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A Integration of WSN with IOT : A Challenge

Suvarna Patil*, Pooja Mishra, Manisha Bhende***, P.P.Shevatekar******
* Departement of Computer Engineering, DYPIEMR, Akurdi

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ABSTRACT

The Internet of Things isa global network of interconnected things or objects which have a unique IP address. To understand IOT application various heterogeneous technologies will be integrated in the future. Useful applications of WSN such as healthcare application, Building and Industry automation, habitat monitoring, environmental monitoring, agricultural automation and transportation monitoring can be deployed to connect effectively to the outside world. To improve deployment and implementation of existing application integration of IOT technologies with WSN will be effective. Such a smart network with smart objects can communicate with the inside as well as outside world smartly. To communicate the information to a central node, IP enabled sensor nodes are usedwhich will provide functionalities such as storing, representing, searching and organizing by using semantic technologies. Through gateway the information WSN data will be exported to the various devices connected to the internet.

1. INTRODUCTION

Wireless sensor networks (WSN) provides a virtual layer which enablesto transfer and share the information about the physical world provides access to any computational system. WSNs are an invaluable resource for the development of the Internet of Things (IoT). It is necessary to ensure that the devices of a WSN should be completely integrated into the Internet or not in view of security. In such integration process different security challenges that may arise are mentioned in this paper and focus on the issues that occurs at the network level. In the future Internet of Things (IoT), the everyday objects present around us will behave as proactive actors of the Internet to sense or generate and consume information. The elements of the IoT includesall the devices that are already embedded in the technological world (such as air conditioners, cars or fridges), and outside objectsto this environment (such as perishable food and garments), or even non-living things (such as woods, livestock). To provide a qualitativestep in several sectors computational capabilities need to be embedded in all kinds of objects. One of the most important elements in the IoT is wireless sensor networks (WSN). The advantages of integrating both WSN and other IoT elements can be beneficial forremote access as heterogeneous communication systems can be used to associate and provide services to all things around. This integration is a supported by various international oraganisations. To communicate the information to a central node, IP enabled sensor nodes are usedwhich will provide functionalities such as storing, representing, searching and organizing by using semantic technologies. Through gateway the information WSN data will be exported to the various devices connected to the internet. Block diagram of IOT integrated with WSN is shown in figure 1.
There are a number of challenges to find a solution for the evolution of WSN towards IOT such as security, hardware and software. Discussed in detail as follows,

1.1 Network Security

Security is integrated in system to protect the integrity, confidentiality and availability of data in traditional TCP/IP network. The system becomes reliable which protects the system from malicious attacks to avoid malfunctioning of systems and also information disclosure. As the deployment of sensor nodes in heterogeneous environment and different application requirement, security in WSN needs the special

requirements of privacy, trust and security apart from traditional security protection. As per requirement of different application environment, system requires security protection in terms of confidentiality, integrity,

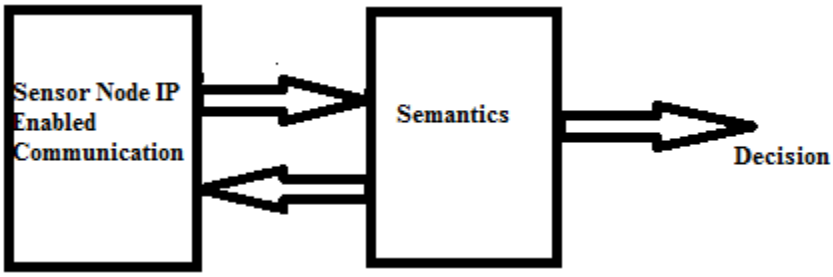

Figure. 1 IOT-enabled WSN

non-repudiation, availabilityand privacy of user. Special security requirement in WSNs needs to protect the sensor nodes from tampering, also protect the channel, and to protect routing in the network layer. The technology of security in WSNs consists of message encryption, authentication, access control, etc. The necessities of WSNs are as follows: data aggregation, routing node security, key management and crypto algorithms.
To enhance node security, secure wakeup and secure bootstrapping is included in duty cycle. A low duty cycle is important to increase lifetime of sensor nodes which are battery powered. The wake-up radio listens on the channelwhen the sensor node is in sleep state. To enhance security of wake-upradio, the wake-up codeis generated by encoding a wake-up signal. As the wake-up code is usedonly once and as it is specific for each node, while waking up a nodeit canbe sent in clear.

1.2 Hardware

While integrating WSNs with IOT major issue to be faced is nature of hardware devices. The nodes of sensor devices consist of memory, batteries, processing devices, transceivers and sensors. The challenges are minimization, maximizing the nodes processing capability, energy consumption, and the security of the hardware device.

- *Energy:* While performing the sensing transmission and analyzing job, a sensor device should take care to have minimal energy consumption. As batteries of the devices have low energy and cannot be changed easily as devices are mounted at different locations.
- *Processing:* The sensor devices should be capable to implement a variety of applications from measurement of simple environmental parameters to the capturing of multimedia data including audio and video.
- *Sensor devices security:* As WSN devices are electronic devices that have a microprocessor which perform its tasks. These devices may have chance to get exposed to security attacks.

4.3 Software

One of the challenges for limited energy constraint is the coordination of sensor devices. The algorithm to be developed must take into consideration these energy constraints for efficient network. Data processing (compression and aggregation) is important before disseminating it to the next node to minimize energy consumption of a node during transmission. There should minimal human interaction rather network should be self-organized. One of important challenge of an IoT based network is the integration of heterogeneous devices causing the complication of the integration process.

2. WIRELESS SENSOR NETWORKS

The WSN paradigm has attracted scientists and engineers as a part of crucial and important concept. Their use ranges from simple Air-Conditioning Systems to military application. Even in biological and chemical attack detection and investigation.

WSNs have mainly two types of deployment:

• *Structured* - the sensors are deployed in a standard, fixed, pre-determined way.

• *Unstructured*-It implies a dense random deployment within an area. Network maintenance such asmanaging connectivity between sensors and detecting sensor node or network failures is difficult to detect in unstructured WSN due toseveral nodes.

A structured network is that fewer nodes can be deployed with lowernetworkmaintenance and management cost. The two ways of communication in WSNs are the single-hopand the multi-hop. Networks are designed based on the energy conservation of the sensors.

• *Single-hop*: All the sensors send theinformation collected, directly to the BS.

• *Multi-hop*: The sensors send the data to a neighbour node, and nodes collect the information and finally send them to the BS.

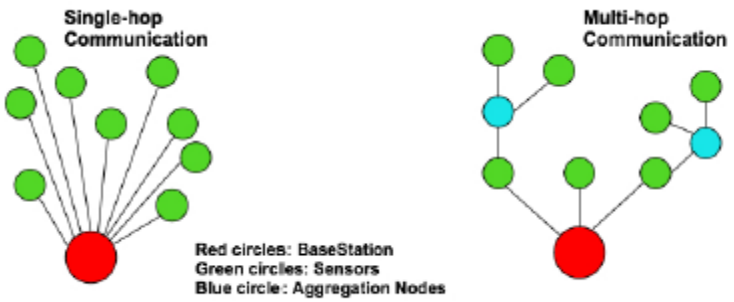

Figure 2. Single-hop and Multi-hop Communication

The easy way of establishing single-hop WSNs makes themthe most commonly used and widely known type. In multihop network, even though the sensors consume more energy as moreprocessing power is needed they are more appropriate forlarge scale WSNs where the BS is located in distance from thenodes.

As mentioned before, the use of WSNs varies a lot, and therange of applications is increasing rapidly.

Applications of WSN are:

- Military Applications
- Environmental Applications.
- Traffic Control and Monitoring Applications
- Commercial Applications
- Health/ Medical Applications
- Home Automation

The smart home services are main concept in area of WSN. A mostimportant challenge in WSN is the energy consumption and conservationof energy in sensor nodes. Sensors are battery-operated and in the simple scenarios with single-hop communication, data gathering and data dissemination of the data can be expensive in terms of energyconsumption. Other Challenges of WSN are fault tolerance, node deployment, transmission media, scalability, data aggregation and Quality of Service.

Some specific routingprotocols and algorithms that have designed to overcomechallenges are as follows:

I. Flat based or data-centric routing- In this all nodes perform the same functions. In this network, each sensor node collaborates together to perform the sensing task but it is not impossible to assign a global identifier to each node. The base station sends queries to specified regions and looks for data from the sensors located in the selected regions.

II. Hierarchical based or cluster-based routing- In this each node has a different role. Higher energy nodes are used to gather process and disseminate the information. The low energy nodes are used to perform the sensing in the proximity of the target node. Cluster creation and assigning duties to cluster head contribute to overall network lifetime, system scalability and energy efficiency.

III. Location based- In this, nodes are positioned such a way to route the data in the network. By taking into consideration the strength of the signal received, the destination of each node can be calculated.

In the routing protocol operations, following techniques can bespecified,

- Multi-path based.
- Query-based.
- Negotiation-based
- QoS-based or coherent-based

3. INTERNET OF THINGS (IOT)

As continuous technological evolution in field of computer takes place every year, it is same with WSN and internet. Internetis a way to provide communication between systems atdistant locations, where every other communication system cannot be used. Such a system was developed to provide infinite information at global level. With helpof the wirelesstechnology, the information can be accessedremotely (over 3G, satellites, etc.) all over the world with the use of various smart devices that have wirelessaccess and an Internet browser (smartphones, laptop, tablets, netbooks). That concept can be extended to the formation of aninterconnected network, in which every day objects involved in it, that is the Internet of Things (IoT). It performs self-configuring wireless networks of sensors that create aworld where every of its entities sends information to otherobjects. In this type of network everything istagged and communication is done through tagged information, provides data and knowledge that is convenient in dayto day life. All the WSNs under one network that are connected with one another through differing kinds of network, modify objects and devices from every environment(network) to be active participants and communicate with one another, exchange knowledge, monitor numerous areas all round the globe, record and perceive events and actions, be in a position to sense changes (sensing) and react autonomously and accordingly(actuating). Services are able to interact with these s ensible objects using standard interfaces which will give the mandatory link via net, to query and alter their state and retrieve any information related to them, taking into consideration security and privacy problems.

To identify a specific node in the network a specific number (*id*) is used, which is used as an address to its location. The purpose of *ids* can be topology-localization. They can be used to assign each node individually, but specific spots in the area which is being monitored. A smartphone is used (e.g. iPhone) for purposes of monitoring the mobility of a person and how the data aretransmitted (over wireless network). Assume that the person will carry the smartphone atall times, so that the device can give live information of theexact location in an area. Those together willresult in a monitoring service, and try to map aperson's movement within an area. The concept is used for recording and finding position with respect to room in which he is entering. Thinkingof the first action that a person does when entering a room isto switch on the light that will give the clue that is needed tounderstand the location inside the house. In the figure below, which is the scenario visually represented, the sensors areplaced in a way to be close to the doors and in a high level sothat they can receive the luminance of the light as soon as the source is off. Though scenario presented is simple, the slight drawback the entirescenario look for alternative routes or more advancednetworking and sensing. To be more precise, when the personleaves the room it does not necessarily means that he willswitch off the light. So, when he comes back to that room, there will be no change in sensing of the nodes. The iPhone can be used as a tool to locate object, to get the specific coordinates of the person which is inside thehouse. The accelerometer of the iPhone is to understand the way the phone is held by the user the accelerometer is used. In the current scenario, assuming that the userwill have the device on him while

moving around, it willcontinuously send a signal with his coordinates over thewireless network. The objective of the work is to propose a noncomplex WSN solution for smart home services.

4. CONCLUSION

WSN and IoT, are not considered as a single technology. They describe complex systems ranging from different technologies under basic physical communication layers to top most application systems and are integrated to use in many application areas and also in different environments. Resulting in a complex standardization environment beneficial for human community. As per discussion in this paper, variety of existing applications, challenges and ongoing standardization activities for WSNs are useful. All these applications help to create different opportunities for industry, research organizations as unique characteristics of WSNs. All these considerations make WSN attractive in current and future infrastructure applications. To integrate WSNs into the Internet of Things, initially only selected applications representing a high diversity of monitored environments are to be considered.

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BIBLIOGRAPHY OF AUTHORS (10 PT)

Faculty Name:Mrs. Suvarna Patil
Designation:Assistant Professor
Qualification:M.E.(Computer), B.E.(Computer)
Area of Specialization: Wireless Sensor Networks, Internet of Things
Experience :-Teaching:12 years

Faculty Name :Mrs. Pooja Mishra
Designation :Assistant Professor
Qualification :M.E.(Computer),B.E. (Computer)
Area of Specialization :Networking
ExperienceTeaching: 9 years,Industry:6 months

Faculty Name:-Dr. Manisha Bhende
Designation:-Associate Professor
Qualification:-Ph.D.,ME(Computer)
Area of Specialization:-Wireless Sensor Networks,IoT,Network Security,Mobile Computing
Experience :-Teaching: 18 years