ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

Environment Monitoring System based on IoT

Gauri Sahoo [1], Pankaja Pawar[2], Kiran Malvi[2] , Aarti Jaladi[2] , Karishma Khithani[2]

Asst. Professor, Dept. of Electronics, Vivekanand Education Societys Institute of Technology, Chembur East, Mumbai, India.[1]

B.E Students, Dept. of Electronics, Vivekanand Education Societys Institute of Technology, Chembur East, Mumbai, India.[2]

ABSTRACT: In recent years, we have seen a new era of short range wireless technologies like Wi-Fi, Bluetooth [7], ZigBee [6], emerging in front of us. The project aims at building a system which can be used on universally at any scale to monitor the parameters in a given environment.Using raspberry-pi as our main board and sensors will collect all the real time data from environment and this real time data will be fetched by the web server and display it. User can access this data from anywhere through Internet.Raspberry Pi works as a base station which connects the number of distributed sensor nodes via zigbee protocol.Wireless Sensor Networks (WSN) has been employed to collect data about physical phenomenon in various applications such as habitat monitoring. The Internet of Things (IoTs) can be described as connecting everyday objects like smart-phones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves. In wireless sensor network system the sensor node sense the data from the sensor and that data collects the end tags, end tags send its data to the router and router to coordinator and supply multi-clients services including data display, the whole data will be stored in base station and the stored data will send to the cloud (Ethernet) and also the client can visit the base station remotely via (website) Ethernet.

KEYWORDS: Rasberry pi, zigbee, sensor nodes

I. INTRODUCTION

These smart sensors constitute a network topology such as mesh topology through self-organisation[10]. The development in wireless sensor networks can be used in monitoring and con- trolling various parameters in the agriculture field, weather station field. The sensor network hardware platforms are basically low-power embedded systems with some different sensors such as onboard sensors and analog I/O ports to connect sensors. Like hardware, software should also be developed, including OS,sensor/hardware drivers, networking protocols and application-specific sensing and processing algorithms. ZigBee is a high level communication protocol which is specifically designed for wireless sensor network, it is a simple, efficient, reliable, and low cost, low-power standard of wireless technology[6]. The Internet of Things (IoT) is an emerging key technology for future industries, and environmental monitoring [1]. This paper presents a wireless sensor network system, developed using open-source hardware/software platforms, Raspberry Pi and the ZigBee module. Such a design has the advantages of low cost, easy to build, and easy to maintain, as compared to some earlier designs such as the Texas Environmental Observatory (TEO) system [5]. Wireless sensor network (WSN) is a low cost, low power wireless network made up of thousands of smart sensor nodes which monitor physical or environmental conditions, such as temperature, pressure, moisture, humidity, light, orpollution at different area or different location. These smart sensors constitute a network topology such as mesh topology through self-organization [11].

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

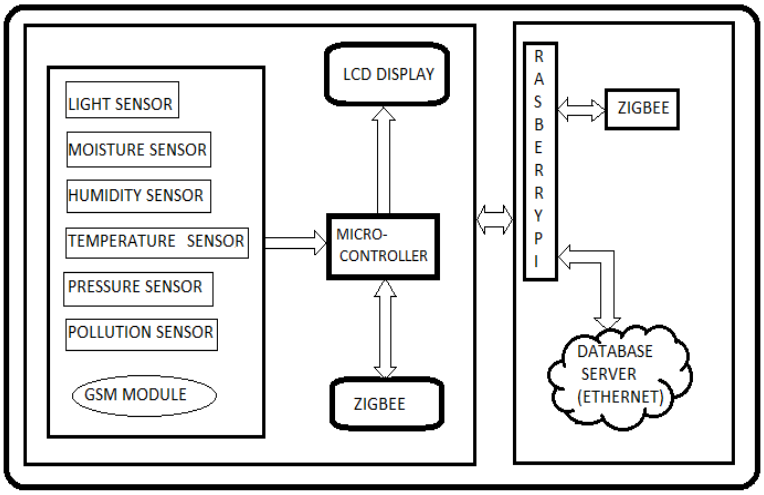


FIG.1. THE COMPLETE SYSTEM ARCHITECTURE OF THE ENVIRONMENT MONITOR

The figure 1 shows the overall system architecture of environmental monitoring wireless sensor network system [3]. Sensor node is a major part in this system it is responsible for information or sensor data. Raspberry pi manages multiple sensor nodes. Design and Implementation of Environment monitoring system using Raspberry-Pi which contains interfacing with various sensors (temperature, Humidity, CO2, Vibration). Real time data will be collected by all the sensors and will be fetched by the Webserver. the gateway node of wireless sensor network, that is raspberry pi (base station) consist of database server and web server in one single-boardcomputer hardware platform, it reduces the cost and complexity of deployment. Sensor node sense the data from the sensor and that data receives the end tag ,end tag search the nearest router if router in its range it immediately send the data to the router, next router to coordinator, here coordinator is directly communicate with the base station. Base station sends all data to the cloud or Ethernet (Database server). The WSN is built using a coordinator node and several sensor nodes, a workstation and a database.

A. RASPBERRY PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse.It is developed by U.K government; Raspbian which is recommended by raspberry pi foundation. The raspberry pi is the cheapest ARM11 powered Linux operating system single board computer board. This board runs an ARM11 microcontroller @1GHz and comes with a 1GB of RAM memory[16,17], as this model has better specifications as compared to other raspberry pi models such as raspberry pi B and B+ model[4]. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.It supports 32GB external SD or micro SD card, the device consist a 4USB ports

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

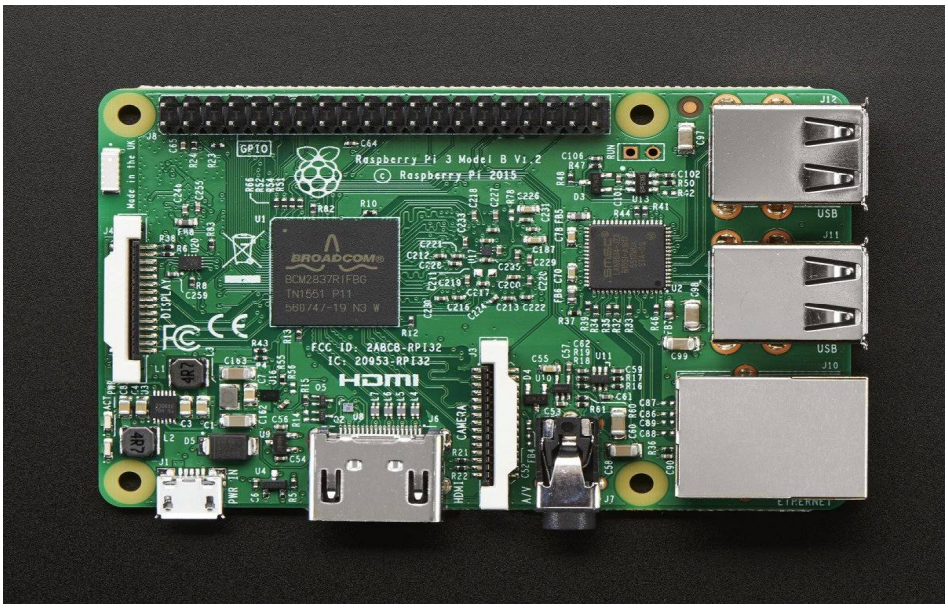


Fig. 2. RASPBERRY PI

B. ARDUINO MEGA(MICROCONTROLLER):

The Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila. Arduino Mega, etc. I used Arduino Uno in this development. Arduino is based on ATmega328. The package contains a 16 MHz ceramic resonator, a USB connection, a power jack and ICSP header and a reset button. Instead of using the FTDI USB-to-serial driver chip our Arduino features the Atmega16U2 chip programmed as a USB-to-serial converter.

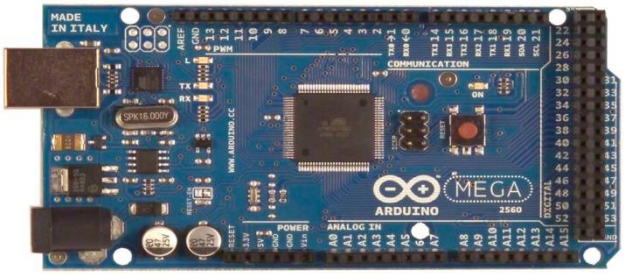


Fig.3. Arduino Mega 2560

C. ZIGBEE

Zigbee is a high-level communication protocols used to create wireless networks. Transmission distances to 10–100 meters depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network topology. The Zigbee transmission data rate is 250 Kbit/s [6].Zigbee is an established set of specifications for wireless personal area networking (WPAN), i.e. digital radio connections between computers and related devices. For the wireless communication between sensor nodes and the gateway node ZigBee RF modules were used. All the ZigBee devices are based on ZigBee standard which has adopted IEEE 802.15.4

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

for its physical layer and MAC protocols. The wireless devices based on this standard operate in 868 MHz, 915 MHz and 2.4 GHz frequency bands having a maximum data rate 250Kbps.

Fig. 4. XBEE module

For wireless network of ZigBee, it will consist of at least two nodes including coordinator node and sensor node types (Router/End device) to be able to communicate and work in PAN (Personal Area network)[7]. XBee module supports both transparent and application programming interface serial interfaces.

II. DESIGN OF SENSOR NODE

The figure 5 shows design of sensor node, sensor node is a combination of sensors, controller and zigbee.ZigBee devices are particularly suitable for fast prototyping for wireless sensor network applications.The XBee module S2 is connected to sensor node board. it can be easily integrated into any microcontroller or microprocessor systems such as Raspberry Pi through UART serial communication interface.

The XBee module is configured as a router on the sensor nodes. This chip is a high performance, low power 8 bit microcontroller, 32 KB in system self-programmable flash program memory, 1KB EEPROM, 2KB internal SRAM, 10-bit ADC, so it is possible to connect a number of sensors sensor node board[8].Sensor node sense the data from the sensor and sends to the to the end tag. End device can only communicate with the coordinator or the router. Router can relay messages in a mesh network and Coordinator has the capability to control the entire network[8].

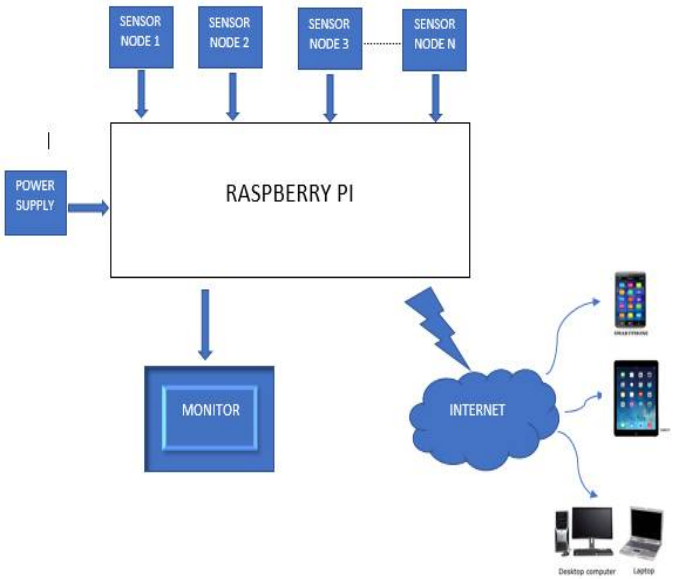


Fig. 5. Sensor node connections to Raspberry Pi

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

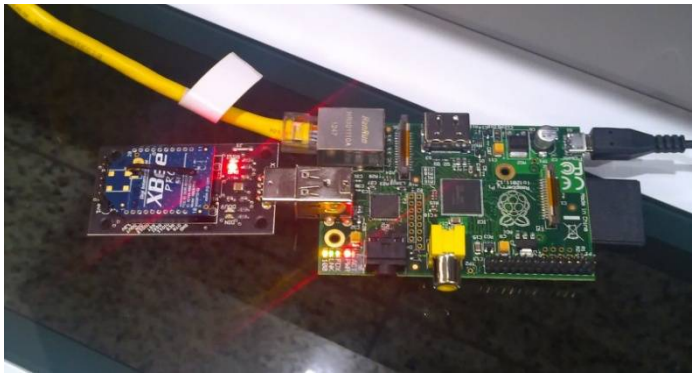
(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

III. INTERFACING BETWEEN RASPBERRY PI AND XBEE

Xbee module is configured as coordinator on the raspberry pi. Raspberry pi can be connected to XBee module directly through USB cable and also by UART serial communication interface [3].The base station also acts as a gateway in this application. The data collected or detected by sensor node sends to the base station and inserts the data received from sensor nodes into database of raspberry pi.Raspberry pi acts as a base station which connects to sensor nodes by zigbee communication protocol and clients by external network (internet etc.).Python is a widely used general-purpose, high-level programming language ,its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. For wireless communication and multihop networking protocol, we used XBee series module S2 from Digi international. Multiple users can access the raspberry pi through Ethernet or Wi-Fi connection within local area network or from anywhere on the internet.



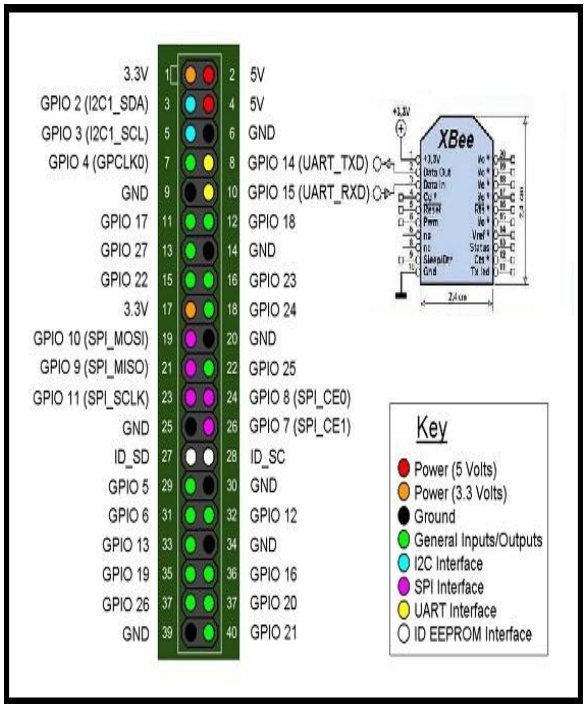


Fig. 6. Interfacing between Raspberry Pi and XBee

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

IV. FLOWCHART

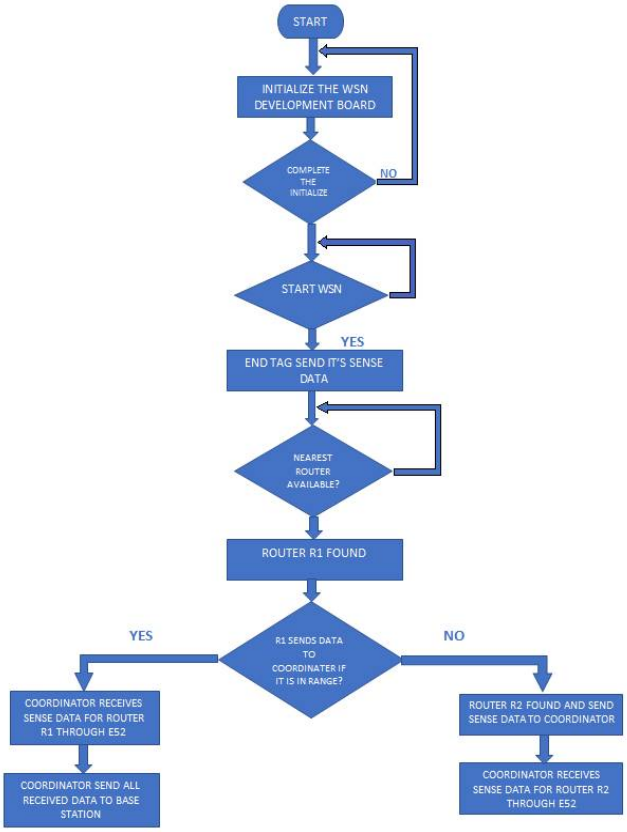


Fig. 7. Program Flowchart of End Tag, Router and Coordinator.

The Fig. 7. shows the program flowchart of end tag, router and coordinator. First initialize the WSN board means initialize the sensor node, sensor node sense the data from the sensor and that data receives the end tag, end tag to router and router to coordinator and finally all data stored in base station, base station send its all data in cloud (Ethernet).R1 and R2 are routers and E52 are the end tag device. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library.

V. RESULTS

In wireless sensor network, there are three types of devices: coordinator, router and end tags shows in figure 8. Open source data platform for the Internet of Things provides access to a broad range of embedded devices and web services. So, here one Xbee is configured as a coordinator, which is connected with the raspberry pi using UART protocol shows in figure 9,10. Here sensor node is configured as router (R1and R2) and end tag(E52),it will send its real time data to the nearest router. There is only one coordinator in the network, which communicates with the base station (raspberry pi).

Step1: In WSN system the sensor node sense the data from the sensor.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

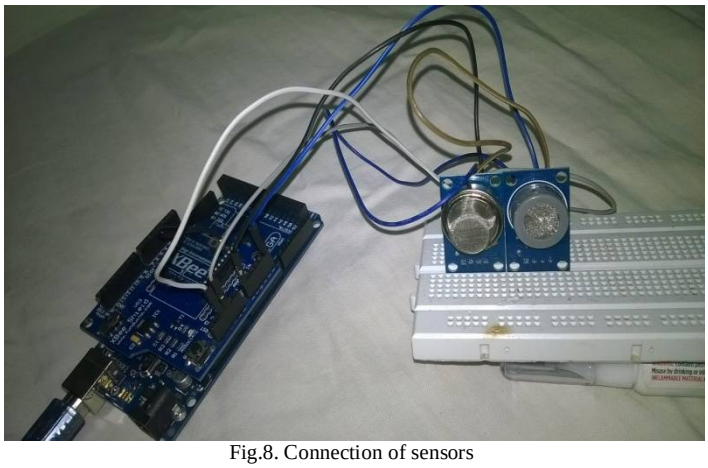


Fig.8. Connection of sensors

Step2: Sense data receives the end tags and end tag search the nearest router.
Step3: If router it in range than end tag sends the data to the router.
Step4: router to coordinator and coordinator directly communicate with base station.

Fig.9. XBee is configured with Raspberry pi

Step5: In base station stored the all data, the client can visit directly to the base station.

Fig.10. Raspberry pi connection with UART

Step 6: Base station sends all data to the cloud or Ethernet (Database server), end Users or clients can interact with the web application within the local area network.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

Step7: In wireless sensor network, there are three types of devices, each device sending and receiving data display on the screen.

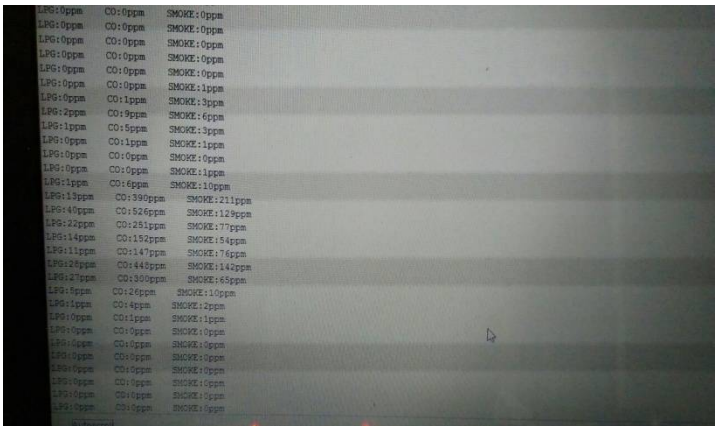


Fig. 11. Sensors output

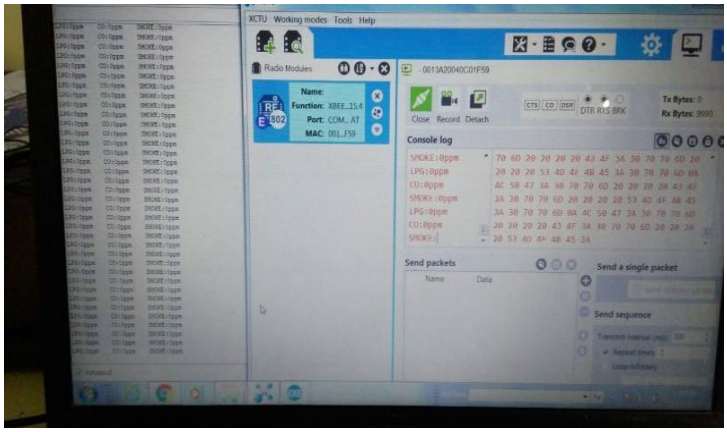


Fig.12. Output on another device received through Xbee

Fig. 1 shows the overall architecture of the system while fig. 5 shows the sensor node connections. The major components used such as Raspberry Pi, Arduino Mega and XBee Module are shown in the figures 2,3 and 4. Fig. 6 and fig. 9 shows the interfacing of Raspberry Pi with XBee module. Fig. 7 shows the algorithm of the program of Xbee configuration in the form of a flowchart. Fig. 8 shows the connection of sensors while fig. 10 shows the connection of Raspberry Pi with UART cable used for transmission and reception. Fig. 11 illustrates the output of sensors in the Arduino software. Fig. 12 shows the same output of sensors on another device on XCTU software transmitted through XBee module.

VI. CONCLUSIONS

Comparing with collection and forwarding information or data of traditional base station (gateway), this system has low-cost, low power consumption, and easy to maintain. This paper designs a wireless sensor network system using Raspberry Pi as a base station, XBee as a networking protocol, sensor node as combination of sensors and controller. Hence we can create sensor-logging application, location-tracking applications, and a social network of things with status updates, so that you could have your location parameter control itself based on your current location. One major advantage of the system lies in the integration of the gateway node of wireless sensor network, database server, and web server into one single compact, low-power, credit-card-sized computer Raspberry Pi, which can be easily

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 1, January 2017

configured to run without monitor, keyboard, and mouse. Such a system is very useful in many environmental monitoring and data collection.

REFERENCES

1. Kochlan, M.; Hodon, M.; Cechovic, L.; Kapitulik, J.; Jurecka, M., "WSN for traffic monitoring using Raspberry Pi board," Computer Science and Information Systems (FedCSIS), 2014 Federated Conference on, vol., no., pp.1023,1026, 7-10 Sept. 2014.
2. Nikhade, Sudhir G.; Agashe, A.A., "Wireless sensor network communication terminal based on embedded Linux and Xbee," Circuit,Power and Computing Technologies (ICCPCT), 2014 International Conference on,vol.,no.,pp.1468,1473, 20-21 March 2014.
3. Sheikh Ferdoush, Xinrong Li "Wireless Sensor Network System Design using Raspberry Pi and Arduino for Environmental Monitoring Applications", Elsevier The 9th International Conference on Future Networks (FNC-2014)
4. Vujovic V, Maksimovic M. "Raspberry Pi as a wireless sensor node: performances and constraints", The 37th International ICT Convention – MIPRO 2014, ISSN 1847-3938, ISBN 978-953-233-078-6, Opatia, Croatia 2014.
5. Jin-Shyan Lee, Yu-Wei Su, and Chung-Chou Shen "A Comparative Study of Wireless Protocols: Bluetooth, UWB, ZigBee, and Wi-Fi" The 33rd Annual Conference of the IEEE Industrial Electronics Society (IECON) Nov. 5-8, 2007, Taipei, Taiwan
6. Andrew N Sloss, Dominic Symes, Cris Wright "ARM system developer's guide designing and optimizing system software" book published in 2004
7. X.Wei, J.Liu, G.Zhang. "Applications of web technology in wireless sensor network",The 3rd IEEE InternationalConference on Computer Science and Information Technology (ICCSIT), pp. 227-230, 2010.
8. Vinay Raghavan and Hamid Shahnasser "Embedded Wireless Sensor Network for Environment Monitoring". Journal of Advances in Computer Networks Vol. 3, No. 1, March 2015.
9. J. Yang, C. Zhang, X. Li, Y. Huang, S. Fu, M.F. Acevedo. "Integration of wireless sensor networks in environmental monitoring cyber infrastructure", Wireless Networks, Springer/ACM, Volume 16, Issue 4, pp. 1091- 1108, May 2010
10. Cheah Wai Zhao , Jayanand Jegatheesan , Son Chee Loon , "Exploring IOT Application using Raspberry Pi", International Journal of Computer Networks and Applications Volume 2, Issue 1, January - February (2015).
11. R. Mittaland M. P. S. Bhatia , "Wireless sensor networks for monitoring the environmental activities" in Proc. 2010 IEEE International Conference on Computational Intelligence and Computing Research, 2010, pp. 1–5.