The techniques that depend on measuring the ranging information from signal strength and time of arrival requires specialized hardware which is typically not available on the sensor nodes.

1.3.5 Calibration

Calibration is the process of adjusting the raw sensor readings obtained from the sensors into corrected a values by comparing it with some standard values Manual calibration of sensors is a sensor network is at the time consuming and difficult task due to the failure of sensor nodes and random noise which makes manual calibration of the sensors is too expensive. Various Calibration issues in sensor networks are as follows;

- A sensor network consists of large number of sensors typically with no calibration interface.
- Access to individual sensors in the field can be limited.
- The reference values might not be readily available.
- Different applications require different calibration.
- It requires calibration in a complex dynamic environment with many observables like ageing, decaying, damages etc.
- Other objectives of calibration include accuracy resiliency against the random errors ability to be applied in various scenarios and to address a variety of error models

1.3.6 Network Layer

Over the past few years sensor networks are being built for specific applications and routing is important for sending the data from sensor nodes to the Base Station (BS).The various issues at the Network Layer includes Energy efficiency is a very important criterion. The network layer needs to find various methods for discovering energy efficient routes and for relaying the data from the sensor nodes to the base station so that the lifetime of a network can be optimized. Routing Protocols should incorporate multipath design technique. Multi-path is referred to those protocols which set up multiple paths so that a path among them can be used when the primary path fails. Path repair is desired in routing protocols whenever a path break is detected. Fault tolerance is another desirable property for routing protocols. Routing protocols should be able to find a new path at the network layer even if some nodes fail or blocked due to some environmental interferences.

- The sensor networks collect information from the physical environment and are highly data centric In the network layer in order to maximize the energy savings a flexible platform for performing routing and data management has to be provided

- The data traffic that is the generated will have a significant. Redundancy among individual sensor nodes. Since multiple sensors may generate same data within the vicinity of a phenomenon. The routing protocol should exploit such redundancy to improve energy and bandwidth utilization.

1.3.7 Transport Layer

The End to End reliable communication is provided at the Transport layer The various design issues for Transport layer protocols are.

- In transport layer the messages are fragmented into several segments at the transmitter and reassembled at the receiver. Therefore a transport protocol should ensure orderly transmission of the fragmented segments.

- Limited bandwidth results in congestion which impacts normal data exchange and may also lead to packet loss.

- Bit error rate also results in packet loss and also wastes energy. A transport protocol should be reliable for delivering data to potentially large group of sensors under extreme conditions.

- The End to End communication may suffer due to the various reasons such as the placement of nodes is not predetermined and external obstacles may cause poor communication performance between the two nodes If this type of the Problem is encountered then end to end communication will suffer. Another problem is failure of nodes due to battery depletion.

- In the sensor networks, the loss of data, when it flows from source to sink is generally tolerable. But the data that flows from sink to source is sensitive to message loss.

1.3.8 C Data Aggregation and Data Dissemination

The Data Aggregation is defined as the process of aggregating the data from multiple sensors to eliminate redundant transmission and then providing fused information to the base station. Some design issues in the data aggregation are.

The sensor networks are inherently unreliable and certain information may be unavailable or expensive to obtain. It is also difficult to obtain complete and up-to date information of the neighboring sensor nodes to gather information. Making some of the nodes to transmit the data directly to the base station or to have less transmission of data to the base station to minimize energy. Eliminating transmission of the redundant data using meta- data negotiations improving clustering techniques for data aggregation to conserve energy of the sensors. Improving In-Network aggregation techniques to enhance energy efficiency.in-Network aggregation means sending partially aggregated values rather than raw values, thereby reducing the energy consumption. The Data dissemination is a process by which data and the queries for the data are routed in the sensor network. The Data dissemination is a two-step process. In the first step, if a node is interested in some events like temperature or humidity, Network. In the second step, the nodes that have the requested data will send the data back to the source node after receiving the request. The main difference between the data aggregation and the data dissemination is that, in data dissemination all the nodes including the base station can request for the data and in data aggregation all the aggregated data is transmitted to the base station periodically In addition, during the data aggregation the data can be transmitted periodically, while in data dissemination the data is always transmitted on demand.

1.3.9 Quality of Service

The Quality of service (QoS) is the level of service provided by the sensor networks to its users. Quality of Service for sensor networks is the optimum number of sensors sending information towards information-collecting sinks or a base station. The sensor networks are getting implemented in more number of applications which includes the mission critical applications such as the military applications and the nuclear plant monitoring applications QoS is being given considerable review as the events occurring in these situations are of utmost importance. The QoS routing algorithms for wired networks cannot be directly applied to Wireless Sensor Networks. The performance of the most wired routing algorithms relies on the availability of the precise state information. The nodes in the sensor network may join, leave, and rejoin, and links may break at any time Hence maintaining and re-establishing the paths dynamically is a problem in Wireless Sensor Networks and it is not a big issue in wired networks Many times routing in the sensor networks need to sacrifice the energy efficiency to meet delivery requirements Even though multichip reduce the amount of energy consumed for data collection, the overhead associated with it may slow down the packet delivery. Also redundant data makes routing a complex task for data aggregation thereby affecting the Quality of Service in WSN Buffering in routing is advantageous as it helps to receive many packets before forwarding them. But multichip routing requires buffering of huge amount of data This limitation in buffer size will increase the delay. The packets that occur while travelling on different routes and even on the same route make it difficult to meet QoS requirements. The QoS designed for WSN should be able to support scalability. Adding or removing of the nodes should not affect the QoS of the Wireless Sensor Networks.

1.3.10 Security

In many applications security in the sensor networks is an important factor as the performance and the low energy consumption. Security in a sensor network is challenging as WSN is not only being deployed in battlefield applications but also for surveillance, building monitoring and burglar alarms and in critical systems such as airports and hospitals. Since the sensor networks are still a developing technology Researchers and developers agree that their efforts should be concentrated in developing and integrating security from the initial phases of sensor application developments. By doing so, a stronger and complete protection against illegal activities can be provided and at the same time stability of the systems can also be maintained. Following are the basic security requirements to which every WSN application should adhere to: The Confidentiality is needed to ensure sensitive information which is to be well protected and not revealed to unauthorized third parties during the communication process confidentiality is required in sensor networks to protect information

1.4. Mobility Based Protocols

Mobility brings new challenges to routing protocols in WSNs. The sink mobility requires energy efficient protocols to guarantee the data delivery originated from source sensors towards mobile sinks.

1.4.1 Data MULES Based Protocol

Data MULE based Protocol was proposed to address the need of guaranteeing cost effective connectivity in a sparse network while reducing the energy consumption of the sensors [28]. It is a three-tier architecture based on mobile entities called Mobile Ubiquitous LAN Extensions (MULE).

1.4.2 Scalable Energy-Efficient Asynchronous Dissemination (SEAD)

SEAD is a self-organizing protocol, which was proposed to trade-off between minimizing the forwarding delay to a mobile sink and the energy savings. SEAD considers data dissemination in which a source sensor reports its sensed data to multiple mobile sinks and consists of three main components namely the dissemination tree (d-tree) construction, data dissemination and maintaining linkages to mobile sinks.

1.4.3 Dynamic Proxy Tree Based Data Dissemination

A dynamic proxy tree based data dissemination framework [29] is proposed for maintaining a tree connecting a source sensor to multiple sinks that are interested in the source. This helps the source to disseminate its data directly to those mobile sinks. In this framework, a network is composed of stationary sensors and several mobile hosts called sinks. The sensors are used to detect and continuously monitor some mobile targets while the mobile sinks are used to collect data from specific sensors called sources, which may detect the target and periodically generate detected data or aggregate detected data from a subset of sensors. Because of the target mobility, a source may change and a new sensor closer to the target may become a source. Each source is represented by a stationary source proxy and each sink is represented by a stationary sink proxy. The source and sink proxies are temporary in the sense that they change as the source sensors change and the sinks move. A source will have a new source proxy only when the distance between the source and its current proxy exceeds a certain threshold. Likewise, a sink will have a new sink proxy only when the distance between the sink and its current proxy exceeds a certain threshold. The design of such proxies reduces the cost of pushing data and querying data from the source and the sink proxies.

1.5 Multipath Based Protocols

1.5.1 Disjoint Paths

Sensor disjoint multipath routing [30,31] is a multipath protocol. In the sensor-disjoint path routing, the primary path is the best available, whereas, the alternate paths are less desirable as they have longer latency. The disjoint makes those alternate paths independent from the primary path. Thus, if a failure occurs on the primary path, it remains local and does not affect any of those alternate paths. The sink can determine which of its neighbors can provide it with the highest quality data characterized by the lowest loss or lowest delay after the network is flooded with some low-rate samples Although disjoint paths are more resilient to sensor failures, they can be potentially longer than the primary path and thus having less energy efficiency.

1.5.2 Braided Paths

Braided multipath [31] is a partially disjoint path from primary one after relaxing the disjointedness constraint. To construct the braided multipath, first primary path is computed. Then the best path from a source sensor to the sink is computed. Those best alternate are called as idealized braided multipath. Moreover, the links of each of the alternate paths lie either on or geographically close to the primary path. Therefore, the energy consumption on the primary and alternate paths seems to be comparable as opposed to the scenario of mutually ternate and primary paths.

1.5.3 Heterogeneity Based Protocols

In heterogeneity sensor network architecture, there are two types of sensors namely line powered sensors which have no energy constraint and the battery powered sensors having limited lifetime and hence should use their available energy efficiently by minimizing their potential of data communication and computation. In this section the uses of heterogeneity in WSNs to extend network lifetime and a few routing protocols are presented.

1.5.4 Information Driven Sensor Query (IDSQ)

IDSQ [32] addresses the problem of heterogeneous WSNs of maximizing information gain minimizing detection latency and energy consumption for target localization and tracking through dynamic sensor querying and data routing. To improve tracking accuracy and reduce detection latency, communication between sensors is necessary. In order to conserve power only a subset of the sensors need to be active when there are interesting events to report in some parts of the network. The choice of a subset of active sensors that have the most useful information is balanced by the communication cost needed between those sensors. Useful information can be sought based on predicting the space and time the interesting events would take place. In IDSQ protocol, first step is to select a sensor as leader from the cluster of sensors. This leader will be responsible for selecting the optimal sensors based on some information utility measure.

1.5.5 Cluster-Head Relay Routing (CHR)

CHR routing protocol [33] uses two types of sensors to form a heterogeneous network with a single sink, a large number of low-end sensors, denoted by L-sensors, and a small number of powerful high-end sensors, denoted by H-sensors. Both types of sensors are static and aware of their locations using some location service. Moreover, those L- and H-sensors are uniformly and randomly distributed in the sensor field. The CHR protocol partitions the heterogeneous network into groups of sensors (or clusters), each being composed of L-sensors and led by an H-sensor. Within a cluster, the L-sensors are in charge of sensing the underlying environment and forwarding data packets originated by other L sensors towards their cluster head in a multi hop fashion. The H-sensors, on the other hand are responsible for data fusion within their own clusters and forwarding aggregated data packets originated from other cluster heads towards the sink in a multi hop fashion using only cluster head L-sensors use short-range data transmission to their neighboring H-sensors within the same cluster and the H-sensors perform long-range data communication to other neighboring H-sensors and the sink.

1.5.6 QoS-based Protocols

In addition to minimizing energy consumption, it is also important to consider the quality of service (QoS) requirements in terms of delay, reliability, and fault tolerance in routing in WSNs. In this section, a sample of QoS based routing protocols that help to find a balance between energy consumption and QoS requirements is reviewed

1.5.7 Sequential Assignment Routing (SAR)

SAR is the routing protocols for WSNs that introduces the notion of QoS in the routing decisions. It is a table-driven multi-path approach striving to achieve energy efficiency and fault tolerance. The routing decision in SAR is dependent on three factors such as the energy resources, QoS on each path, and the priority level of each packet (34, 35). The SAR protocol create trees rooted at one-hop neighbors of the sink by taking QoS metric energy resource on each path and priority level of each packet into consideration. By using created trees, multiple paths from sink to sensors are formed. One of these paths is selected according to the energy resources and QoS on the path. Failure Recovery is done by enforcing routing table consistency between upstream and downstream nodes on each path.Any local failure causes an automatic path restoration procedure locally. The objective of SAR algorithm is to minimize the average weighted QoS metric throughout the lifetime of the network. If topology changes due to node failures, a path re-computation is needed.as a preventive measure, a periodic re computation of paths is triggered by the base-station to account for any changes in the topology. A handshake procedure based on a local path restoration scheme between neighboring nodes is used to recover from a failure. The failure recovery is done by enforcing routing table consistency between upstream and the downstream nodes on each path. Simulation results showed that the SAR offers less power consumption than the minimum-energy metric algorithm which focuses only on the energy consumption of each packet without considering its priority. Although this ensures fault-tolerance and easy recovery, the protocol suffers from the overhead of maintaining the tables and states at each sensor node especially when the number of nodes is huge.

1.5.8 Real Time Routing Protocol for Sensor Networks (SPEED)

SPEED [36] is another QoS routing protocol for sensor networks that provides soft real time end-to-end guarantees. The protocol requires each node to maintain information about its neighbors and uses geographic forwarding to find the paths. In addition, SPEED strive to ensure a certain speed for each packet in the network so that each application can estimate the end-to-end delay for the packets by dividing the distance to the sink to the speed of the packet before making the admission decision. Moreover, SPEED can provide the congestion avoidance when the network is congested. The routing module in SPEED is called as stateless geographic non-deterministic forwarding. The beacon exchange mechanism collects information about the nodes and their location. Delay estimation at each node is basically made by calculating the elapsed time when an acknowledgement is received from a neighbor as a response to a transmitted data packet by looking at the delay values SNGF selects the node which meets the speed requirement

CHAPTER 2

PROBLEM STATEMENT

2.1 Objective

The objective of this work is to investigate strategies that balance the use of the GPS unit with the need to conserve energy. There have been several network routing protocols are analyzed and it can be examined in the context of wireless sensor networks that: There are two such possible routing protocols, namely direct communication with the base station and minimum-energy multi-hop routing using our sensor network and radio models. In multi-hop we found that conventional clustering approach (LEACH, HEED, APTEEN ,EECHWSN etc.) to routing are used and they have many drawbacks of using such an approach when the nodes are all energy-constrained. While using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of messages. The devices are mobile so the position of a sensor can change over time. The model describes the environment, wireless communication and mobility of the devices. The dynamics of the system of devices are captured in discrete time steps. In each time step a node can communicate, perform some computation, and change its location. We will assume that every node is capable of self-positioning but activates that module selectively. This allows for balancing the energy costs of self-positioning among all nodes and results in reduced positional error.

2.1.1 Routing protocols in WSN

The Routing [1] in wireless sensor networks have certain issues such that there is no infrastructure, wireless links are unreliable, sensor nodes may fail and routing protocols have to meet strict energy saving requirements. To minimize the energy consumption the routing techniques proposed in the literature for WSNs employ some well-known routing tactics as well as tactics special to WSNs, e.g., the data aggregation and in-network processing, clustering, different node role assignment and data-centric methods. Almost all the routing protocols can be classified according to the network structure as flat hierarchical or location-based. In flat networks, all nodes play the same role while hierarchical protocols aim at clustering the nodes so that cluster heads can do some aggregation and reduction of data in order to save the energy. The location-based protocols utilize the position information to relay the data to the desired regions rather than the whole network. Furthermore, these protocols can be classified into multi path based, query-based, negotiation-based QoS-based and coherent based depending on the protocol operation. The sample of routing protocols in each of the categories in preceding sub-sections is reviewed. While using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes direct communication will require a large amount of transmit power from each node. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of message.

There are many protocol use in wireless sensor network.

2.2 Hierarchal based protocol

- LEACH
- HEED
- TEEN
- APTEEN
- EEHCWSN

2.2.1 Low energy adaptive clustering hierarchal (LEACH)

LEACH [22] is the first and the most popular energy-efficient hierarchical clustering algorithm for WSNs that was proposed for reducing power consumption. In LEACH, the clustering task is rotated among the nodes, based on the duration. Direct communication is used by each Cluster Head (CH) to forward the data to the Base Station (BS). It uses clusters to prolong the life of the wireless sensor network. LEACH is based on an aggregation (or fusion) technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual sensors LEACH divides the network into several clusters of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, in order to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and dying quickly. The operation of LEACH is divided into rounds having two phases each namely.

- A setup phase to organize the network into clusters, CH advertisement and transmission schedule creation.
- A steady-state phase for data aggregation, compression and transmission to the sink

LEACH is completely distributed and it requires no global knowledge of network it reduces energy consumption by

(a) Minimizing the communication cost between the sensors and their cluster heads
(b) Turning off non-head nodes as much as possible.

2.2.2 Hybrid Energy-Efficient Distributed Clustering (HEED)

HEED [24] extends the basic scheme of LEACH by using residual energy and node degree or density as a metric for the cluster selection to achieve power balancing. It operates in multi-hop networks, using an adaptive transmission power in the inter clustering communication. HEED was proposed with four primary goals namely prolonging network lifetime by distributing energy consumption, terminating the clustering process within a constant number of iterations, minimizing control overhead and producing well-distributed CHs and compact clusters.

2.2.3 Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN)

TEEN [25,26] is a hierarchical clustering protocol, which groups sensors into clusters with each led by a CH. The sensors within a cluster report their sensed data to their CH. The CH sends aggregated data to higher level CH until the data reaches the sink. Thus, the sensor network architecture in TEEN is based on a hierarchical grouping where the closer nodes form clusters. This process goes on to the second level until the base station (sink) is reached. TEEN is useful for applications where the users can control a trade-off between the energy efficiency, data accuracy, and response time dynamically

2.2.4 Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network Protocol (APTEEN)

APTEEN is an improvement to TEEN to overcome its shortcomings and it aims at both capturing periodic data collections and reacting to time-critical events. Thus, APTEEN is a hybrid clustering-based routing protocol that allows the sensor to send their sensed data periodically and react to any sudden change in the value of the sensed attribute by reporting the corresponding values to their CHs. The architecture of APTEEN is same as in TEEN, which uses the concept of hierarchical clustering for energy efficient communication between source sensors and the sink. APTEEN supports three different query types namely

- Historical query, to analyze past data values
- One-time query, to take a snapshot view of the network and

Persistent queries, to monitor an event for a period of time. APTEEN guarantees lower energy dissipation and keeps the larger number of Sensors alive.

2.2.5 Energy Efficient Homogenous Clustering Algorithm for Wireless Sensor Networks

Singh et al [27] proposed homogeneous clustering algorithm for Wireless Sensor Network that saves power and prolongs the network life. The life span of the network is increased by ensuring a homogeneous distribution of nodes in the clusters. A new cluster head is selected on the basis of the residual energy of existing cluster heads, holdback value, and nearest hop distance of the node. The homogeneous algorithm makes sure that each node is either a cluster head or a member of one of the clusters in the wireless sensor network. In the proposed clustering algorithm the cluster members are uniformly distributed and thus, the life of the network is more extended. Further, in the proposed protocol, only cluster heads broadcast cluster formation message and not the every node. Hence, it prolongs the life of the sensor networks. The emphasis of this approach is to increase the life span of the network by ensuring a homogeneous distribution of nodes in the clusters so that there is not too much receiving and transmitting overhead on a Cluster Head.

CHAPTER 3
LITERATURE SURVEY

3.1 Previous Work through the Literature Survey

2000: B. Karp, H. T. Kung, GPSR: greedy perimeter stateless routing for wireless networks: This work deals with position information that is used in many parts of the network infrastructure, including topology maintenance, medium access control (MAC) protocols and routing protocols like geographic routing [1], event localization, target tracking and sensed data mapping. Many algorithms have been proposed to solve this problem in different scenarios.

2003:W. Navidi, T. Camp, Stationary distributions for the random waypoint mobility model: The positions of the nodes change over time. The random waypoint mobility model is used to describe node movement. Under this model each node selects a destination point from the space and moves along a line towards it. In each time step the node moves a random distance chosen uniformly from the interval [0,δ] on this line When the node reaches the destination it selects a new destination point for the next time step. This model has been used extensively in this literature of Navidi et. al. **2004:**L. Hu, D. Evans, and Localization for mobile sensor networks: Several very good positioning algorithms have been proposed over the last decade. The seminal paper by Hu and Evans [14] proposed an algorithm called MCL that produced good positional accuracy in sensor networks with mobile nodes. This kicked offa series of work that all increased the positional accuracy, often without significant increase in computation or communication costs. All of these algorithms utilized the available location information very efficiently to greatly reduce positional error. **2009**: I. Constandache, S. Gaonkar, M. Sayler, R.R. Choudhury, L. Cox, Enloc: Energy efficient localization for mobile phones:Constandache et al [4] uses heuristics and mobility predictions to maximize the positional accuracy for a given energy budget. **2010 :** R. Zviedris, A. Elsts, G. Strazdins, A. Mednis, L. Selavo Lynxnet: wild animal monitoring using sensor networks: They have reported that the extra hardware modules attached to sensors to enable self-positioning often consume significant energy and results in faster battery draining for seed nodes [2]. In recent years the monetary cost and size of self-positioning hardware has decreased enough that equipping all sensors with these modules is becoming less prohibitive.

2010 : J. Paek, J. Kim, R. Govindan, Energy-efficient rate-adaptive GPS-based positioning for smartphones: Peak et al [5] store historical information about where GPS is not known to work well (e.g. urban areas) and use Bluetooth and a duty-cycled accelerometer to compute location uncertainty.

2010: R. Jurdak, P. Corker, D. Dharma, G. Salagnac, Adaptive GPS duty cycling and radio ranging for energy-efficient localization:
Jurdak et al [10]covered two important respects: first, it investigate the effect of duty cycling on far more sophisticated (and range-free) algorithms compared to them, and second, it do not use predictive mobility models.

3.1.1 Medium Access control

Communication is the major source of energy consumption in WSNs. The medium access Control protocols directly control the radio of the nodes in the network. The medium access Control protocols should be designed for regulating energy consumption which in turn increases the lifetime of the network. The various design issues of the Medium Access Control (MAC) protocols suitable for sensor network environment are.

The MAC layer provides fine-grained control of the transceiver and allows on and off switching of the radio. The design of the MAC protocol should have this switching mechanism to decide when and how frequently the on and off mechanism should be done.This helps in conserving energy. A MAC protocol should avoid collisions from interfering nodes, over-emitting, overhearing, control packet overhead and idle listening. When a receiver node receives more than one packet at the same time these packets are referred as The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S Mac (Sensor MAC)
Time-MAC and Wise-MAC
A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst. Thus, a node which has more data gets more time to access the medium “Collided Packets”, which are to be sent again thereby increasing energy consumption. When a destination node is not ready to receive

messages then it is said to be over-emitting. Overhearing occurs if a node picks up packets that were destined for some other node. The Sending and the receiving of less useful packets results in Control Overhead. An Idle Listening is an important factor as the nodes often hear the channel for possible reception of the data which is not sent. Scalability Adaptability and Decentralization are the other important criteria in designing a MAC protocol. The sensor network should adapt to the changes in the network size node density and topology. Also some nodes may die overtime, some may join and some nodes may move to different locations. A good MAC protocol should accommodate these changes to the network. A MAC protocol should have minimum latency and high throughput when the sensor networks are deployed in critical applications .A MAC protocol should include Message Passing. Message Passing means dividing a long message into small fragments and transmitting them in burst. Thus, a node which has more data gets more time to access the medium. There should be uniformity in reporting the events by a MAC protocol. Since the nodes are deployed randomly, nodes from highly dense area may face high contention among themselves when reporting events resulting in high packet loss consequently the sink detects fewer events from such areas. Also the nodes which are nearer to the sink transmit more packets than the nodes which are away from the sink The MAC protocols should take care of the well-known problem of Information asymmetry Which arises if a node is not aware of packet transmissions that are two hops away The MAC Protocols should satisfy the Real-time requirements. MAC being the base of the communication stack, timely detection, processing and delivery of the information from the deployed environment is an indispensable requirement in a WSN application. Some popular MAC Protocols are S-Mac (Sensor MAC), Time-MAC and Wise-MAC

3.1.2 Drawbacks in the existing system analysis

Above works has assumed that every node is capable of self-positioning but governs the use of that module by activation and deactivation to conserve battery capacity. While they come up with several simple, intuitive strategies for activation it is far from clear how these strategies perform. We analyzed that several different activation strategies for duty cycling the self-positioning module using simulations and report their performance Specifically we they show that effective duty cycling strategies not only save energy but can reduce the mean positional error. There is a trade-off between battery power consumed in self-positioning and the positional error achieved. Higher numbers of seeds decrease the positional error and increase the energy consumption, and vice versa.

CHAPTER 4

PROBLEM FORMULATION

We will discuss a conventional clustering approach to routing and the drawbacks of using such an approach when the nodes are all energy-constrained. Using a direct communication protocol, each sensor sends its data directly to the base station. If the base station is far away from the nodes, direct communication will require a large amount of transmit power from each node. This will quickly drain the battery of the nodes and reduce the system lifetime. However, the only receptions in this protocol occur at the base station, so if either the base station is close to the nodes, or the energy required to receive data is large, this may be an acceptable (and possibly optimal) method of communication. The second conventional approach we consider is a "minimum-energy routing protocol. There are several power-aware routing protocols discussed in the literature. In these protocols, nodes route data destined ultimately for the base station through intermediate nodes. Thus nodes act as routers for other nodes' data in addition to sensing the environment. These protocols differ in the way the routes are chosen. Some of these protocols [6, 10, 14], only consider the energy of the transmitter and neglect the energy dissipation of the receivers in determining the routes. In this case, the intermediate nodes are chosen such that the transmit amplifier energy (e.g., ET xamp(k; d) = amp k d2 is minimized; thus node A would transmit to node C through node B if and only if: ET xamp(k; d = dAB) + ET xamp(k; d = dBC) < ET xamp(k; d = dAC) (3) or d 2 AB + d 2 BC < d2 AC (4) However, for this minimum-transmission-energy (MTE) routing protocol, rather than just one (high-energy) transmit of the data, each data message must go through n (low energy) transmits and n receives. Depending on the relative costs of the transmit amplifier and the radio electronics, the total energy expended in the system might actually be greater using MTE routing than direct transmission to the base station. To illustrate this point, consider the linear network shown in Figure 2, where the distance between the nodes is r. If we consider the energy expended transmitting a single k-bit message from a node located a distance nr from Base Station r n nodes. Simple linear network. the base station using the direct communication approach and Equations 1 and 2, we have: Edirect = ET x(k; d = n r) = Eelec k + amp k (nr)2 = k(Eelec + ampn2r 2) (5) In MTE routing, each node sends a message to the closest node on the way to the base station. Thus the node located a distance nr from the base station would require n transmits a distance r and n 1 receives. EMTE = n ET x(k; d = r)+(n 1) ERx(k) = n(Eelec k + amp k r 2)+(n 1) Eelec k = k((2n 1)Eelec + ampnr2) (6) Therefore, direct communication requires less energy thMT routing if: Edirect < EMTE Eelec + ampn2r 2 < (2n 1)Eelec + ampnr2 Eelec amp > r 2n 2 (7) Using Equaion.

4.1 Algorithm

4.1.1 Euclidean distance algorithm.

Finding the closet pair of point

We now consider the problem of finding the closet .pair of points in a set q of n greater than 2 points are" closest" refers to the usual Euclidean distance .Distance the distance between point p1=(x1,y1) and p2=(x2,y2) is root of ($(x1-x2)^2+(y1-y2)^2)^{1/2}$ two point is the set q be continue In which case the distance between there is zero. This problem has application is

```
Euclid (a,b)
1    if b==0
2    return a
3    else  return EUCLID(b, a mod b)
```

An example of the running of EUCLID, consider the computation of gcd (30 , 21).

```
Euclid (30,21)  =  Euclid (21,9)
                =  Euclid (9, 3)
                =  Euclid (3,0 )
                =  3.
```

For the examples of the Euclidean algorithm are used to traffic control systems a system for controlling air or sea traffic might need to identity the two closet vehicles in order to potential collisions.

CHAPTER 5
METHODOLOGY

5.1 Solution Methodology

The devices are represented by a set of n nodes= {u1,...,un}and a two-dimensional Euclidean space R where a transmitted message can be received by another node. This work uses the unit disk model of communication where the communication. The positions of the nodes change over time. The random waypoint mobility model is used to describe node movement. Under this model each node selects a destination point from the space R a line towards it. In each time step the node moves a random distance chosen uniformly from the interval. The nodes in the system under consideration are mobile so their position is always changing which necessitates periodic position estimation. It is assumed that each node in the system is equipped with a GPS unit that can be activated and deactivated at the discretion of the node. When a GPS unit at a node i is activate dit provides the node with its position pt (i) but consumes a large amount of energy. When a GPS unit is deactivated a nodes relies on a network positioning algorithm to estimate its position. The objective of this work is to investigate strategies that balance the use of the GPS unit with the need to conserve energy .A GPS activation strategy is a component of a positioning algorithm and determines when a node's. GPS unit is active. If a GPS unit is active a node knows its position. Three activation strategies have been formulated for this work: fixed, random and error. The activation strategy is integrated formulated for this work: fixed, random and error.

5.1.1 System Architecture

- Define maximum no. of nodes, n
- Display y axis of field length (meters)
- N=20
- Define maximum field length where nodes are placed
- M=100
- generate x and y position of nodes
- Display neighboring node id for each node.

- Display current x and y position for nodes at each step.
- Initial position of nodes:
- id x position y position
- 1 81 66
- 2 91 4
- 3 13 85
- 4 91 93
- 5 63 68
- 6 10 76
- 7 28 74
- 8 55 39
- 9 96 66
- 10 96 17
- 11 16 71
- 12 97 3
- 13 96 28
- 14 49 5
- 15 80 10
- 16 14 82
- 17 42 69
- 18 92 32
- 19 79 95
- 20 96 3

5.1.2 Show Neighbor nodes

- node 1has neighbor node 1 4 5 9 19
- node 2has neighbor node 2 10 12 13 15 18 20
- node 3has neighbor node 3 6 7 11 16
- node 4has neighbor node 1 4 9 19
- node 5has neighbor node 1 5 17

- node 6has neighbor node 3 6 7 11 16
- node 7has neighbor node 3 6 7 11 16 17
- node 8has neighbor node 8
- node 9has neighbor node 1 4 9
- node 10has neighbor node 2 10 12 13 15 18 20
- node 11has neighbor node 3 6 7 11 16 17
- node 12has neighbor node 2 10 12 13 15 18 20
- node 13has neighbor node 2 10 12 13 15 18 20
- node 14has neighbor node 14
- node 15has neighbor node 2 10 12 13 15 18 20
- node 16has neighbor node 3 6 7 11 16
- node 17has neighbor node 5 7 11 17
- node 18has neighbor node 2 10 12 13 15 18 20
- node 19has neighbor node 1 4 19
- node 20has neighbor node 2 10 12 13 15 18 20

5.1.3 Show Node Current Position

- X position Y position
- 79.0399 66.7841
- 89.5388 4.9155
- 13.7209 83.5791
- 92.9085 90.2813
- 63.6694 65.3563
- 11.0050 74.3021
- 29.2039 74.8094
- 57.1188 40.4856
- 94.6405 64.7399
- 95.9737 15.9417
- 15.6578 72.2514

- 94.9313 1.3513
- 95.2052 30.1452
- 48.0546 6.6502
- 80.9776 9.4152
- 11.7105 80.2852
- 44.4311 67.1138
- 91.7399 30.2732
- 77.3767 94.8570
- 95.6350 -0.1469

5.1.4 Calculate Node Distance

- **0 63 67 27 15 68 50 34 16 54 64 67 40 68 57 69 35 39 28 69**
- **63 0 109 85 66 105 92 48 60 13 100 6 26 42 10 108 77 25 91 8**
- **67 109 0 79 53 10 18 61 83 106 11 116 97 84 100 4 35 94 65 117**
- **27 85 79 0 38 83 66 61 26 74 79 89 60 95 82 82 54 60 16 90**
- **15 66 53 38 0 53 36 26 31 59 49 71 47 61 59 54 19 45 33 73**
- **68 105 10 83 53 0 18 57 84 103 5 111 95 77 95 6 34 92 69 113**
- **50 92 18 66 36 18 0 44 66 89 14 99 80 71 83 18 17 77 52 100**
- **34 48 61 61 26 57 44 0 45 46 52 54 39 35 39 60 29 36 58 56**
- **16 60 83 26 31 84 66 45 0 49 79 63 35 74 57 84 50 35 35 65**
- **54 13 106 74 59 103 89 46 49 0 98 15 14 49 16 106 73 15 81 16**
- **64 100 11 79 49 5 14 52 79 98 0 106 90 73 91 9 29 87 66 108**

- **67 6 116 89 71 111 99 54 63 15 106 0 29 47 16 115 83 29 95 2**
- **40 26 97 60 47 95 80 39 35 14 90 29 0 53 25 97 63 3 67 30**
- **68 42 84 95 61 77 71 35 74 49 73 47 53 0 33 82 61 50 93 48**
- **57 10 100 82 59 95 83 39 57 16 91 16 25 33 0 99 68 23 86 18**
- **69 108 4 82 54 6 18 60 84 106 9 115 97 82 99 0 35 94 67 116**
- **35 77 35 54 19 34 17 29 50 73 29 83 63 61 68 35 0 60 43 85**
- **39 25 94 60 45 92 77 36 35 15 87 29 3 50 23 94 60 0 66 31**
- **28 91 65 16 33 69 52 58 35 81 66 95 67 93 86 67 43 66 0 97**
- **69 8 117 90 73 113 100 56 65 16 108 2 30 48 18 116 85 31 97 0**

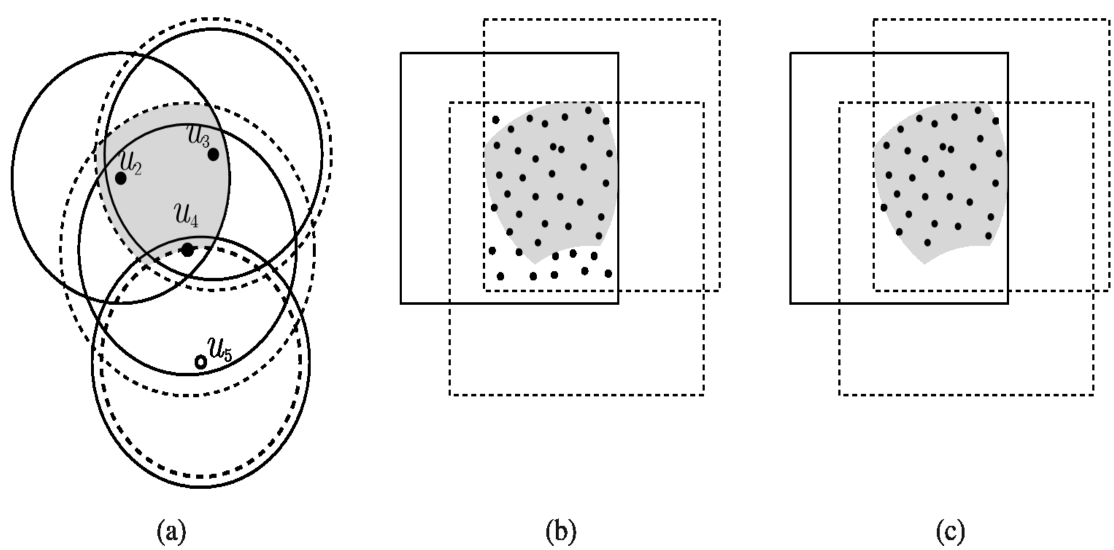

Fig. calculate the node

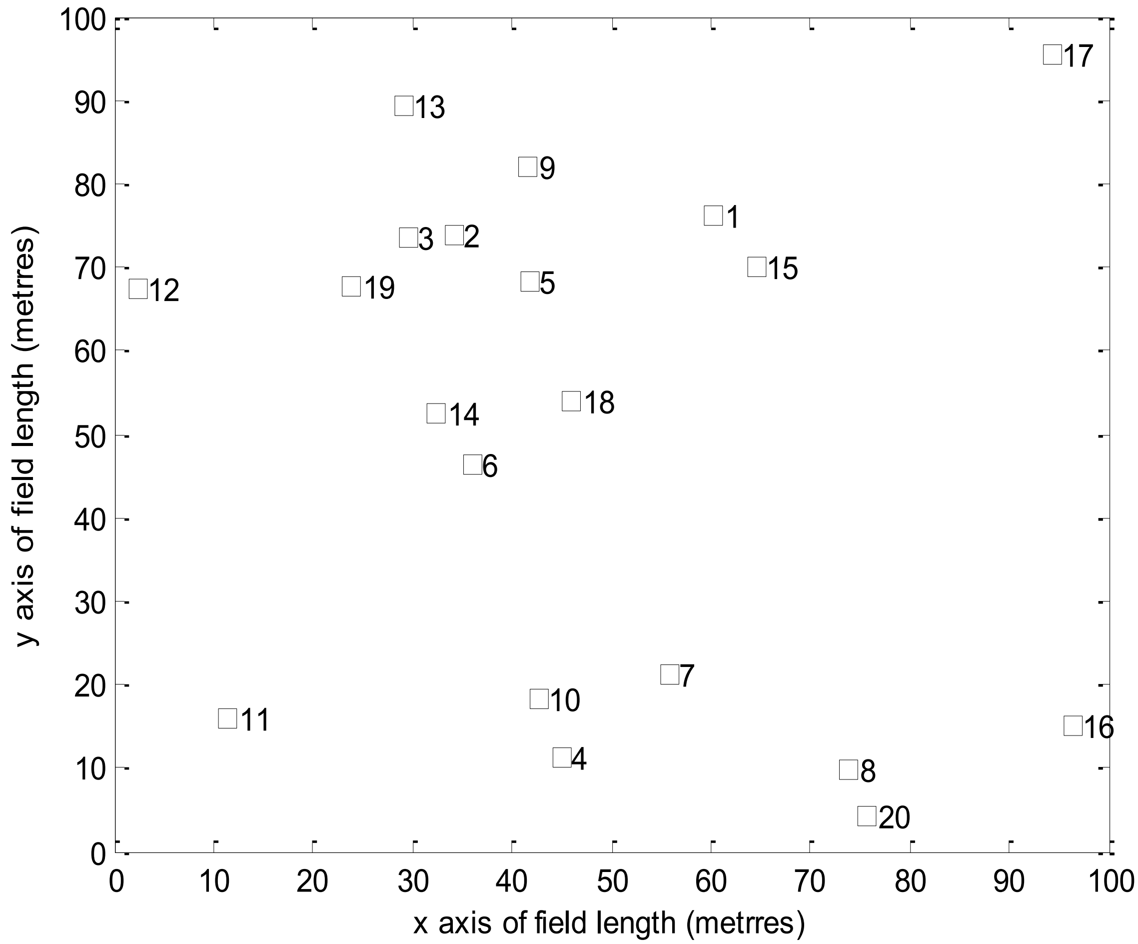

Fig Old Position

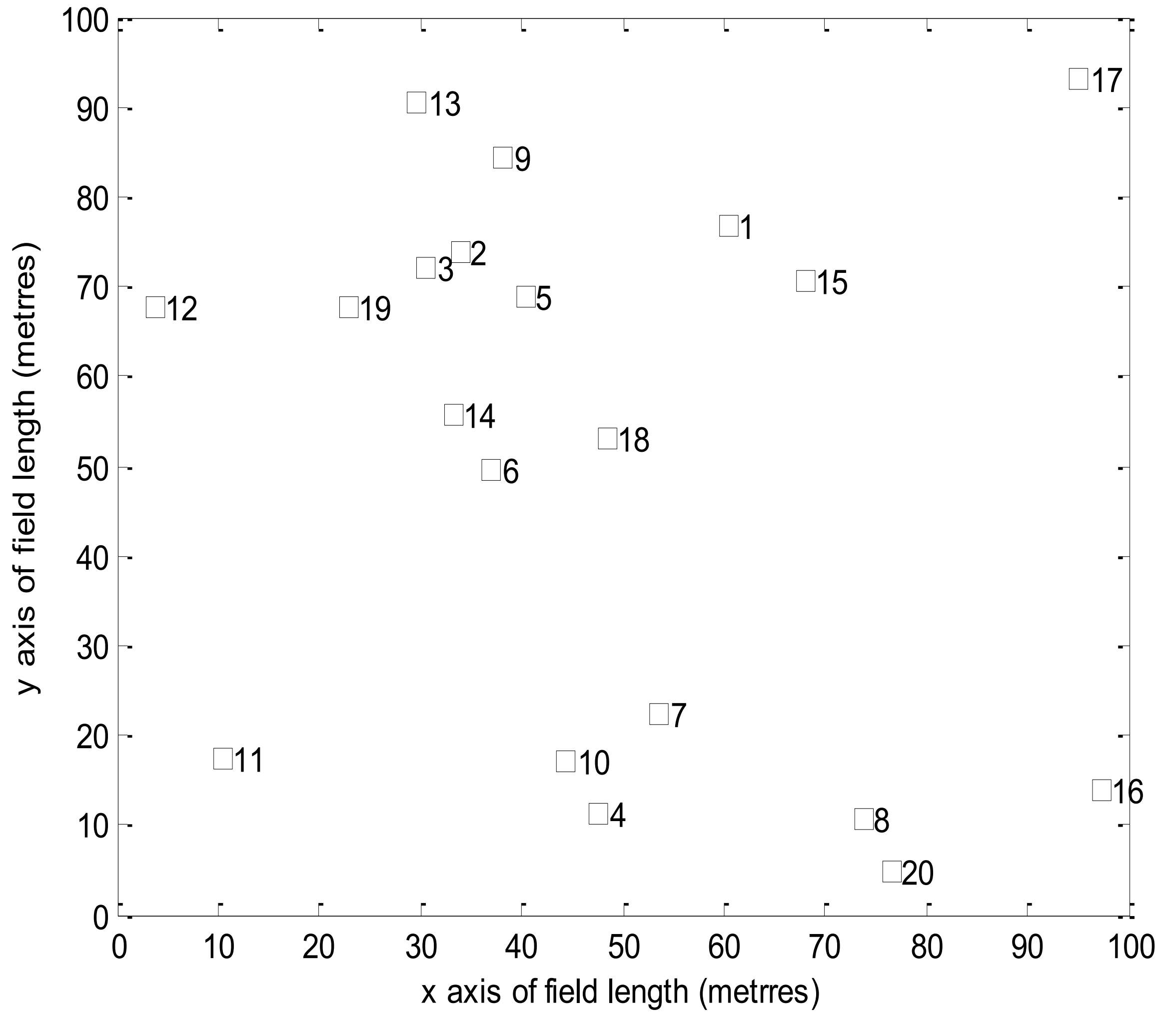

Fig Old position

CHAPTER 6

RESULT

6.1 show result

When an n>2 point (node) are deploy at the time then the two node are point are same position but distance are zero then the individual sensor are dying quickly and avid the battery depletion and save the energy of battery.

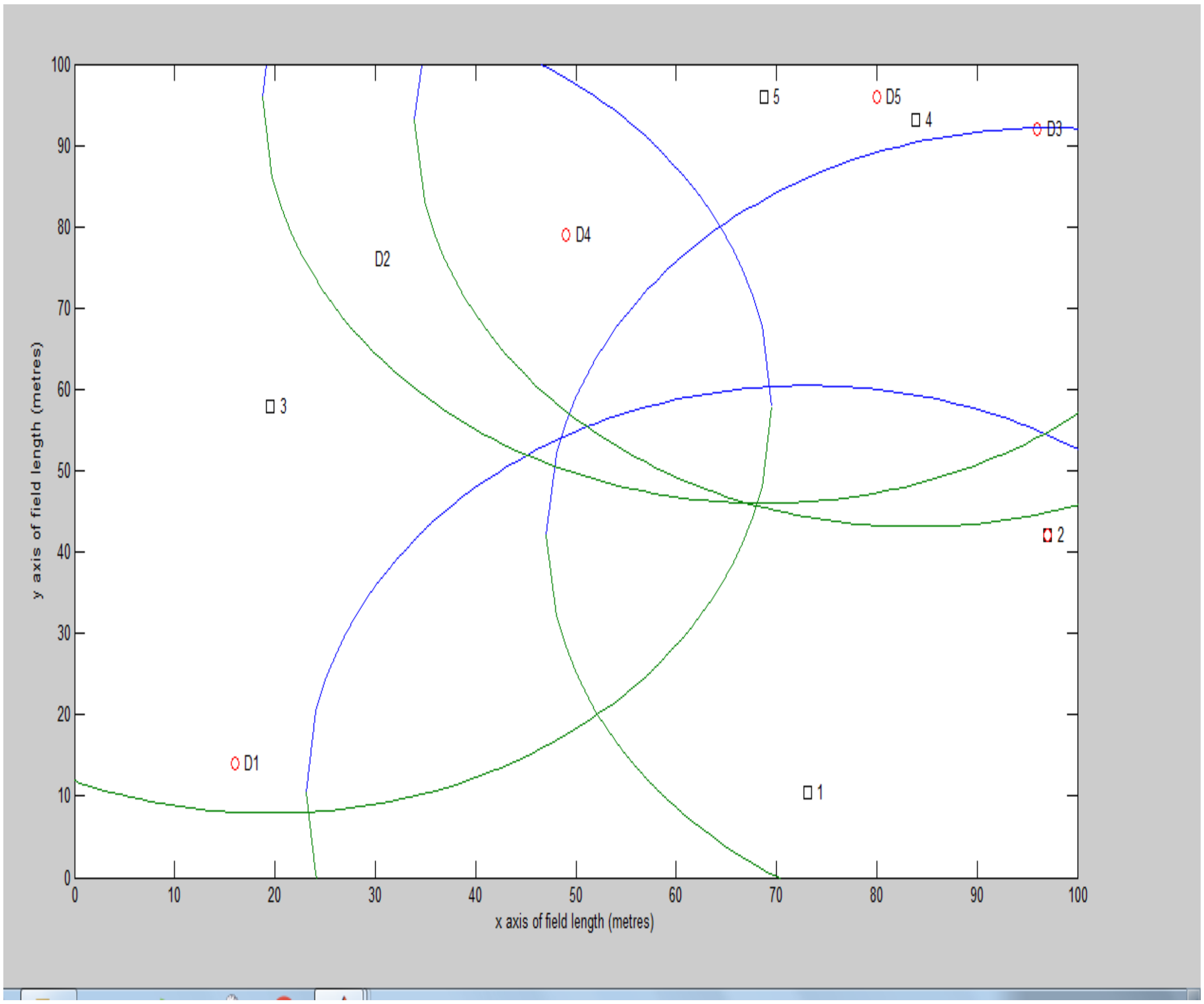

Fig- result

A computer simulation using mat lab that implements the model described below will be extended to evaluate the GPS activation strategies.

- The purpose of the evaluation of the strategies is to compare the performance of the three strategies in terms of positional error and energy usage.
- The expected positional error will be considered as performance measurement for reporting the quality of a positioning algorithm.
- The differences in energy consumption between the strategies due to computation will be compared to the requirements of a GPS unit.
- The simulation will be conducted on a system of $n = 80$ nodes that reside in a field of size 1000×1000 meters. The initial location for each is completely random.
- The communication range of each node will be $r = 100$ meters. The simulation is executed for 1000 time steps.
- Energy consumption will be measured by the mean number of GPS activations per time step. The mean number of GPS activations per time step used for all activation strategies. The values will be determined based on the mean number of GPS activations for a given error threshold b. The positional error over time will be related to node speed δ so a range of activations will be determined different node speeds.
- In the event the positional error exceeds the threshold and the node has the largest positional error when compared to its first and second neighbor nodes, the GPS unit at the node is activated. The GPS unit is deactivated at the beginning of each time step.
- The basis for this strategy is to improve positional error in regions with high positional error and limit the number of activations in a local region of the network.

CHAPTER 7

CONCLUSION AND FUTURE WORK

Above works has assumed that. Every node is capable of self-positioning but governs the use of that module by activation and deactivation to conserve battery capacity. While they come up with several simple intuitive strategies for activation, it is far from clear how these strategies perform We analyzed that several different activation strategies for duty cycling the self-positioning module using simulations and report their performance. Specifically we they show that effective duty cycling strategies not only save energy but can reduce the mean positional error. There is a trade-off between battery power consumed in self-positioning and the positional error achieved. Higher numbers of seeds decrease the positional error and increase the energy consumption, and vice versa.

In the event the positional error exceeds the threshold and the node has the largest positional error when compared to its first and second neighbor nodes, the GPS unit at the node is activated. The GPS unit is deactivated at the beginning of each time step. The basis for this strategy is to improve positional error in regions with high positional error and limit the number of activations in a local region of the network. The work considers a system of battery operated computing devices that are capable of wireless communication. Each device is located in an environment and communicates with nearby nodes via the exchange of messages. The devices are mobile so the position of a sensor can change over time. The model describes the environment, wireless communication and mobility of the devices. The dynamics of the system of devices are captured in discrete time steps. In each time step a node can communicate, perform some computation, and change its location. We will assume that every node is capable of self-positioning but activates that module selectively This allows for balancing the energy costs of self-positioning among all nodes and results in reduced positional error.

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