Energy Efficient Gathering Through Pegasis Routing Protocol

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Abstract: ***-Wireless sensor network (WSN) is an ad hoc network in which each sensor is defined with their limited energy. In WSN nodes are deployed into the network to monitor the physical or environmental condition such as temperature, sound, vibration at different location. Each node receives the information (data) and then transmits to the base station. In this paper we are analyzing each sensor consumes some energy in receiving or sending the data over the network. The lifetime of the network depend on the energy spent in each transmission. So we need an energy efficient protocol that plays an important role in offering high energy efficiency and long span of network lifetime. One of such protocols is PEGASIS; it is a near optimal chain-based routing protocol. This protocol starts forming a chain using Greedy algorithm then randomly selects a chain leader for the formed chain after that data transmission takes place. In PEGASIS, it takes the advantage of sending data to its closest neighbor. It save the energy for WSN and increases the lifetime of the network. In this project work, we analyses an energy efficient routing protocol, it achieves energy conservation and reduced power required to transmit data per round.***

Keywords: - WSN, PEGASIS and IEEE 802_15_4.

I. INTRODUCTION

Wireless sensor network is most important technologies in recent years. In past years it has received big attention from both academic and industry in the world. A WSN typically lies of a huge number of low-cost, low-power, and multifunctional wireless sensor nodes, with sense, wireless communications and computation abilities. WSN has a many application like a monitoring, environment, military surveillance, and industrial process control. In some WSN application, the distribution of sensor node is acted in ad hoc style less certain planning and engineering. Once the sensor different attacks at different layers and its counter measure. In section IIIliterature survey, related work of some existing approaches and finally in section V we present the conclusion of our work node has been distributed, it must be able to automatically create itself into a wireless communication network.

Because of the strict energy constraints of huge number of thickly deployed sensor nodes, it needs a group of network protocols to execute a variety of network control and organization functions such as synchronization, node localization, and network security. When some routing protocols are applied on WSN then energy-constrained of some networks have become a shortcomings. Ex, in a flooding mechanism given node have been broadcast data and control packet that has been received to the relief of the nodes in the network. This process continues till the destination node is reached, and this mechanism doesn’t take into report energy constraint by WSNs.

II. CLASSIFICATION OF VARIOUS ISSUES IN WSN

Functions such as localization, coverage, storage, synchronization, Security, data aggregation and compression are explored as sensor network services. Implementation of protocols at different layers in the protocol can significantly affect energy consumption, end-to-end delay, and system efficiency. It is important to optimize communication and minimize energy usage as sensor nodes operate on limited battery power. Energy usage is a very important concern in a WSN; and there has been significant research focus that revolves around Harvesting and minimizing energy [6].

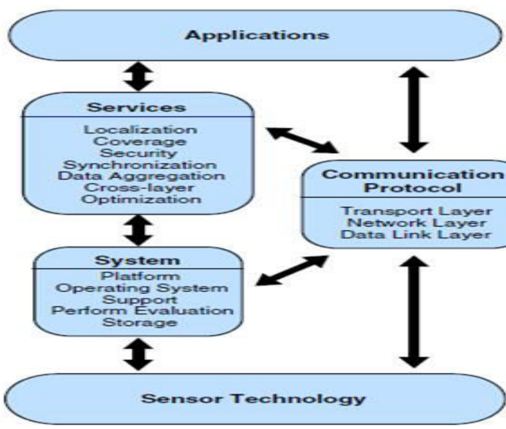

Fig-1. **Broad classification of various issues in WSN**

When a sensor node is depleted of energy, it will die and disconnect from the network which can significantly impact the performance of the application. Sensor network lifetime depends on the number of active nodes and connectivity of the network, so energy must be used efficiently in order to maximize the network lifetime.

Energy conservation in a WSN maximizes network lifetime and is addressed through efficient reliable wireless communication, intelligent sensor placement to achieve adequate coverage, security, efficient storage management through data aggregation and data compression.

There are five types of WSNs:

- Terrestrial WSN.
- Underground WSN
- Underwater WSN.
- Multi-media WSN
- Mobile WSN

Applications:-

Monitoring applications include indoor/outdoor environmental monitoring, Health and wellness monitoring, power monitoring, inventory location monitoring, factory and process automation, and seismic and structural monitoring.

Tracking applications include tracking objects, animals, humans, and vehicles.

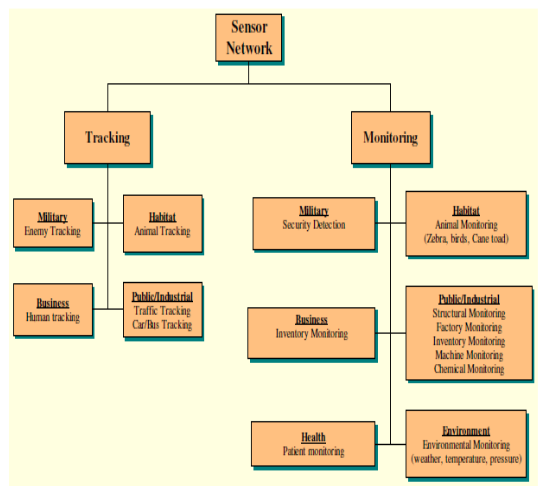

Fig-2. **Overview of sensors application**

The applications for WSNs involve tracking, monitoring and controlling. WSNs are mainly utilized for habitat monitoring, object tracking, nuclear reactor control, fire detection and traffic monitoring. Area monitoring is a common application of WSN. WSN is deployed over a region where some incident is to be monitored [9].

The key constraints in the development of WSN are limited battery power, cost, memory limitation, limited Computational capability and the physical size of the sensor nodes. Most of Battery energy is consumed by receiving and transmitting data. If all sensor nodes transmit data directly to the BS, the furthest node from BS will die early. On the other hand, among sensor nodes transmitting data through multiple hops, node closest to the BS tends to die early, leaving some network areas completely unmonitored and causing network partition. In order to maximize the lifetime of WSN, it is necessary for protocols to prolong sensor nodes lifetime by minimizing transmission energy consumption. Such this type of protocol is PEGASIS.

PEGASIS (Power-Efficient gathering in Sensor Information System) is a near optimal protocol for high rate data gathering applications in sensor networks. PEGASIS protocol is the formation of a chain among the sensor nodes so that each node will receive from and transmit to a close neighbor. Gathered data moves from node to node, get fused and eventually a designated node transmits it to the BS. This protocol is most suited for surveillance application such as motion detection [1].

The use of wireless sensor networks is increasing day by day but the problem of energy constraints prevails as there is limited battery life. In order tosave energy dissipation caused by communication in wireless sensor networks, it is necessary to schedule the state of the nodes, changing the transmission range between the sensing nodes, use of efficient routing and data routing methods and avoiding the handling of unwanted data. In general, routingin WSNs [2] can be divided into flat, hierarchical, and location based routing depending on the network structure. Hierarchical Routing is the well-known technique with special advantages related to scalability and efficient communication. PEGASIS, PEGASIS, TEEN [3] and APTEEN use this technique for routing. In hierarchical architecture, higher energy nodes can be used to process and send the information, while low-energy nodes can be used to perform the sensing in the proximity of the target. Location- Based Routing Protocols like MECN [4] sensor nodes are addressed by means of their locations. The distance between neighbouring nodes can be estimated on the basis of incoming signal strengths. Relative coordinates of neighbouring nodes can be obtained by exchanging such information between neighbours. The Low-Energy Adaptive Clustering Hierarchy (PEGASIS) is a cluster based routing protocol. In this paper section 2 will introduce the PEGASIS routing protocol in detail, Section 3 will cover the simulation of PEGASIS protocol and the section 4 shows the simulation analysis by varying the percentage of cluster heads in the network in each simulation of PEGASIS protocol. Performance is analyzed in terms of lifetime, energy dissipation and throughput of the network and Section 5 concludes this paper. Sensor nodes are micro-electro-mechanical systems [2] (MEMS) that produce a measurable response to a change in some physical condition like temperature and pressure. The continual analog signal sensedby the sensors is digitized by an analog-to-digital converter and sent to controllers for further processing. Sensor nodes are of very small size, consume extremely low energy, are operated in high volumetric densities, and can be autonomous and adaptive to the environment. The spatial density of sensor nodes in the field may be as high as 20 nodes/m3.As wireless sensor nodes are typically very small electronic devices, they can only be equipped with a limited power source [3]. Each sensor node has a certain area of coverage for which it can reliably and accurately report the particular quantity that it is observing. Several sources of power consumption in sensors are: (a) signal sampling andconversion of physical signals to electrical ones; (b) signal conditioning, and (c) analog-to-digital conversion.

There are three categories of sensor nodes:

(i) Passive, Omni Directional Sensors: passive sensor nodes sense the environment without manipulating it by active probing. In this case, the energy is needed only to amplify their analog signals. There is no notion of "direction" in measuring the environment.
(ii) Passive, narrow-beam sensors: these sensors are passive and they are concerned about the direction when sensing the environment.
(iii) Active Sensors: these sensors actively probe the environment.

Since a sensor node has limited sensing and computation capacities, communication performance and power, a large number of sensor devices are distributed over an area of interest for collecting information (temperature, humidity, motion detection, etc.). These nodes can communicate with eachother for sending or getting information either directly or through other intermediate nodes and thus form a network, so each node in a sensor network acts as a router [4] inside the network. In direct communication routing protocols (single hop), each sensor node communicates directly with a controlcentre called Base Station (BS) and sends gathered information. The base station is fixed and located far away from the sensors. Base station(s) can communicate with the end user either directly or through some existing wired network. The topology of the sensor network changes very frequently. Nodes may not have global identification. Since the distance between the sensor nodes and base station in case of direct communication is large, they consume energy quickly. In another approach (multi hop), data is routed via intermediate nodes to the base station and thus saves sending node energy. A routing protocol [5] is a protocol that specifies how routers (sensor nodes) communicate with each other, disseminating information that enables them to select routes between any two nodes on the network, the choice of the route being done by routing algorithms. Each router has a priori knowledge only of the networks attached to it directly. A routing protocol shares this information first among immediateneighbours, and then throughout the network. This way, routers gain knowledge of the topology of the network. There are mainly two types of routing process: one is static routing and the other is dynamic routing.

Dynamic routing performs the same function as static routing except it is more robust. Static routing allows routing tables in specific routers to be set up in a static manner so network routes for packets are set. If a router on the route goes down, the destination may become unreachable. Dynamic routing allows routing tables in routers to change as the possible routes change. In case of wireless sensor networks dynamic routing is employed because nodes may frequently change their position and die at any moment. The advantages and disadvantages of wireless sensor networks can be summarized as follows:

Advantages:
• Network setups can be done without fixed infrastructure.
• Ideal for the non-reachable places such as across the sea, mountains, rural areas or deep forests.
• Flexible if there is ad hoc situation when additional workstation is required.
• Implementation cost is cheap.

Disadvantages:
• Less secure because hackers can enter the access point and get all the information.
• Lower speed compared to a wired network.
• More complex to configure than a wired network.
• Easily affected by surroundings (walls, microwave, large distances due to signal attenuation, etc.)

Applications:

The applications for WSNs involve tracking, monitoring and controlling. WSNs are mainly utilized for habitat monitoring, object tracking, nuclear reactor control, fire detection, and traffic monitoring. Area monitoring is a common application of WSNs, in which the WSN is deployed over a region where some incident is to be monitored. For example, a large quantity of sensor nodes could be deployed over a battlefield to detect enemy intrusions instead of using landmines. When the sensors detect the event being monitored (heat, pressure, sound, light, electro-magnetic field, vibration, etc.), the event needs to be reported to one of the base stations, which can than take some appropriate action (e.g., send a message on the internet or to a satellite). Wireless sensor networks are used extensively within the water/wastewater industries. Facilities not wired for power or data transmission can be monitored using industrial wireless I/O devices and sensor nodes powered by solar panels or battery packs. Wireless sensor networks can use a range of sensors to detect the presence of vehicles for vehicles detection. Wireless sensor networks are also used to control the temperature and humidity levels inside commercial greenhouses. When the temperature and humidity drops below specific levels, the greenhouse manager can be notified via e-mail or a cell phone text message, or host systems can trigger misting systems, open vents, turn on fans, or control a wide variety of system responses. Because some wireless sensor networks are easy to install, they are also easy to move when the needs of the application change.

Classification:-

Routing techniques are required for sending data between sensor nodes and the base stations for communication. Different routing protocols are proposed for wireless sensor network. These protocols are classified according to different parameters. Protocols can be classified as proactive, reactive and hybrid based on their mode of functioning and type of target applications. In a proactive protocol the nodes switch on their sensors and transmitters, sense the environment and transmit the data to a BS through the predefined route. The Low Energy Adaptive Clustering hierarchy protocol (LEACH) utilizes this type of protocol [7]. In case of a reactive protocol if there are sudden changes in the sensed attribute beyond some pre-determined threshold value, the nodes immediately react. This type of protocol is used in time critical applications. The Threshold sensitive Energy Efficient sensor Network (TEEN) [8] is an example of a reactive protocol. Hybrid protocols like Adaptive Periodic TEEN (APTEEN) incorporate both proactive and reactive concepts [9]. They first compute all routes and then improve the routes at the time of routing. Further, routing protocols can be classified as direct communication, flat and clustering protocols, according to the participation style of the nodes. In direct communication protocols, any node can send information to the BS directly. When this is applied in a very large network, the energy of sensor nodes may be drained quickly. Its scalability is very small. SPIN is an example of this type of protocol. In the case of flat protocols, for example Rumor Routing, if any node needs to transmit data, it first searches for a valid route to the BS and then transmits the data. Nodes around the base station may drain their energy quickly. Its scalability is average. According to the clustering protocol, the total area is divided into numbers of clusters. Each and every cluster has a cluster head (CH) and this cluster head directly communicates with the BS. All nodes in a cluster send their data to their corresponding CH (example: TEEN). Furthermore, depending on the network structure, protocols can be classified as hierarchical, data centric and location based. Hierarchical routing (examples: LEACH, TEEN, APTEEN) is used to perform energy efficient routing, i.e., higher energy nodes can be used to process and send the information; low energy nodes are used to perform the sensing in the area of interest. Data centric protocols are query based and they depend on the naming of the desired data, thus it eliminates much redundant transmissions. The BS sends queries to a certain area for information and waits for reply from the nodes of that particular region. Since data is requested through queries, attribute based naming is required to specify the properties of the data. Depending on the query, sensors collect a particular data from the area of interest and this particular information is only required to transmit to the BS and thus reducing the number of transmissions. SPIN [10] was the first data centric protocol. Location based routing protocols [11] need some location information of the sensor nodes. Location information can be obtained from GPS (Global Positioning System) signals, received radio signal strength, etc. Using location information, an optimal path can be formed without using flooding techniques. GEAR is an example of a location based routing protocol. The present review discusses the intricate details of the roles of different routing protocols. Furthermore it provides a comparative analysis between these.

III. LITERATURE SURVEY

Samia A. Ali and Shreen K. Refaay [1] proposed an efficient routing protocol called CCBRP (chain–chain based routing protocol); it achieves both minimum energy consumption and minimum delay. The CCBRP protocol mainly divides a wsn into a number of chains (greedy algorithm is used to form each chain in pegasis protocol) and runs into two phases.
The proposed CCBRP outperforms LEACH, PEGASIS and CCM with respect to the product of the energy consumed and the experienced delay.
Nisha Sarwade et. al. [2] presented in this paper some of the major power-efficient hierarchical routing protocols for wireless sensor networks.
This work introduces the cluster based Hierarchical model, various power-efficient hierarchical cluster routing protocols and compare these Hierarchical routing protocols using some parameters. This paper is proposed for prolonging the life of WSN.
Tarun Gulati and sunita Rani [3] presented in this paper, we describe PEGASIS; it is chain based protocol that is near optimal for a data-gathering problem in sensor networks. PEGASIS outperforms LEACH by eliminating the overhead of dynamic cluster formation, minimizing the distance non leader-nodes must transmit, limiting the number of transmissions and receives among all nodes, and using only one transmission to the BS per round.
The Proposed work is about to select the next neighboring node reliably. The proposed system will increase the overall communication and increase the network life.
RATHNA.R and Sivasubramanian [4] presented this paper is about the wireless sensor network in environmental monitoring applications. A Wireless Sensor Network consists of many sensor nodes and a base station. The number and type of sensor nodes and the design protocols for any wireless sensor network is application specific.
The sensor data in this application may be light intensity, temperature, pressure, humidity and their variations.
Wenjing Guo et. al. **[5]** proposed a routing protocol for the applications of Wireless Sensor Network (WSN). It is a protocol based on the PEGASIS protocol but using an improved ant colony algorithm rather than the greedy algorithm to construct the chain. Compared with the original PEGASIS, this one, Pegant, can achieve a global optimization. It forms a chain that makes the path more even-distributed and the total square of transmission distance much less. Moreover, in the constructing process, the energy factor has been taken into account, which brings about a balance of energy consumption between nodes. In each round of transmission, according to the current energy of each node, a leader is selected to directly communicate with the base station (BS). Simulation results have show that the proposed protocol significantly prolongs the network lifetime.
Tao Liu et. al [6] proposed a new type of routing protocol for WSN called PECRP (Power-efficient Clustering Routing Protocol), which is suitable to long-distance and complex data transmission patient-surveillance. PECRP

combines the advantages of some excellent cluster-based routing protocols together, such as HEED (Hybrid Energy efficient Distributed Clustering Approach), PEGASIS (Power Efficient Gathering in Sensor Information Systems) and so on. PECRP uses multi-hop transmission that is called "circle domino effect" based on distance to BS to balance energy consumption between nodes. This paper proves the rationality that multi-hop transmission can prolong the lifetime of WSN in narrow sense situation based on Mathematical proofs.

Hyunduk Kim et. al. [7] proposes DERP (Distance-based Energy-efficient Routing Protocol) is a chain-based protocol that improves the greedy-algorithm in PEGASIS by taking into account the distance from the HEAD to the sink node. The main idea of DERP is to adopt a PRE-HEAD (P-HD) to distribute the energy load evenly among sensor nodes. In addition, to scale DERP to a large network, it can be extended to a multi hop clustering protocol by selecting a "relay node" according to the distance between the P-HD and SINK.

IV. PROBLEM STATEMENT

The motive of the energy metric is to find a routing path that can deliver a packet to its destination with consuming less energy. This is the general common routing metric for WSNs because the energy consumption is the major issue for all type of application in WSNs.

V. CONCLUSION

In this paper, one of the main challenges in the design of routing protocols is energy efficiency due to the limited energy resources of sensors in WSN. Routing protocol can effectively increase WSN performance using efficiently utilizing energy of sensor node. Therefore, routing protocols designed for WSNs should be as energy efficient as possible to prolong the lifetime of individual sensors, and hence the network lifetime. Because of this reason PEGASIS protocol can be selected for better performance in terms of energy efficiency and network life time. PEGASIS overcome the issues of WSN. Hence future work may be well focused on modifying or improved PEGASIS routing protocols such that the improved PEGASIS protocol could minimize energy of the sensor network and extended the lifetime of network.

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