

Convergence of Wireless Sensor Networks, Internet of Things, Big Data: Challenges

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ABSTRACT

Sensors are everywhere nowadays and Wireless Sensor Networks become very popular. It is one of the most important elements of Internet Of Things and IOT integrates the physical world with the virtual world. IOT is defined as interconnection of objects equipped with the sensors, actuators and processors. These devices can communicate with each other to serve a meaningful purpose. They are intelligently connected using wired or wireless network. The development in the various areas of Wireless Sensors and Internet of things have been contributing to the generation of large volume of data known as Big Data. This paper reviews the open challenges in the convergence of WSN,IOT and Big Data.

Keywords:Big Data,IOT,Privacy, Security, WSN

1. INTRODUCTION

Today Internet become a part of our life and touched almost every corner of the globe (Sethi & Sarangi, 2017). In the past decade, Internet has penetrated, influenced and changed the life of people in every walk of life, in a way beyond our imagination, Who would have imagined that one day, mobile would show you the way,let you hail taxis, shop for veggies and mobiles sitting at home. IOT is defined by different authors in different point of view. Vermesan et al. define the Internet of Things as an interaction between the physical and digital worlds. It is devised by Kevin Ashton and refers to uniquely identifiable objects and visualized as “internet like “structure. IOT acts as a bridge between cyber and physical world. In common language, these devices are new kind of world and connected together so as to achieve very complex tasks. IOT systems enable the deeper automation, analysis and integration within the system. It utilizes the existing technologies such as sensing, networking and robotics.

IOT is not a single technology and IOT devices are equipped with the sensors, actuators, processors and

transceivers for the interconnection. Sensors and transducers are the devices which help in interacting with the physical environment.The most important aspect of “Context Awareness “is achieved by Sensors. The data generated from these devices have to be collected efficiently and stored for deriving useful information for the decision makers. The data can be stored in the remote server or the network itself. IOT objects are limited in size, power, computational capability and storage capacity.

Wireless Sensor Network consists of small and smart sensing nodes which are used to monitor the environment such as temperature, pressure etc..at different locations but with limited power ,storage, computational capabilities and energy. They are widely used in different types of applications in various domains, that includes health-care, industrial, under-water monitoring, disaster management and many other fields. Wireless Sensors becomes an integral part of the Internet of Things. In wireless Sensor network, there are two radio components are used for sending the data/ Zigbee radio is used to send the data within the network and WiMax radio is used for sending the data to the internet.

The collected data from the WSN is used for decision making. The data generated by the millions of sensors produce big data. Big data sources are commonly (Dr.T.Abdul Razak,, et al., August 2014)digitally generated, passively produced, automatically collected and continuously analysed, Gathering large volume and variety of data are more useful in different types of IOT applications. In smart house applications, variety of sensors are deployed and data generated by the sensors are collected in order to analyse the data for deriving useful information. Big data is described as 3 V characteristic namely: Variety, Velocity,Volume, The volume of data generated cannot be handled by the traditional databases. Velocity refers the speed at which

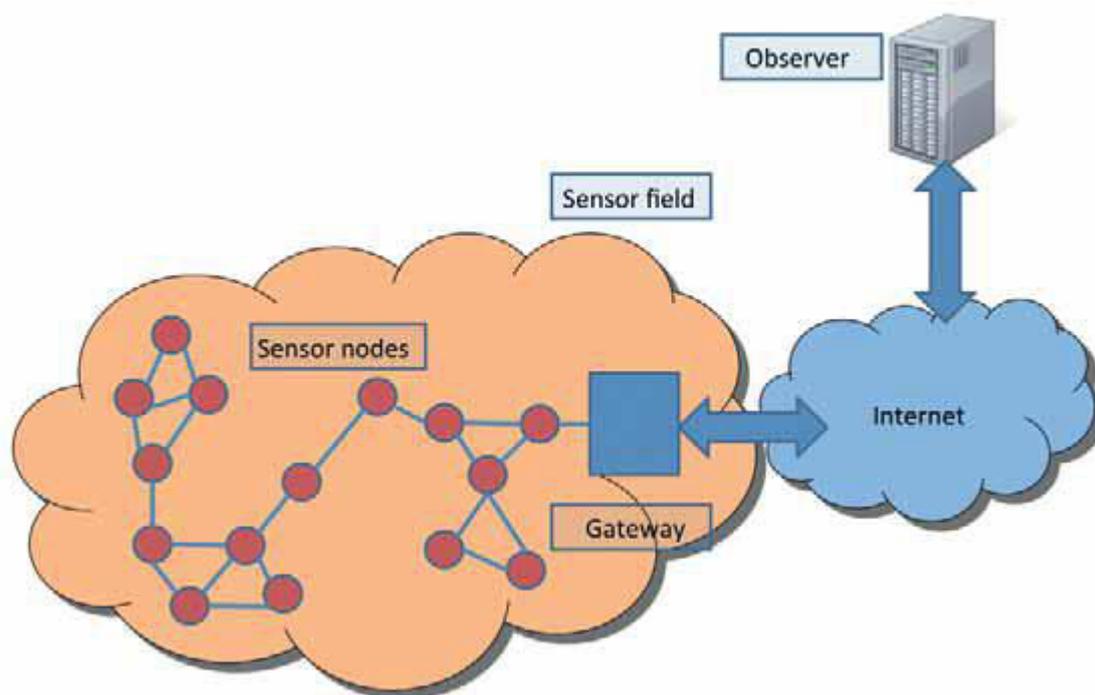


Fig 1: Wireless Sensor Network connected with Internet

the data is generated to meet the demands of the industries and variety means the various formats of the data from the heterogeneous resources. Querying, collecting, storing and analysing of such data brings the challenges for the research community.

The rest of the paper is organized as follows. Section 2 describes about the various applications of Internet of things, Section 3 describes about the Literature Review, Section 4 explains the various convergence challenges and section 5 describes the conclusion.

2. APPLICATIONS OF IOT

Ability to network embedded devices with limited memory, CPU power finds Internet of things applications in different domains of real world.

Environmental Monitoring: In these type of applications, sensors used to monitor the air, water quality, soil condition, movements of wild life and their habitats helps in assisting the environmental protection.

Smart Grid Applications: Optimizing the energy consumption by integrating switches, bulbs, television and enabling communication to the power supply experience in the end through more reliable, on-time flights.

company effectively. This in turn leads to the balancing of power generation and energy usage. In the smart grid applications, energy and power related information is collected in the automated fashion for improving the efficiency, reliability and economics.

Medical and healthcare: IOT devices are used to enable the remote health monitoring and emergency notification with the help of sensors. Some of the hospitals are using “smart bed” concept for monitoring patient’s health and movement. Wearable heart monitors are also introduced in the healthcare systems.

Building and Home Automation: IOT devices can monitor and control all types of electrical, Mechanical and electronic devices in various types of buildings such as residential, industrial, institutions etc.. Smart buildings are introduced with the help of energy management systems.

Airline: An equipment tracking application provides an airline’s engineers with a live view of the locations of each piece of maintenance equipment. By increasing the efficiency of engineers, these applications are not only generating significant cost savings and process improvements, but also impacting the customer

Smart Transportation: These type of applications are managing the track information, maintaining the transport and route optimization.

3. LITERATURE REVIEW

Authors (Sethi & Sarangi, 2017) discussed about the IOT architectures, protocols and applications in this paper. They explained about the three layer and five layer architecture of IOT and different components of IOT. Various types of protocols are also discussed in their paper.

(Shah & Ambareen, n.d.) They discussed about the security threats in the integration of WSN with IOT. Authentication and Integrity are the main security concerns of the integration of both the technologies.

Authors (Sharma, et al., 2013) discussed about the various research issues and challenges in the design of WSN. Energy constraints of sensor nodes are critical aspect for designing hardware and software. They explained about the issues include synchronization, QOS, Security, Architecture and data collection methods.

Authors (Christin, et al., n.d.) outlined the three major challenges in the domain of security, quality of service and configuration management for integrating IOT and WSN. They analysed the three approaches and presented high diversity in terms of monitored subjects and environments. The solutions currently deployed in the internet are not suitable for the same purpose. Suitable Modifications are required for handling these challenges in the resource constraint WSN platforms.

Elisa Bertino suggested that the existing data security Solutions are not suitable for IOT since IOT devices are heterogenous in nature. Author outlined the key challenges in this area and also explained the efficient and scalable encryption protocols , software protection techniques for small devices and data packet loss analysis for sensor networks.

Authors (Chih-Chieh Hung & Chu-Cheng Hsieh, n.d.) explained about the characteristics and various challenges of big data management in wireless sensor network. They have also provided the glimpse of data management issues and solutions in WSN. They analysed the case studies of exploiting big data systems for data management on WSN.

4. CONVERGENCECHALLENGES

Security : Wireless Sensor network poses more severe challenges compared to the traditional network owing to the hostile nature of their deployment. Any attack to the hardware or software impact the significant damage to the network. Since WSN is deployed in very critical applications such as patient monitoring,

building monitoring, protecting the data is playing a vital role. Every sensor node and base station must be able to verify the trustiness of the data and sender for maintaining the data accuracy.

Spoofing, altering the route information, sink hole attacks and denial of service are the some of the threats in WSN. Every connected device in IOT provides the opportunities for the intruder. Integrating WSN with IOT have to address the additional threats such as selective forwarding, data transfer, malfunctioning of the devices and eaves dropping imposed by the internet.

Intruders can create an illusion of secure communication and can collect the sensor data from the base station. Proposed protocols must ensure the Confidentiality, Integrity and Authentication of WSN with IOT. Security techniques used for conventional servers are not best suited for IOT since the sensors in these devices are small, energy constraint in nature and less computational resources.

Management of Data: Enormous amount of data are generated from heterogeneous sources. These streams of data may be in different ways for different purposes. The generated data can be categorized as structured and unstructured data. The collected data is required to store, analyse and process in an efficient manner. The data needs to be integrated. Data needs to be pre-processed before storing into the storage mechanism. Since the data is real time, continuous one, communication is resource intensive. Key problems in management of data includes storing, analysing, data dissemination and filtering. We need advanced applications for the aggregation and filtering. Another challenge in Big data is efficient representation of structured and unstructured data.**Quality of Service:** Since the sensor nodes are energy constraint devices, resource utilization of heterogeneous devices becomes part of the QOS. Sensor networks need to be supplied with the required amount of bandwidth so that it is able to achieve a minimal required QoS. In WSN, sudden changes in the topology leads to the reconfiguration and introduces delay. Novel approaches should be designed to ensure the Quality of Service for the convergence.

Privacy Protection: In IOT, objects are connected through internet and data is collected from the devices. The data includes meta-data information such as location, context, time and personal information about the user also. From this, it is very much evident that data has to be protected with the help of tools and suitable privacy policies.

Configuration management: Since the nodes are autonomous and deployed in human unattended places, self configuration is required in the integration. It includes the construction of routing, allocation of addresses, identifying the faulty nodes and configuring themselves. Internet Is not supporting and hence these needs to be addressed efficiently.

Architecture Challenge: IOT covers wide range of devices from smart devices to different types of sensors such as mobile, camera,chemical sensor etc. These devices can be connected using wireless medium or ad-hoc manner. Failure of any device leads to the architectural challenge.

Hardware Challenge: Sensors and smart devices in the IOT are energy constraint in nature. Cost of the hardware is also to be considered. The design of the hardware

Interoperability : Connected devices are heterogeneous in nature leads to the problem in interoperability. Standards and integration of protocols are needed to solve this issue.

Storage : Based on the context, smart objects are collecting large volume of data. Cloud systems can be used for the efficient storage and based on amount of data, storage has to be allocated.

5. CONCLUSION

With the emerging concept of “computing everywhere and anywhere”, Internet of things applications are rapidly increasing nowadays. Wireless sensors are providing back-end services for detecting the context and collecting the data from IOT objects. As the numbers are increasing, a massive amount of data has been generating from these sources. There are many problems result in the integration of IOT and WSN and handling large volume of data. In this paper, various applications of IOT and the integration of IOT and WSN challenges are also discussed. Various challenges pertaining to the collection of Big Data generated by wireless sensor networks are also studied.

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