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WIRELESS SENSOR NETWORK & ITS IMPORTANCE

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Abstract
The current technology is Wireless sensor Network which comprises of thousands of tiny, inexpensive, battery operated devices known as sensor node. These sensor nodes are pontentialy capable of capturing real time data , process and transmit it with high resolution to the base station. The real challenge for wireless sensor network is to design optimal routing protocol which enhance the network lifetime by reducing energy consumption. Energy saving is the main component in designing of network architecture. Here we compiled available information in comparison to new developed protocol with leach protocol using Network Simulator 2 (NS2). It proves the effectiveness of our proposed protocol in terms of higher packet delivery ratio, throughput, energy efficiency and network lifetime**.**

Introduction
Wireless sensor network has recently come into prominence because they hold huge potential to revolutionize many segments of our economy and life, from environmental monitoring and conservation, to fabrication and business asset management and wellness maintenance services. [1] It consists of a large number of sensor nodes connected to each other and are used to sense data from surrounding on the basis of temperature, pressure, heat, sound, vibration and communicate it to data centers. Sensing is the technique which is used to collect information about physical object or an event occurring in the environment. An object performing such a sensing task is called a sensor. Sensing and transmission of data is cooperative done with all the sensor nodes. Every sensor node is equipped with a microcontroller for processing data, radio system for wireless communication, memory for storage and limited energy sources (battery).
A range of communication of sensor node is 300m for indoor application and for outdoor (line of sight) is up to 1.6km. It is known that communicating 1 bit of data requires far more energy than processing that bit on wireless medium. Despite the advances in technologies, wireless communication will continue to dominate the energy consumption of networked embedded systems for the foreseeable future. [2]
The purpose of this article is to provide an energy efficient routing protocol for wireless sensor network. As we know WSN is battery operated and are placed in secluded environment where recharging of battery and manual handling is not possible. Energy dissipation is a major factor in WSN during communication between nodes and base station which leads to exhaustion of energy residues and network failure. So we need to give importance to this field of wsn and develop protocols which enhances network lifetime by reducing energy consumption.

Sensor architecture
Wireless sensor network consists of a large number of sensor nodes. Each node acts as an individual computer which cooperatively work to transmit data. Every node has a central unit (processor for processing data), memory (storage capabilities), battery (power source) and transceiver (communication). There can be application dependent extra components such as an area locator, a mobilize and a power generator (Fig 1).
These devices capture data from its surroundings in the form of electrical signal. This signal is converted into digital signal with the help of A/D converter and processed in the CPU and later transmitted to other nodes through wireless mode. Battery is the only power source for this device. Component of sensor node (fig 2)

Power source:
Sensor nodes require energy for processing and transmission of data The only energy residue for these nodes is the battery. Sensor nodes are provided energy through these batteries. It plays an important role in determining the sensor node lifetime. The amount of power dissipated from a battery should be carefully monitored. Sensor nodes generally have a limited size of the battery. Moreover, sensors must have a long lifetime from months to years, since the replacement of the battery is not an easy option for networks with 1000s of physically embedded nodes. This causes energy consumption to be one of the most important factors in determining the sensor node lifetime.

CPU:
The processing unit, usually low speed device with small storage capabilities (microprocessor) performs tasks like routing and processing of sensor data, etc. The choice of processing unit also determines, to a great deal, both the energy consumption as well

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as the computational capability of a sensor node. [4] Commonly known microprocessors are Atmel's AVR microcontroller, Intel's Strong ARM microprocessor, and Texas Instruments' MP430 microprocessor.

Memory:

This is the space used to store data for processing in the CPU. They have low storage capabilities and their size can affect consumption of power and cost [3].

Wireless sensor network characteristics

Wireless systems are planned according to sensor networks specific characteristic and developed for a purposeful application. Network characteristics have a definite impact on the possibilities and capabilities of the network. Some of its central characters are

1. **Large scale deployments:** Sensor nodes are deployed randomly over a wide area and can autonomously configure themselves into a communication net.
2. **Ease of use:** Sensor nodes are simple sensing devices which can be easily deployed and operated.
3. **Limited power supply**: WSN is formed by the large number of battery operated sensor nodes which has limited energy source. They are deployed mainly in isolated area where it is difficult to recharge or replace the batteries.
4. **Application specific:** Sensor network are designed and developed depending upon the type of network structure designed for the application or the network operations carried out using these protocols for a specific application model. [5]
5. **Harsh environmental conditions**: Sensor nodes are located in harsh environments such as underwater, forest, atmosphere. They must have a potential to resist in severe conditions.
6. **Node failures:** As sensor nodes are deployed in a harsh and hostile environment, nodes are prone to physical damages or failure.
7. **Dynamic network topology:** Network topology changes due to the node damage, removal of node, addition, energy loss or channel fading.
8. **Node type**: A group of nodes selected for forming a wireless network are of two types, homogeneous and heterogeneous. Homogeneous nodes are those who hold the same capacities and duties. Heterogeneous group has some nodes more powerful than another, they are provided with special responsibility and our known as cluster head. They are used to gather information from low power nodes and transmit it to Base station.
9. **Mobility of nodes:** Sensor nodes are free to move or change their location according to their requirement in application.
10. **Many to one traffic:** Data is sensed by multiple sensor nodes and cooperatively transmitted to a single source (sink). Data traffic is in many to one form. This increases the network traffic and energy consumption [4].

Advantages/Disadvantages

Advantages

Reduce your cabling cost:

Installation expenses are reduced by eliminating wiring/cabling and battery replacement. The monetary value of integration, maintenance as well as the cabling weight induces non negligible constraints that can be more costly than the cost of cabling alone. In going to low installation price, inexpensive devices, smaller sensing transducers, longer lasting, it is also, adaptive and can be reconfigured to operate in different areas.

Data transmission in harsh environment:

Wireless sensor network is deployed in isolated and hostile environment where human intrusion is difficult, so this network plays an important function in supplying real time data to a base station for further processing.

Toughened and miniaturized wireless measurement products:

Isolated area where installation of wired network is not possible are directly in scope with the help of hardened and miniaturized wireless network.

Locating wireless instruments by GPS

The combination of wireless technology along with the GPS helps in locating sensor nodes. This helps in managing network, measuring energy consumption and testing instruments.

Real time monitoring

Real time measurement is monitored and all measurements are recorded and stored in sensor nodes. Each measurement is time stamped and Geo-located in real time within a 1 Hz to 5hz bandwidth. It is thus possible to efficiently study the changes and geo – locate it when the alarm is being released

Disadvantages

One of the greatest disadvantages of large scale wireless sensor networks lies in the complexity of logistics involving selective replacement of sensors that have run out of vitality.

Lower speed compared to wired networks

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Wired network have greater speed than wireless.

Less secure:

Less security because the hacker's laptop can act as an Access Point. If you tries to connect to their device, they'll read all your important information (username, password) as wireless medium is more vulnerable to web attack.

Complexity

More complex to configure than wired network.

Surrounding condition

Network ability is affected by surrounding conditions. E.g: walls (blocking), microwave (interference), long distance (attenuation).The network gets disturbed by several elements like Bluetooth.

Cost

Still requires more money at large scale as it does provide sensing quantities in buildings easier and does not reduce sensor node installation cost [5]

Application

WSN has a wide range of application in the field of science, medicine, business, communication, agriculture and security. Earlier it was used in complicated applications like radiation and nuclear threat detection, habitat monitoring, military surveillance and monitoring seismic disturbance. But nowadays sensor nodes are used in commercial application like lightning and other sensor controlling system in industrial and office buildings, agriculture, vehicle or mobile device tracking, to maintain traffic flow. [6]

There is a widespread use of WSN in environmental monitoring. With this scientist need not to go deep in the fields with the harsh condition to record new observation. Instead, they can easily gather information regularly with the help of sensors.

Agriculture

Wireless sensor networks are nowdays playing an important role in agriculture industry (Fig 3 A) . Sensor networks are used to monitor environmental parameters of crop cultivation. The information provided by sensors will help farmer's to analyze and process in the decision making of when to water crops or when to use different types of pesticides and fertilizers on crops. To avoid the risk of frost, fungus and crop diseases, sensors are used in combination to measure humidity, temperature, wind, water and light. We can control water usage in a more efficient and economic way of monitoring moisture in soil, air, humidity and weather forecasting.

Forest

The best method to detect forest fire is through sensor network.((Fig 3 B) The nodes installed in a forest are equipped with temperature, humidity and gas sensors to detect fire in trees or vegetation immediately. This is used in fire fighting process, and also provide direction to fire brigades to know the direction in which fire is spreading. In addition to this it can detect unauthorized human movements in forest to prevent poaching and hunting of wild animals. Sensors have a significant role in the prediction of climate change by monitoring micro-climate in the woods. The information about the physical, chemical and biological status of soil in the root system of a tree makes a substantial contribution in the intensive monitoring of forest ecosystems.

Green house

Sensor networks are applied to check temperature and humidity levels inside commercial greenhouses ((Fig 3 C). If temperature and humidity is below provided levels, information is sent to the greenhouse manager via e-mail or text message. In many of the advanced system they can trigger alrm on extended level to maintain.They can also open vents, turn on fans, or control a wide variety of system responses. To achieve reliable and reproducible outcomes we need to accurately measure temperature and humidity level with high spatial resolution, horizontal as well as vertical.

In livestock

A wireless system, consists of sensors and transmitters to keep livestock (Fig 3 D) healthy with a minimum use of resources. PH level and temperature inside the cow's body is determined and wirelessly send it to an control node via an encapsulated measuring probe known as bolus.The aim of this application is to develop a wireless rumen monitoring system for early detection of rumen conditions due to acidosis by measurement, transmission and indication of the pH-value of the rumen to dairy manager.

Smart road application:

The function of sensors can lead to these tasks by making a series of smart applications that may pass to a good and safe world. From many years, many transport infrastructures-bridges (Fig 3 E), tunnels have broken down due to natural disasters or because of inadequate care. Bridge in Minneapolis collapsed in 2007 killing people. In 2008 this bridge was re-constructed using a sensing system to gather information regarding structural behavior and erosion. Monitoring bridges is one of the successful applications of wireless sensor network. The sensor networks for these sorts of bridges include accelerometers, strain gauges, anemometers, weigh-in-motion devices and temperature sensing elements.

Similarly, monitoring systems are used to measure condition inside the tunnel. (Fig 3 F) From air flow to visibility and a wide range of gases (CO, CO_2, NO_2 , O_2) are the parameters used to determine air quality inside tunnels. Many of the systems are wired

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but with the deployment of Wireless Sensor Networks it would be costless, more safe and reduce installation and maintainence time.

Traffic control

Traffic conditions can be easily monitored and kept in line at peak times by WSNs. In temporary situations such as road works and accidents can be monitored in situ. Further, the integration of monitoring and management operations, such as signpost control, is facilitated by a common WSN infrastructure.

Conclusion & futurework

In this thesis, a brief introduction of wireless sensor network and its application is given. As every technology has its pros and cons , this technology also has many constraints. One of its constraint is its dependency on energy . So to improve its performance and network lifetime, it is a requirement to provide an energy efficient routing protocol for the transmission of data. This thesis includes survey of various routing protocols based on clustering technique and found Leach as one the efficient routing protocol. In this thesis an improvement to Leach protocol is done by further modifying it to bring better results. In this proposed method CSMA/CA and TDMA are used for improving data transmission by sensing channel for avoiding collision and packet loss. Then randomization is done which means a node inclusion /exclusion technique is used for far away cluster to improve its lifetime. For the transmission of data, optimal path is chosen with least number of hops and higher energy residual and least traffic load. Then a comparison of simulation result are on the basis of network performance, network delay, packet delivery ratio, data packet . The graphs show satisfactory results of proposed method [7-11].

Wireless sensor network is an emerging technology and has a huge scope of research and development. In this field energy is the main constraint and has huge research possibilities. Certainly further energy improvement is possible by improving routing protocol and cluster head selection technique [12-13].

This field of energy optimization in wireless sensor network has an immense scope of research and development and taken into interest by all manufacturers and developers of network architecture. The main problem is to develop an energy efficient routing protocol to maintain energy dissipation while transmission of data [14].

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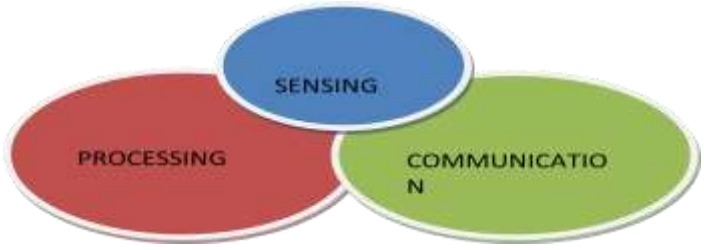

Fig 1:Function of Sensor node: Showing a sensor architecture

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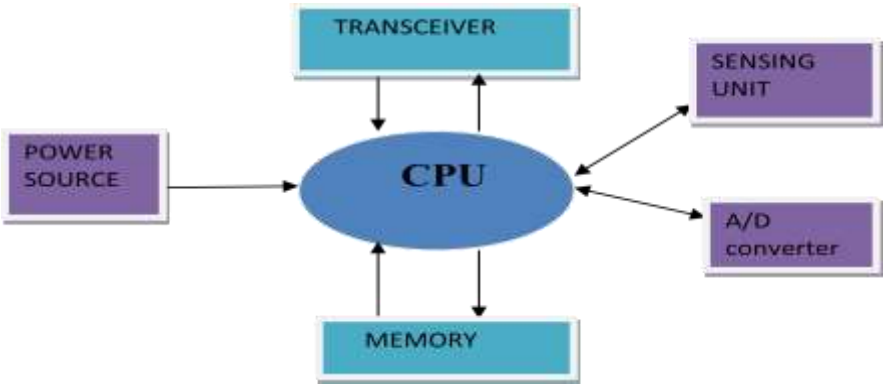

Fig 2: Components of sensor node: Showing various components of sensor node.

Fig3 – Application of Sensor in various Field

Fig3 A. – Sensor in Field

Fig 3 B. Sensor Network in Forest

Fig 3 C. Sensor Network in Green House

Fig 3 D. sensor in cows rumen

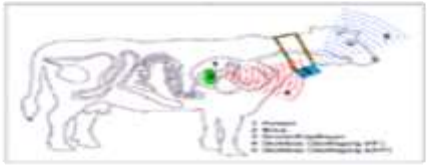

Fig3 E. Sensor fitted in Bridge

Fig 3 F. Tunnel sensor node

Fig 3:Applications of sensor network in various field: 3A. Normal Field, 3B. Forest, 3C. Green Houses, 3D. Cow Rumen, 3E. Bridges, 3F. Tunnel.