ISSN: 2582-8118 ***Volume 1, Issue 4; July 2021***

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYSIS IN SCIENCE AND ENGINEERING

Web: https://www.iarj.in/index.php/ijrase/index

8. Communication in the Wireless Sensor Systems Domain

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ABSTRACT:

In recent years, wireless systems based on Internet of Things (IoT) have grown rapidly in a variety of industries. Devices and sensors can communicate with each other without human intervention in the IoT (Internet of Things) network. As part of the Internet of Things, the WSN (Wireless Sensor Network) has proliferated into a variety of real-time applications. The Internet of Things (IoT) and Wide Area Networks (WSNs) now impact nearly every aspect of our daily lives, both critical and non-critical. Battery-powered nodes are the most common type of WSN node. As a result, energy-efficient data aggregation techniques that extend the network's lifespan are of paramount importance.

Several methods and algorithms for aggregating data in IoT-WSN systems in an energy-efficient manner were presented. The sensing capabilities of Wireless Sensor Networks (WSNs) have the potential to radically alter the way we live and work. Military operations, surveillance systems, and intelligent transportation systems (ITS) are just a few of the many areas in which WSNs can be put to use. Due to the concept of "3 any," wireless networks are becoming increasingly popular. These tiny, low-cost, low-power, and multifunctional sensor nodes are the result of technological advances in wireless communication. Sensor networks' routing problems are handled by the network layer. Because radio transmission and reception use a lot of energy, this is an important factor to look into. In wireless sensor networks, energy conservation is essential. After Bluetooth, ZigBee is the next big thing in personal area networking. A new ZigBee-based wireless meter reading system has emerged following an introduction to this technology.

KEYWORD:

WSN, Sensor, Wireless, ZigBee, IoT.

Introduction:

By providing feasible communication, reliable inspection, and performing applications, WSNs have become a vital component in a wide range of applications, including environmental [1] monitoring, [2] military surveillance, and [3] medicine. Using a large number of sensor nodes that are all connected wirelessly, WSNs can transmit and receive data about their surroundings.

Sensors, radio transceivers, processors, and power supplies are all included in every sensor node. WSN development is a difficult task because of the complexity of these systems.

WSNs must also meet a number of other requirements, such as a power consumption limit that is the most important one. Many current studies concentrate on surveying WSNs because of this. Researchers in [4, 5] discussed the idea of WSNs as well as some of their unique characteristics.

They discussed WSN generations, routing, architecture, and storage management. Wireless networking technology has had a profound impact on our daily lives in many ways. Among future technologies, the Internet of Things (IoT) is one of the most rapidly evolving.

The Internet of Things (IoT) enables the physical connection of multiple devices, which fundamentally alters our daily lives. Because of this, the demand for communications systems is rising rapidly, especially in fields where activity is on the rise.

Due to advancements in wireless communication, it is now possible to build sensor node-based wireless sensor networks. Sensor nodes are small, low-cost, low-power devices that can sense, communicate wirelessly, and compute.

Data collection begins as soon as sensors are placed in the network, and the Base Station receives the data as soon as they are connected.

It is also possible to think of WSN as a network of low-size and low-complexity devices called nodes, which are capable of sensing the environment and transmitting data gathered from the monitored area; the gathered data is either transmitted directly to the sink, which can use it locally, or it is connected to other networks (such as the internet) through gateway nodes.

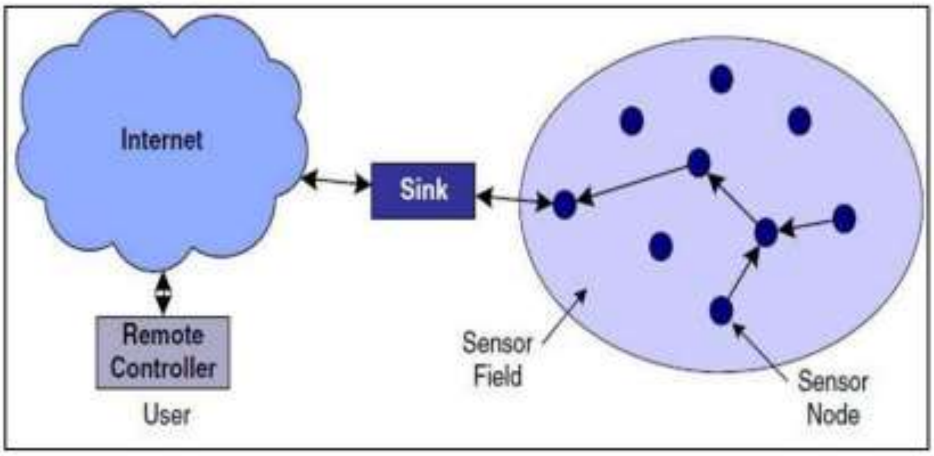

Figure.1: Architecture of a typical WSN

As the foundation for the IOT-based systems all around us, heterogeneous WSN has become the cornerstone [3], introducing significant improvements in the near future. This has led to energy consumption issues [4] that have attracted a great deal of attention.

Increasing communication and information exchange rates have resulted in unsustainable increases in energy consumption and carbon emissions [5], on the one hand. Sensor nodes must be able to operate for long periods of time (even years) for a variety of applications (e.g., environmental control, agricultural protection, border surveillance and security etc.) [6].

Data reliability and device compatibility can be harmed by dead nodes in an application, and this can have a significant impact on the application's long-term viability if sensors are using a lot of power. There are typically four major units in a sensor node:

- in addition to the computer's processor
- sensing/identification system
- both the comms unit and the
- power supply unit

According to the diagram in Figure 2, a sensor node's main components are a sensing unit, a processing unit, a transceiver, and a power unit. Using an ADC, or Analog to Digital converter, the sensing unit measures a physical quantity and converts it to a digital value.

To perform further computations, the processor and transceiver are used, and the Base Station or other nodes can transmit and receive data. A sensor node's power unit is the most conspicuous component. For unattended applications, once the battery is depleted, it cannot be replaced. The Mobilizer, Power Generator, and Location Finding System, for example, are all application-specific units.

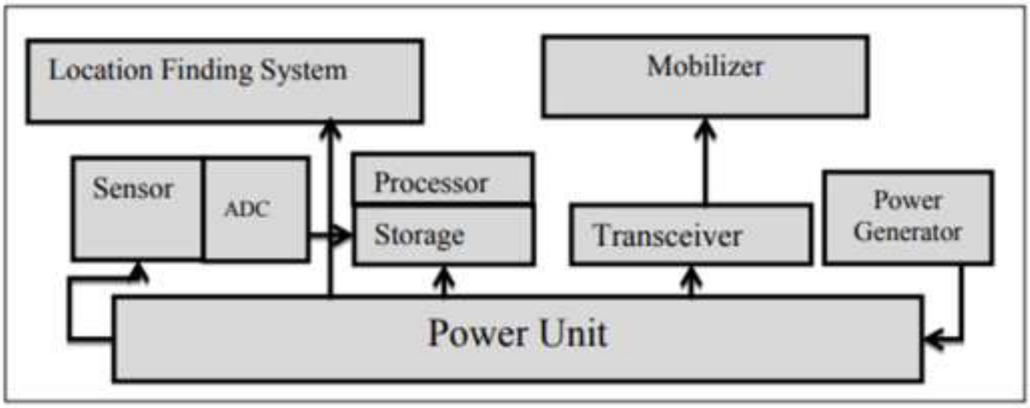

Figure.2: Components of a sensor node

Role of IoT in WSN

With the help of IoT architecture, we've built a WSN-powered solar-powered precision agricultural (PA) network to meet the demand for figuring out the most efficient ways to run a smart agriculture management system. When it comes to saltwater intrusions, soil moisture, water levels, wet conditions and general land conditions in an IoT-enabled system that is easy to use for farmers is a major benefit to this system's design. The sensors can be used to monitor the atmosphere for a longer period of time and return data. It was proposed in [17] that a robust routing protocol for an IoT sensing network should be implemented. Initially, a rendezvous area was constructed in the middle of the network field. Clustering and multipathing were employed to reduce energy consumption and increase resiliency. With the help of the Castalia simulator, the newly introduced protocol was tested under various conditions, including packet transmission, average energy consumption, end to end latency, and network durability. The IoT and WSN algorithms based on IoT were classified into two groups: energy conscious, delay, throughput, data transmission, and packet loss aware.

Applications of WSN:

Seismic, low sampling rate magnetic, thermal, visual, infra-red, acoustic and radar sensors are just some of the many types of sensors that can be used in wireless sensor networks. As an example, they are capable of keeping tabs on a slew of environmental factors like temperature and humidity as well as vehicular movement and weather-related conditions like lightning and pressure as well as soil composition and noise levels, as well as the presence or absence of specific objects and the mechanical stress levels on attached objects. It is possible to divide WSN applications into the following categories:

a. For use by the armed forces:
b. Uses in relation to the environment:
c. Medical applications:
d. application in the home:
e. Direction of traffic:

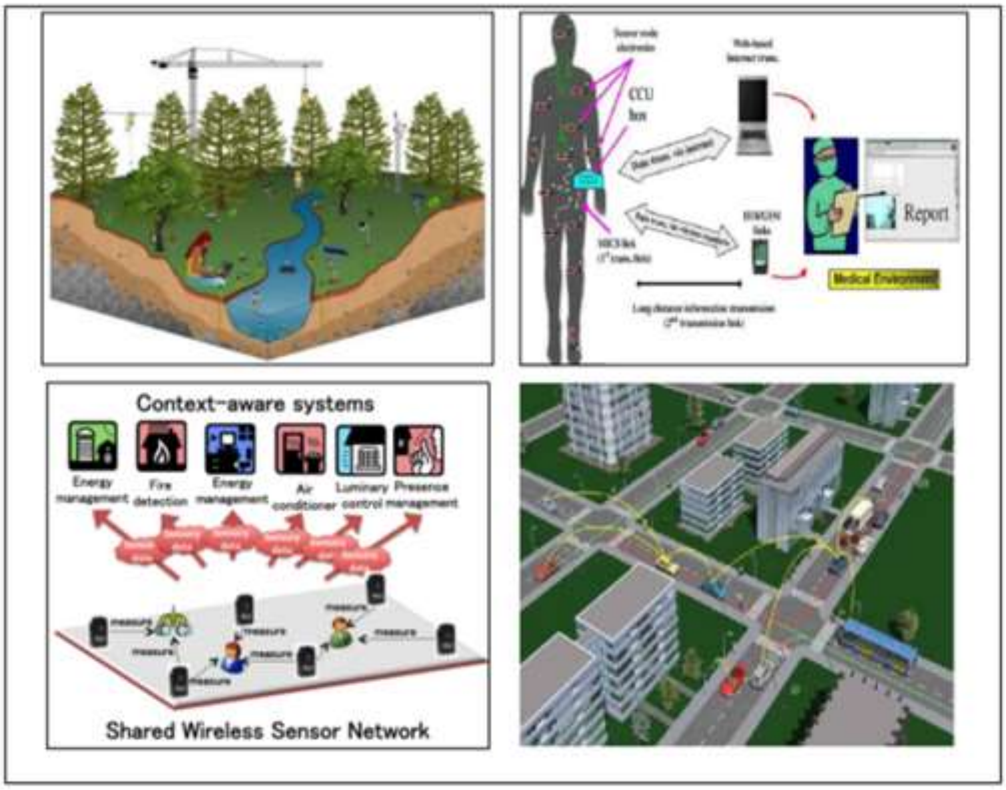

Figure.3: Applications of WSN

Energy Efficient Routing in WSN:

All layers of the networking protocol stack must be aware of energy constraints because sensor nodes have limited energy supply and bandwidth.

The goal of the network layer is to find ways to reduce the amount of energy needed to set up a route and transmit data from sensors to the sink in order to extend the life of the network. An important consideration in WSNs is the selection of routing strategies.

All routing protocols share the same objectives [6], such as enhancing network resilience, availability, and service, extending the lifespan of sensor networks, simplifying the architecture, reducing energy consumption, and enhancing WSN performance.

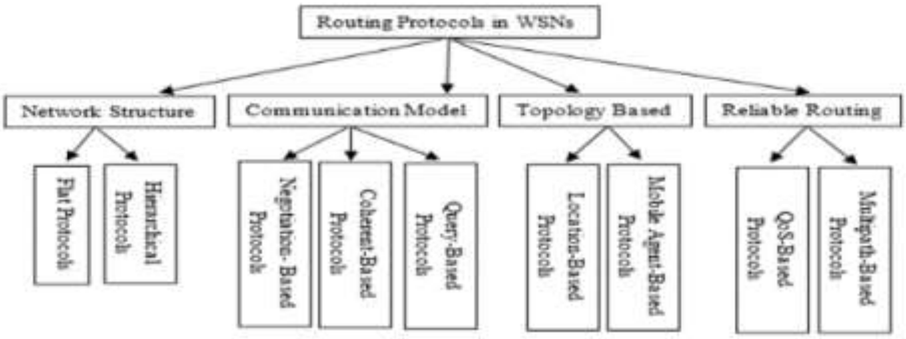

Figure.4: classification of routing protocols

Review of Literature:

There has been an increase in the use of wireless sensor networks in the construction of smart city infrastructure such as urban transportation monitoring systems, urban environmental monitoring systems, and urban waste management systems in recent years. On the Beijing-Hangzhou Grand Canal, Rady et al. put in place the world's largest wireless sensor network detection system on the Fuhu Bridge, which uses a sensor node to gather data from the bridge and a wireless sensing network [2].

Large bridge called "Pulse." [3] Xiao and colleagues came up with a set of smart city structures. As an event-driven structure, the building is capable of monitoring heterogeneous sensor management and collaboration in public areas. The results of experiments conducted on a subway test bench show that the proposed structure can improve abnormal event detection, simplify operator tasks, and ensure emergency communication between passengers.

The mesh network architecture proposed by Bhola et al. [4] is novel. WSN is able to gather environmental data more quickly thanks to this structure. New Internet-of-of-things technologies will be used to optimize environmental monitoring methods in smart cities in the future. Two integer linear planning formulas based on actual pollutant proliferation models are proposed by Keswani and Bhaskar for urban environmental pollution, and they handle minimal costs for WSN deployment for air pollution monitoring [5].

They developed an effective WSN deployment to monitor air pollution by applying the model to real-world data (like street lights in Nordoham City).

Objectives:

- Analysis of currently available market solutions.
- Review of current methods of information transfer and exchange.
- Modification of an existing protocol to meet the needs of the global community.
- An investigation into WSN performance

Research Methodology:

Comparative study of the LEACH and PEGASIS protocols

Hierarchical low-energy clustering (LEACH) Nodes form clusters on their own using LEACH, which is a self-organizing single hop hierarchical protocol. Because new CHs are elected every round in LEACH, routing overheads are a necessity. To cut down on this wasteful use of precious energy, we'll need a new cluster head replacement algorithm that works well. Additionally, MODLEACH includes a dual-transmission-power-level mechanism in its modified LEACH (MODLEACH). The latter allows nodes that are far and close to BS to send their data at different power levels, ensuring that the network has a healthy balance of electricity.

Sensor information systems utilize less energy during data collection (PEGASIS) Each node in the chain of PEGASIS communicates only with the other nodes that are directly adjacent to it. The chain's construction begins at the node that is farthest from the BS. For the purposes of initiating data transmission and fusing data, each node except the end nodes uses token passing as a starting point. Each node's average energy consumption per round is reduced, resulting in a network lifetime improvement of up to 300 percent over LEACH.

Energy-saving features have been added to mobile sinks Routing protocol built on the PEGASIS platform (MIEEPB) Multi-chain model MIEEPB incorporates sink mobility, allowing for smaller chains and lower loads on leader nodes. Using a mobile sink reduces the amount of power used by sensor nodes while also speeding up data delivery to all of the nodes. The nodes connected by a multi-chain are closer together thanks to the multi-chain concept. Because there are fewer nodes in the chains, the network overhead is reduced.

Simulating the performance of MODLEACH and MIEEPB was done using MATLABR2013a and a number of variables, including network lifetime, residual energy, the number of dead nodes, and normalized average energy consumption, were taken into consideration. According to the comparison, MIEEPB offers a 72% improvement over MODLEACH. Table 1 shows the simulation parameters.

Table 1: Network parameters

Network parameters	Value
Network Size	100*100m^2
Initial energy of nodes	0.5J
Packet Size	3000bits
Number of nodes considered for simulation	100 nodes
Number of nodes taken for simulation	3500 rounds
Transceiver idle state energy consumption	50nJ/bit

Result and Discussion:

The simulation's outcomes are shown in Fig. 5. There are 750, 1120, 1750 and 820, 1250, 3000 rounds in which the first, 10 and 100 nodes of MODLEACH and MIEEPB die out. Remaining energy in the network is shown in Fig. 5(b). MODLEACH and MIEEPB were found to have a residual energy of 0J and 2J, respectively, around 1500. Figure 5(c) compares the number of dead nodes over rounds, while Figure 5(d) compares MODLEACH and MIEEPB's normalized average energy consumption.

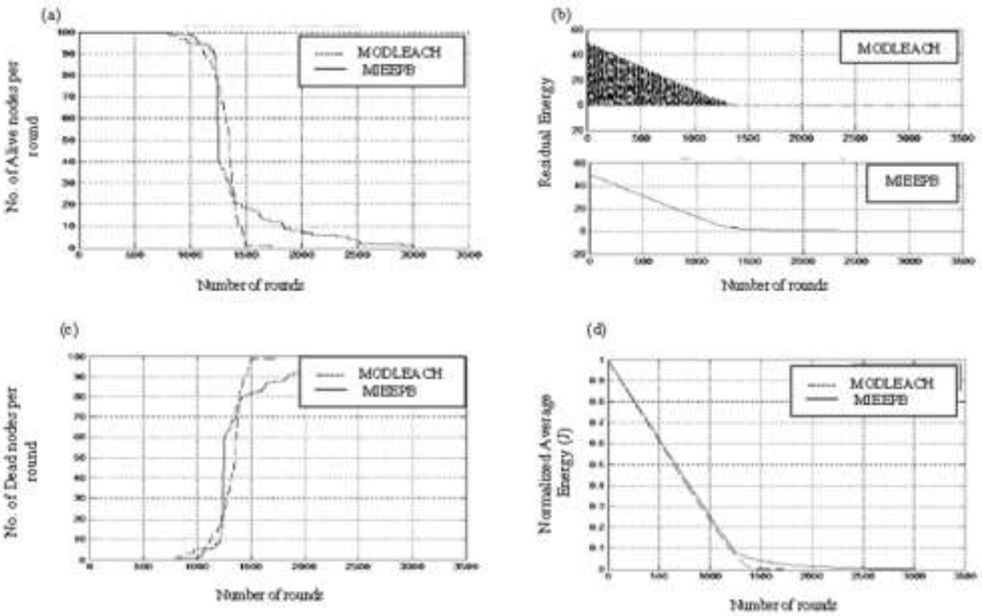

Figure.5: (a) Network lifetime; (b) Network residual energy (J); (c) Number of dead nodes; (d) Comparison d) Network average normalized energy (J)

Conclusion:

WSNs have grown as a result of advances in computer technology, which allow them to constantly monitor the necessary parameters. WSN systems based on the Internet of Things (IoT) have recently gotten a lot of attention.

However, when transmitting point-to-point, these systems are constrained by bandwidth, power, and resources that are limited. Data aggregation techniques aim to save energy, improve lifetime, improve quality of service, and provide the network with high levels of security.

ZigBee, a new wireless protocol in the personal area, has a wide market because of its low cost, low data rate, and low power consumption. It improves the reliability of environmental monitoring techniques in coal mines and is therefore extremely important for Chinese mine safety.

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