A Survey on Wireless Sensor Network based Internet of Things

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Abstract:- Internet of things (IoT) is one of the fields, where much research work is being done. Nowadays, wireless systems which are based on IoT are developing very fast in different sectors. The Internet of Things is the kind of network in which any machine or tools can be operated without any interference of human beings The information shared among different objects will be more useful if a wireless sensor network (WSN) is used with the Internet of things. IoT is a combination of sensors and software with embedded electronics. The WSN based IoT system collects data from the environment through sensor nodes and data can be uploaded on the cloud. Users can access data from anywhere. In this paper, we discuss WSN based IoT systems, elements of the internet of things and the challenges of WSN based IoT systems. WSN nodes are generally small in size and are also battery-driven small machines. The energy- efficient data transfer technique can help in increasing the lifespan of the network.

Keywords:- Internet of Things, WSN, sensor node, cloud computing.

I. INTRODUCTION

In WSN, Sensor nodes sense data from environment and send data to Gateway [1]. Majority of WSN applications, including precision agriculture, forest fire detection, healthcare, and industrial applications, necessitate continuous monitoring of certain physical parameters. Some specific WSN applications, such as video streaming and monitoring of human vitals, necessitate stringent quality of service standards in order to maximise network performance [2,3].

The Internet of things (IoT) connects billions or trillion of objects through internet. It is automatically in sleep mode when not in use. Therefore, devices generally consume less power. It allows people and things to be connected anywhere, anytime through the internet. This kind of technology will help to make a better world for humans [4]. It consists of multiple nodes, a Gateway, database, and webserver. The gateway acts as a bridge between a sensor network and internet. The IoT technique is divided into two parts: data transmission and data manipulation. The data transmission means communication between physical objects and the data server on the internet. The data manipulation means aggregation and further analysis of data generated by physical objects [5]. The various wireless technologies such as Wi-Fi, 4G, Zigbee, LoRa are used in IoT. The selection of wireless technique depends on various parameters such as cost, data rate, transmission range etc. 4 G and Wi-Fi connect to the internet with high throughput, but they cost more. WSN has advantages such as high efficiency and multihop transmission. Most existing sensor networks are based on the Zigbee. All sensed data are sent to the Gateway and Gateway uploads them to the web server through mobile phone or PC. After modifying the raw data coming from the gateway, web server stores them in the data base. Users can access the data from the cloud through internet [6,7]. Billions of objects and devices are currently connected to the internet. However, even today more than 95 % of things in the world are remain unconnected. The IoT based smart environment can be divided into different areas such as smart cities, smart buildings, smart homes, smart transportation, and smart industry [8].

Table 1 depicts a comparison of communication technologies used in smart environments.

Technology	Data rate	Range	Power consumption	Frequency	Applications
Bluetooth	25 Mbps	10 m	Low	2.4 GHz	Smart Home
Zigbee	250 Kbps	Up to 100 m	Low	2.4 GHz,915 MHz, 868 MHz	Smart Home, Smart Health
Wi-Fi	54 Mbps	140 m, 100 m	Medium	2.4 GHz, 5 GHz	Smart cities, smart industry, smart transport
4 G	800 Mbps	1-6 miles	high	700 MHz, 800 MHz, 1900 MHz,	Smart cities, smart industry, smart transport

Table 1: Comparison of communication technologies used in smart environments

II. WIRELESS SENSOR NETWORK BASED INTERNET OF THINGS

Sensor node sense data to environment and send it to base station. Now, base station transfers the data to mobile or laptop. Data can be uploaded on cloud through internet. User can see data (anytime, anywhere) from internet. Figure 1 shows four sensor node and a base station.

Fig. 1: Sensor nodes and a Gateway for WSN

After the beginning of wireless network technology our everyday life has changed very rapidly. There are multiple devices connected and communicating in the world in different sectors. The internet of thing is also the fast in nature developed technologies which is very revolutionary and basically changed our everyday life. IOT also plays its role in developing new applications and technologies. (For example, surveillance camera, environmental monitoring, home appliances). This network works in a sustainable and safe manner [9].

However, in the internet of things, the real time modules like sensors are also linked with each other for the transmission of the tested data to the core repositories in which the data is always available to the user to access according to their needs. As the number of communication devices are having the very high features of the internet of things are quite different [10]. For the realization of the internet of things, system functions are deployed and developed in different environments. These systems face several challenges that affect their proper functioning of the nodes. Some of the challenges are temperature, humidity, sunlight, animal activity, etc. To overcome these challenges several alternative approaches are taken to synchronization protocol for IOT are much needed [11]. The IOT is widely used in wireless sensor networks and also accepted as a revolution in the industry that receives and sends data over the internet. They collect the data in the real time event addressing the various challenges for various applications mainly as education, finance, energy, transportation. There is a risk of cyber-attack in the system. In addition to the vulnerability, the IOT system is evolving at a rapid rate in the terms of diversity and complexity. Here, in a wireless sensor network a set of resources is required to gather the information from the environment [12]. From the increasing the use of wireless sensor network, IOT networks are developing to advance the sensor with their capacity of collecting data from different locations which promote the initialization of these small instrument with such small battery size [13].

III. IOT ELEMENTS

A. Identification
Several methods such as electronic product code are available for identification of IoT network. Identification methods are used to explicitly identify each object within the network.

B. Sensing
The IoT sensing means collecting data from related physical objects within the network and sending it to the database or cloud.

C. Communication
IoT node should operate low power in noisy and lossy communication link.

D. Computation
The Processing units (microprocessor, microcontrollers) and software applications show the computational ability of the IoT. Cloud Platforms are another major computational part the Internet of things.

E. Services
The aim of all IoT applications is to easily complete ubiquitous services.

IV. CHALLENGE OF WIRELESS SENSOR NETWORK BASED IOT

There are different challenges in wireless sensor networks based IoT:

A. Quality of service
All heterogeneous IoT devices must be contributing to the quality of services provided to sensor nodes in terms of intelligence. The better service it provides to its users, the more it is effective for long use which is very effective in different climate conditions.

B. Real time management
It is a very difficult problem for the resource-controlled sensor network to collect the data all the time which needs more power. In that case, a very efficient design and technology is a must need in the internet of things system to

minimize the power use and transmit the data constantly to communicate real time information.

C. Privacy

It is very important to keep data private and not show that data to everyone because sometimes it contains very confidential data which cannot be seen by everyone. Privacy involves the transfer of data from one place to another without coming in contact with a third person.

D. Availability

The availability is to preserve the operational services of the wireless sensor network and it will also help in the maintenance of the entire network until its termination.

E. Data integrity

There is a possibility that the wireless sensor network can be compromised when a malicious node is entering the network and then injects some corrupt information which may lead to the corruption of original data. Let's understand this with an example, if false data is retrieved by the BS, then it will also affect the integrity of data which leads to loss of data.

F. Data aggregation

Wireless sensor nodes are very tiny, and battery driven so the aggregation of the data is our top priority in the system network. During the process of collection of data from the nodes several challenges were found such as high energy use and inefficiency. The main motive is to collect data on the efficiency of the energy usage to its maximum so that more data can be transferred with less energy required. In this field several techniques were proposed to maximize the efficiency of the data with less energy so they can collect more data and perform for the long duration of time and effectively distribute data packets so that energy usage can be minimized.

V. CONCLUSION

Communication networks are quickly transitioning from wired to wireless. WSNs, on the other hand, are becoming a hot topic of research in wireless networks. The paper began with a brief introduction of WSN and Internet of things. Following that, the study discusses the WSN based internet of things and its elements. We have also discussed the challenges of WSN based IoT. It can be concluded that WSN has transformed practically many aspects of modern life.

REFERENCES

[1.] Singh Manish Kumar, Amin, Syed Intekhab and Choudhary, Amit (2021). A survey on the characterization parameters and lifetime improvement techniques of wireless sensor network" *Frequenz*, vol. 75, no. 9-10, 2, pp. 431-448.

[2.] Singh Manish Kumar, Amin Syed Intekhab (2020). Energy Efficient Wireless Sensor Network using Optimum Hops and Virtual MIMO Technique. SN applied science Journal, Vol 2, issue 9.

[3.] Singh M. K., Amin S.I. (2021) Genetic algorithm-based sink mobility for energy efficient data routing in wireless sensor networks "International Journal of Electronics & Communication (AEU), Volume 131.

[4.] C. Perera, C. H. Liu, S. Jayawardena and M. Chen, "A Survey on Internet of Things from Industrial Market Perspective," in *IEEE Access*, vol. 2, pp. 1660-1679, 2014, doi: 10.1109/ACCESS.2015.2389854.

[5.] Y. Kuo, C. Li, J. Jhang and S. Lin, "Design of a Wireless Sensor Network-Based IoT Platform for Wide Area and Heterogeneous Applications," in *IEEE Sensors Journal*, vol. 18, no. 12, pp. 5187-5197, 15 June15, 2018, doi: 10.1109/JSEN.2018.2832664

[6.] Wen-Tsai Sung, Jui-Ho Chen and Ming-Han Tsai, "Applications of wireless sensor network for monitoring system based on IOT," *2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, 2016, pp. 000613-000617, doi: 10.1109/SMC.2016.7844308

[7.] Chaturvedi and L. Shrivastava, "IOT Based Wireless Sensor Network for Air Pollution Monitoring," *2020 IEEE 9th International Conference on Communication Systems and Network Technologies (CSNT)*, 2020, pp. 78-81, doi: 10.1109/CSNT48778.2020.9115733.

[8.] E. Ahmed, I. Yaqoob, A. Gani, M. Imran and M. Guizani, "Internet-of-things-based smart environments: state of the art, taxonomy, and open research challenges," in *IEEE Wireless Communications*, vol. 23, no. 5, pp. 10-16, October 2016, doi: 10.1109/MWC.2016.7721736.

[9.] Kamal Gulati, Raja Sarath Kumar Boddu, Dhiraj Kapila, Sunil L. Bangare, Neeraj Chandnani, G. Saravanan,A review paper on wireless sensor network techniques in Internet of Things (IoT),Materials Today: Proceedings, 2021

[10.] Li Hong-tan, Kong Cui-hua, BalaAnand Muthu, C.B. Sivaparthipan, Big data and ambient intelligence in IoT-based wireless student health monitoring system,Aggression and Violent Behavior, 2021

[11.] Konstantinos Skiadopoulos, Athanasios Tsipis, Konstantinos Giannakis, George Koufoudakis, Eleni Christopoulou, Konstantinos Oikonomou, George Kormentzas, Ioannis Stavrakakis, Synchronization of data measurements in wireless sensor networks for IoT applications, Ad Hoc Networks,

[12.] Volume 89, 2019

[13.] Deebak B.D., Fadi Al-Turjman, A hybrid secure routing and monitoring mechanism in IoT-based wireless sensor networks, Ad Hoc Networks, Volume 97, 2020

[14.] Hosein Azarhava, Mehran Pourmohammad Abdollahi, Javad Musevi Niya, Age of information in wireless powered IoT networks: NOMA vs. TDMA, Ad Hoc Networks,Volume 104, 2020