Green Wireless Sensor Network & Its Significance in IOT

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Abstract

This article focusses on the revolutionary transition of traditional Wireless Sensor Network (WSN) into Green WSN. It shows the importance of entering and visualizing a green WSN. It describes how the green WSN can be applied in the IOT environment. The challenges of GWSN and the future scope of research areas in Green Wireless Sensor Network (GWSN) which will bring a drastic change in the communication and networking industry.

Keywords: Green Wireless Sensor Network, IOT, Communication, Environment, Challenges.

I) Introduction-: The vision of a sustainable development of society will move through the paths of technology. Technology nowadays is becoming an indispensable tool for the society. The excessive use of technology is one of the major reasons for growth of pollution, health hazards and escalation of e-waste. For reducing the consumption of e-waste, the concept of wireless communication came into existence. The wireless communication depends solely on the wireless sensor networks for effectively transmitting data from sender to receiver. It was seen that the energy consumption, the heat dissipated and the security issues were a major concern of the sensor nodes. As, the European Union aims at reducing the greenhouse gas emission by 50% in 2030. The growth of Green WSN will widely come into picture for reducing the energy consumption and providing a drastic change in sustainability of human race.

Green WSN is a network belonging to a group of WSN where the sensors communicate with each other to control a working environment. Each sensor in this network will be able to collect information basing on their own interest. The network is said to called green as it relays the data packet across one node to another at a decreased energy usage [1]. By conservation of energy [2], we can reduce the cost of communication at the nodes as most of the energy will be diverted towards relaying the packets.

II)Components of a Green WSN:

A WSN is a collection of interconnected sensor nodes which are wirelessly connected with a centralized node called base station node or sink node. The entire network can be controlled in a centralized way by a base station node and it can also be used as an entity for communicating with other networks. A sensor node is an electronic device comprising of four components: a sensing unit, processing unit, communication unit & power unit. A sensing unit allows the sensor node to collect data in its normal operating conditions. Data are handled by the processing unit and the communication unit is used to exchange and relay data with other nodes along with the base station node.

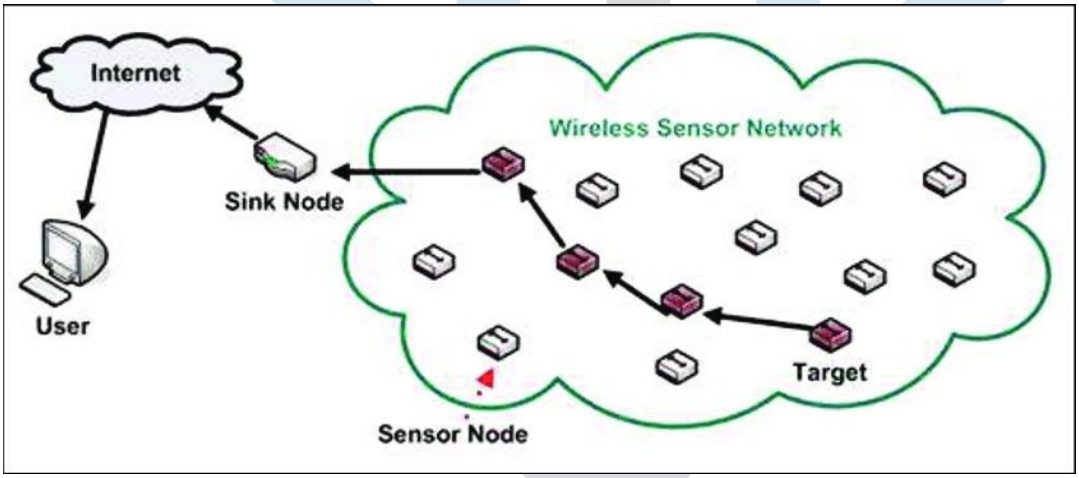

Figure 1: Basic Components of GWSN

The last unit which is the power unit is the most important unit in a WSN which is helpful for supplying power to the sensor nodes for their successful operation. In a traditional WSN, chemical batteries like Lead-acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion) Li ion are used. These batteries longevity decreases with passage of time. So, the power unit has to be made from a renewable/green source of energy to enhance the efficiency of a network. In case of GWSN, we can use solar energy, wind energy, hydroelectric energy etc. for powering up the sensor nodes so that the network becomes energy efficient. The main aim of going for a GWSN is to keep the network nodes alive for a longer interval of time and prolonging the network lifetime.

III)Setbacks of a traditional WSN :

The performance metrics of a WSN is based on 3 factors: Coverage, Energy consumption & Worst case delay between the nodes. Here are a lot of sources of energy wastage in a traditional WSN which are listed below which forces the research to enter into the dynamics of Green WSN:

i) **Collision:** The situation arises when two or more data packets reach the sensor node at the same time resulting into a packet collision. So, the packets are either going to be discarded or it is going to be retransmitted from the source node [5]. Due to this, the packet latency increases and the network efficiency is severely affected [6].

ii) **Overhearing:** This situation arises when a sensor node receives a data packet from the source node even if it does not come within the proposed destination [7,8]. So, a particular node will be heavily crowded and dense once the surrounding nodes start transmitting their respective data packets. This will drastically reduce the mechanism of a WSN.

iii) **Interference:** When a given node comes within the transmission range of two or more neighboring nodes, interference occurs [9]. The interference increases with increase in no. of neighboring nodes thereby increasing chances of packet loss and retransmission.

IV) Applications of GWSN in IOT environment

The combination of Green WSN and IOT will lead to a co-existing environment which is called Green IOT. This will be an energy efficient procedure both in software and hardware which will minimize power consumption, greenhouse effect and emission of CO2 [4].

The utilization of Green WSN will enhance the communication protocols, network-based architecture & maximum utilization of bandwidth with relatively low energy consumption of nodes. In case of Green IOT the major concept includes three things: enabling technologies, leveraging technologies & designing technologies.

Some of the major applications where Green WSN will enhance IOT are:

i)**Smart Home:** This has become a major trend in all the developing countries nowadays. All the electronic appliances will be controlled by a remote smartphone/computer. The devices can also be controlled by voice commands. The network developed with GWSN will help the smart home environment increase its efficiency increasing its self-sustainability and longevity.

ii)**Industrial automation:** The automation industry is now on a larger scale growth in foreign countries. The automation has led to an increase in efficiency and productivity of many industries. The green IOT environment has significantly changed the process of automation.

iii)**Smart healthcare:** Another booming effect of green IOT is healthcare industry. The implementation of smart actuators and sensors for monitoring the health of a patient has presented a radical step in the health sector. This can improve the accessibility of hospitals and also decrease the treatment cost.

iv)**Smart agriculture:** The revolution of Green IOT has increased the production of smart agriculture. The sensors and Green IOT environment have accessibility of recording the present temperature, humidity, weather forecasting which enables farmers to determine which kind of crops needs to be grown on a particular land. The process of watering of crops has also become automated and utility of hydraulic sensors enables the amount of water flow for a particular time.

v)Smart Cities: It represents one of the most prominent applications of Green IOT. Machines are embedded with add-on communication circuitry and sensor circuitry for efficiently relaying the data and making the environment smart enough. The accomplishment of big data environment will improve the quality of life as well as reducing the pollution content alongside.

V) Challenges of GWSN

Every evolution comes with a certain number of challenges. The Green Wireless network are to face some of the major hurdles as listed:

i) **QOS provisioning:** In case of QOS (Quality of Service) provisioning many factors are acting as a challenge for a GWSN:

1)**Heterogeneity of Sensor nodes**: Handling of heterogenous data in a GWSN is a challenging task. The sensor nodes included in the network will produce data related to pressure, sound, humidity, temperature etc. Capturing different range of data at different rates related to different QOS constraints and models is a real challenge in GWSN.

2)**Arrival of Mixed data pattern:** The data monitored by GWSN is normally periodic in nature which is generated by nodes at a definite interval of time. When the pattern of data generated by nodes becomes irregular, it becomes a challenging task for the designer to make QOS based schemes for the GWSN.

3) **Multiple base or sink station:** GWSN are generally associated with one sink station or base station. If according to the requirement the no. of sink station increases, the network must have the diversified level of QOS support which is to be associated with multiple sinks.

ii)**Data processing and Compression techniques:** Big data techniques have now grown leap bound in recent years. Big data processing environment in a GWSN is acting as a critical challenge in order to collect, gather and aggregate large volumes of data [10]. Big data processing is a challenging task. The data received by each node may appear to be insignificant, but the amount of data generated by the entire network is a huge ration. Thus, the amount of data produced requires adaptive techniques for compressing the data bits which itself is a real challenge.

iii)**Network scaling and time varying nature of GWSN**: As, the no. of user density increases, the size of the network will also start increasing [11]. The main hurdle nowadays requires how to increase the network capacity fitting to the user needs. The other difficulty in GWSN is that the system properties changes with respect to time. According to signals and systems concept, it is very difficult to predict the output of a system whose system characteristics vary with time. To make the GWSN network a time invariant system is a major challenge.

VI) Conclusion

The GWSN network will slowly and steadily removing a traditional WSN.As per the prospect of environment, stability, and reliability the GWSN has provided a significant improvement by using renewable source of energy to enhance sensor node lifetime and relaying the data at a decreased energy usage. In future, the research work should be focused on designing a time invariant

GWSN which will stabilize the relaying of data and the big data algorithms for optimizing the aggregation of huge amount of data in GWSN.

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