Middle-East Journal of Scientific Research 24 (10): 3190-3194, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.3190.3194

Internet of Things for Environmental Condition Monitoring in an Industries

K. Yogitha and Dr. V. Alamelumangai

Department of E&I, Annamalai University, India

Abstract: Effective implementation for Internet of Things used for monitoring regular industrial process by means of low cost omnipresent sensing unit. The detailed view about the reliable parameter measurement by means of smart sensors is described. The data like temperature, humidity and pressure monitoring will be done with the help of smart sensors. Data will be transmitted via the Zigbee to internet. The data transfer between Zigbee module and server can't be performed directly so the gateway is used for converting the ZigBee protocol IEEE802.15.4 to internet servers protocol IPv6 IEEE802.3. Transmission of data will be through the IoT technology. The output will be displayed in the form of graph with time slot versus the measured value.

Key words: Internet of Things (IoT) · IEEE802.15.4 · IEEE802.3

INTRODUCTION

Covering a wide application field, WSNs can play an important role by collecting surrounding context and environment information. However, deploying WSNs configured to access the Internet raises novel challenges, which need to be tackled before taking advantage of the many benefits of such integration. Some of the challenges are security and quality of service management and network configuration.

To overcome these challenges innovative security mechanisms must be developed according to the resource constraints to protect WSNs from novel attacks originating from the Internet. QoS in the Internet are not applicable in WSNs, as sudden changes in the link characteristics can lead to significant reconfiguration of the WSN topology. It is therefore mandatory to find novel approaches towards ensuring delay and loss guarantees.In addition to security and QoS management, sensor nodes can also be required to control the WSN configuration, which includes covering different tasks, such as address administration to ensure scalable network constructions and ensuring self-healing capabilities by detecting and eliminating faulty nodes or managing their own configuration. In contrast, the unattended operation of autonomous sensor nodes requires novel means of network configuration and management.

WSN application for signals communication transmission has many technologies such as the Bluetooth, ZigBee and Wi-Fi etc. ZigBee is a typical wireless communication technology, which is widely used in wireless sensing networks. ZigBee wireless sensor network is widely used in military security, environment monitoring and industrial automation. Zigbee provide security and good quality of service [2].

The first step in this paper is monitoring the environmental condition like temperature, pressure, humidity level using the sensors. The measured value will be send to the internet server of a PC via zigbee. We can send the signal to remote PC or PDA through the internet. Now a day we are now moving on to the internet for all kind of activities like monitoring process will also be done without the human intervention. This is possible by means of machine-to-machine communication which is done by Internet of Things (IoT). The receiver Zigbee module will be replaced by an internet server or system or personal computer or a laptop [1].

The contribution of this paper is a utilization of the new method called Internet of things (IOT) for monitoring the environmental conditions in industries. Electronic devices have become a very important and integral part of human beings life. We are using electronics in our day to day appliances like lighting, fan, energy meter, weighing scale some gadgets are mobile devices, laptops, watches, tablets and medical instruments. Internet of Things (IOT) will enables both communicating and non communicating devices to connect and to interact with each other. IOT allows their own machine readable and ability to transfer data over network without human interaction.

Corresponding Author: K. Yogitha, Department of E&I, Annamalai University, India.

Industrial equipment can automatically now send key performance and safe data without the need of long cables but by directly to Bluetooth Smart-ready phones, tablets or computers via the internet or wireless. It allows for higher flexibility in machinery installation and easy integration into the network.

Proposed System Description: The measurement and controlling of industrial environment through the Internet can be mechanized by some certain network architectural design strategies and also by applying ZigBee communication standards. The data transmission of smart sensing devices with ZigBee over the internet can be done by integrating an internet gateway with WSN (ZigBee network). In a ZigBee network, end devices will collect and forward data to the coordinator. ZigBee module and the internet will be connected through the gateway. The function of the gateway module is to convert the ZigBee protocol data format to Internet protocol (IPV6) format by the gateway, [4, 5].

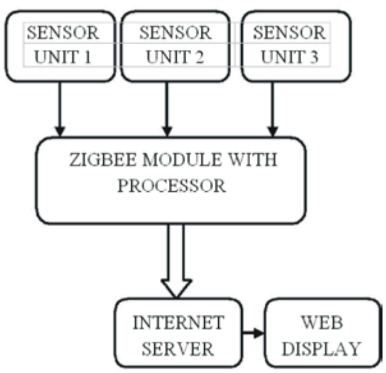

Fig. 1: Overview of system design

Here Figure 1 will give some the basic layout of the key elements of the integrated WSN with internet server systems. Here it consists of i) Sensing devices ii) Internet Server and iii) IoT Gateway.

Sensing Units: We have used the three different types of sensing units for the effective data management and controlling of industrial process. Smart sensors are widely used in a typical IOT system; here the sensors are also driving the emergence of innovative wearable gadgets.

Sensing Unit 1: Measures the Temperature, here we are using the TSYS01 sensor it is a single chip, versatile new type of temperature sensor. The TSYS01 provides factory calibrated temperature information. It is accompanied by high measurement resolution. The sensor can be interfaced to any microcontroller by an I2C or SPI interface. This microcontroller will calculate the temperature result based on the ADC values and the calibration parameters. This type of sensors has an operating temperature Range:- 40°C to +125°C

Sensing Unit 2: Contains the Pressure sensors .Operating pressure range will be from 260 to 1260hPa.

Sensing Unit 3: Contains the humidity sensor HTU20D (F), it is a digital humidity sensor. This sensor provides calibrated linearized signals in digital I²C format. These types of sensors are used where reliable and accurate measurements are needed. Operating range of this sensor will be 0 to 100RH.

ZigBee Wireless Sensor Network: The ZigBee WSN comprises of XBee-S2 modules built by Digit technologies are configured as end devices (sensor nodes) and communicate wirelessly with the coordinator in the form of a mesh topology. If the end device is within the range of the coordinator device then the system runs in star topology, otherwise hopping takes place and the outer most end device will send its data to the nearby router and consequently the data will reach the coordinator. The XBee-S2 module with controller is shown in the Figure 2.

The coordinator is connected with a router through the wired serial connection. The router runs open source embedded Linux (Open WRT) software, providing networking functionality to connect to the internet. This essentially provides internet access to the Xbee-S2 sensor data collected by the Xbee-S2 coordinator.

Fig. 2: XBee s2 modules with controller

Router will acts as an IoT application gateway and interconnects the IPv6 and ZigBee network. A private IPv6 network using a Virtual Private Network (VPN) is used for connecting the IoT application gateway to the server. The server collects sensor data forwarded by the application gateway and store in a database for further processing and then to be viewed via a website. Data can be viewed in terms of previous day, week and month time periods graphically. In the present setup heterogeneous sensing units are designed and developed indigenously for intelligent monitoring systems to integrate with IoT networks.

Sensor Characteristics: The environmental parameters (temperature, humidity and pressure) are important aspects for deciding whether the process should be controlled through the wireless monitoring network used for energy management and safety purpose in industries. The following sensors are used in the present setup.

The sensor nodes used in the ZigBee WSN have a temperature sensor (TSYS01), Pressure sensor used here is LPS25H and humidity sensor used here is HTU20D (F). The entire above mentioned are AC voltage sensor which is operating in low voltage level.

IoT Application Gateway: The transformation of sensed information between the ZigBee and internet server (IPv6) network is done by a program at the IoT application gateway, because the ZigBee network does not have the architecture to communicate with internet protocols. The IoT application gateway consists of a program for trans-forming ZigBee addresses and encapsulating data payloads in an internet protocol.

The XBee-S2 modules produce sample packets which will be converted by the application gateway to IPv6 User Datagram Protocol (UDP) packets and then it will be sent to a server. Command packets to control the XBee-S2 modules are encapsulated in an UDP packet by the server and converted by the IoT application gateway to get the ZigBee packets [10].

Web Display: A windows based server collects sample data by receiving the UDP packets containing sample data from the IoT application gateway and store in a database. These samples can be accessed from the database from a website hosted on the server. The raw sample data sample source (channel and sensor node)and time of arrival is stored in the database. This enables the samples to be ordered by date and organized by their source.

Sample data is displayed on the website in time series graphs. Each graph represents the corresponding sensing input information specifically depict each of the parameter values. The website (in the background process) performs conversion of raw sample data to engineering units for display in these graphs. The above Figure 3 shows the sample output of one sensor unit.

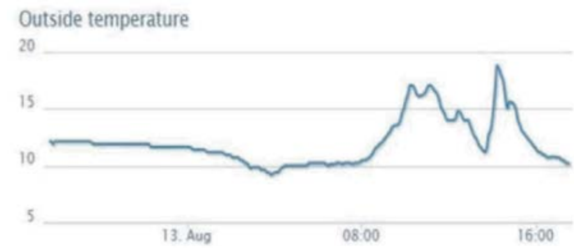

Fig. 3: Temperature sensors output displayed as graph

Implementation Details

IOT Architecture: Architecture of IOT comprises of the following key notes:

Here the base system refers to the classical device which is executing its defined task such as controls the monitored data, interfacing, security system and emergency alarm etc. Wireless technology connects the base system to other devices or system called intranet. It allows monitoring and control of the base system. The various wireless technologies prevalent are Bluetooth, Bluetooth Smart, Zigbee, sub GHz, Wi-Fi etc [7].

Gateway is the window of the local IOT system to the outside world. It can also be a dedicated system gateway or a smart phone. The various technologies used as gateway will includes the following GSM, GPRS, optical fiber or wire line internet. Smart sensors have emerged as a very important thing for the growth of the IOT system. The present day sensors have made it possible to monitor motion, environment and other parameters remotely and transfer to the control system or gateway via wireless technology. It has transformed human life and made them existing device even smarter.

IOT devices are now mostly powered by a battery, precision operational amplifiers and innovative lower power and comparators have become a critical factor for signal bridging between sensors and the controller. Besides, a precise state of charge of battery is needed to optimize the performance and maximize life.

Data Transformation Between ZigBee and Internet Server (IPv6): The direct method to make IPv6 work over ZigBee is to put the IPv6 stack on the peak of ZigBee NWK layer. All the ZigBee nodes are here assigned with an IPv6 address. From Figure 4 Gateway B if a packet is received from the 802.3 (IPv6) networks it will be encapsulated into ZigBee NW K and forwarded to the 802.15.4 network. On the other side when a packet is transmitted from Node A to Host C then Gateway B will be decapsulating the packet and it will use the IPv6 payload inside to continue the transmission. Due to this the data communication in ZigBee (802.15.4) is asynchronous Message passing only through UDP can be used with IPv6 in this situation [4].

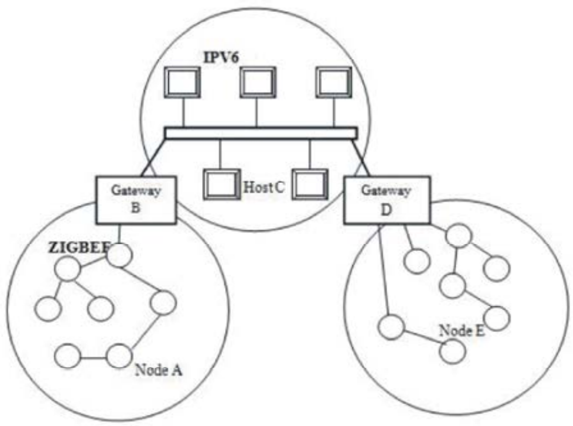

Fig: 4: Network overview

The key issue of IPv6 above ZigBee is the packet size problem. Consider Figure 4 as an example in which the network initiates the Host C must register its IPv6 address (IPC) to pre-assigned Gateway B (here IPv6 address will be denoted as IPB and ZigBee address as ZB). B will help for C to get its ZigBee address (ZC). Node A must register its ZigBee address (ZA) to B also [13, 14].

If node A wants to communicate with host C then it will sends out the packet to ZC. Gateway B will translate the packet into IPv6 format with Destination IP address (IPC) and Source IP address (IPB). In the reverse order for commun icating from host C to node A, node A will send the packet to IPB with a data payload which contains Destination ZigBee address as ZC and Source ZigBee ad dress as ZA. After gateway B receives the packet it will decapsulates the packet and looks for the payload and translates it to 802.15.4 format.

CONCLUSION

In this paper we present a new technique for monitoring and controlling the environmental condition in industries like temperature, humidity and pressure. Here the gateway design which can overlay the ZigBee/ 802.15.4 and the IPv6/802.3 networks together and internetworking among them. It can easily be extended to all kind of IPv6 networks such as IPv6/802.11; IPv6/UMTS etc. The output will be provided in the form of graph on web display with time slot versus the corresponding sensor values.

REFERENCES

1. Sean Dieter Tebje Kelly, Nagender Kumar Suryadevara and Subhas Chandra Mukhopadhyay, 2013. “Towards the Implementation of IoT for Environmental Condition Monitoring in Homes” in IEEE Sensors Journal, 13(10).
2. Alabri, M., S.C. Mukhopadhyay, G.A. Punchihewa, N.K. Suryadevara and Y.M. Huang, 2013. “Comparison of applying sleep mode function to the smart wireless environmental sensing stations for extending the life time,” in Proc. IEEE Int. Instrum. Meas. Technol. Conf., pp: 2634-2639.
3. Atzori, L., A. Iera and G. Morabito, 2010. “The Internet of Things: A survey,” Computer Netw., 54(15): 2787-2805.
4. Hong, S., D. Kim, M. Ha, S. Bae, S. Park, W. Jung and J.E. Kim, 2010. “SNAIL: An IP-based wireless sensor network approach to the internet of things, ” IEEE Wireless Commun., 17(6): 34-42.
5. Mendez, G.M., M.A.M. Yunus and S.C. Mukhopadhyay, 2012. “A Wi-Fi based smart wireless sensor network for monitoring an agricultural environment,” in Proc. IEEE Int. Instrum. Meas. Technol. Conf., pp: 2640-2645.
6. Munguia-Tapia, E., S.S. Intille and K. Larson, 2004. “Activity Recognition in the Home Using Simple and Ubiquitous Sensors,” Proc. Pervasive, LNCS 3001, Springer-Verlag, pp: 158-175.
7. Sundmaeker, H., P. Guillemin, P. Friess and S. Woelffle, 2010. Vision and Challenges for Realizing the Internet of Things. Luxembourg, Germany: European Union, 2010, ISBN 9789279150883.
8. Surie, D., O. Laguionie and T. Pederson, 2013. “Wirel ess sensor networking of everyday objects in a smart home environment,” in Proc. Int. Conf. Intell. Sensors, Sensor Netw. Inf. Process., pp: 189-194.
9. Suryadevara, N.K. and S.C. Mukhopadhyay, 2012. “Wireless sensor network based home monitoring system for wellness determination of elderly,” IEEE Sensors J., 12(6): 1965-1972.
10. Zorzi, M., A. Gluhak, S. Lange and A. Bassi, 2014. “Rom today’s INTRAnet of things to a future Internet of things: A wireless- and mobilityrelated view,” IEEE Wireless Commun., 17(6): 44-51.
11. Shizhuang Lin1, Jingyu Liu and Yanjun Fang, 2007.” ZigBee Based Wireless Sensor Networks and Its Applications in Industrial”, International onference on Automation and Logistics August 18-21, 2007, Jinan, China.

12. Liu Yumei, Zhang Changli and Zhu Ping, 2011. ”The temperature humidity monitoring system of soil based on wireless sensor networks“, 2011 IEEE.
13. Li, J., X. Zhu, N. Tang and J. Sui, ¯Study on zigBee network architecture and routing algorithm?, 2nd International Conference on Signal Processing Systems (ICSPS), Dalian China.
14. Gang, Z. and L. Shuguang, 2010. Study on electrical switching device junction temperature monitoring system based on Zigbee technology?, International Conference on Computer Application and System Modeling (ICCASM), Taiyuan, China, 4: 692-695.
15. Bayındır R., İSefa, İ. Çolak and A. Bektaş, 2008. Fault detection and protection of induction motors using Sensors?, IEEE Transactions on Energy onversion, 23(3): 734-741.