TuEngr Group

International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

A CONCERN REVIEW ON POTENCY OF IoT APPLICATIONS WITH EXAMPLE CASE STUDY

Vijayasaro.V [a *], Niveathasaro.V [b]

[a] *Department of Electronics and Communication Engineering, PRIST University, Thanjavur, 613403 INDIA*
[b] *Department of Electronics and Communication Engineering, Mahath Amma Institute of Engineering and Technology, Pudukkottai, 622001 INDIA*

ARTICLEINFO

Article history:
Received 19 October 2018
Received in revised form 08 February 2019
Accepted 15 February 2019
Available online
18 February 2019

Keywords:
Wireless Sensor Networks; Internet of Things; Temperature and Relative humidity; Gateway.

ABSTRACT

This paper illuminates the significance of Internet of Things (IoT) and its potential strength especially concerning the application areas of IoT that reflects our day to day life in all over the world. The novel approach of wireless sensor networks enhances its features to persuade the demand of people's fastest lifestyle. This paper describes the concept, significance and main applications of Internet of Things (IoT) by exemplifying a simple case study. The case study illustrates the design framework for analysis of temperature and relative humidity in our surroundings and explains the gateway concept in Internet of Things.

1. INTRODUCTION

IoT is the innovative emerging concept for research. Because due to development of technology, future generation depends on sensors to communicate with one another intelligently. More than couple of years with progression of inserted gadgets and remote sensors, the event of IoT applications are beneficial, comfort, simple to utilize, Cost compelling. IoT can possibly speak with boundless gadgets over the web. [1] IoT knowledge is the innovative insurgency for future constant applications. Web of things gives promising answer for incorporating sensors microcontroller remote conventions to associate physical gadget to the web. IoT rises as new stage for purchaser hardware keep on achieving execution regarding force and usefulness and decrease cost of the framework. In the latest scientific era, the evolving technology in the field of electronics are embedded systems and wireless sensor network respectively. [2]

Internet of things is the innovative modern advancement in technology in the last few years that has a unique style which combines both wireless communication and networking in a single platform. Internet of things serves as an outstanding channel by which the data can be composed through the sensors stores and data process occurs in the microcontroller and through the wireless protocols data links to the internet. Internet of things is the current advancement in the technology which is

*Corresponding author (Vijayasaro) E-mail: viji.saro17@gmail.com

primarily designed to make things easier among the people in their day to day life. The most important purpose of internet of things is to monitor and regulate the competence of several applications. [3] The Internet of things is predominantly used in various streams that include teaching field, Business, and research. Internet of things is used by the humans to chat with other organisms that are alive through the high-end technology. Internet of things is the most suitable technology through which the communication and control with the non-living organism can be established using the internet. Integration of sensors, microcontroller, and wireless protocols is optimally possible with the help of internet of things by which the physical device can be connected to the internet. [4]

IoT is another period of knowledge of innovation, mix of to disentangle individual way of life. I0T has capacity to screen and additionally control ability for various applications. IoT can be utilized for different fields, for example, Academics, Business and research. People speak with other living things utilizing different innovation, additionally convey and control with non-living things utilizing web is IoT [5]. Web of things gives promising answer for incorporating sensors microcontroller remote conventions to associate physical gadget to the internet. IOT enables peoples and things to be associated Anytime, Anyplace, with anything and anyone, in a perfect world utilizing any way/organize and any administration". IOT rises as new stage for customer hardware keep on achieving execution as far as power and usefulness and decrease cost of the framework. [6-9]

2. IoT STANDARDIZATION AND PROTOCOLS

There will be around 50 to 100 billion devices will be connected to the internet electronically by the year 2020. The tremendous increase in the things linked to the internet from the year 1988 and the projections until 2020 is shown in Figure 1. The machines can communicate with each other through a smart technology called Internet of Things (IoT) and through the common channel variety of information is communicated [10]. The wide acceptability of this new modern technology is entirely based on the regularization which makes the technology more compactable, interoperable and reliable.

This also makes the application more acceptable globally [11] Nowadays approximately more than sixty companies that use prominent technologies in communication process are following the international standards includes IETF, IEEE, ITU for creating a novel IP related technologies for Internet of things [12].

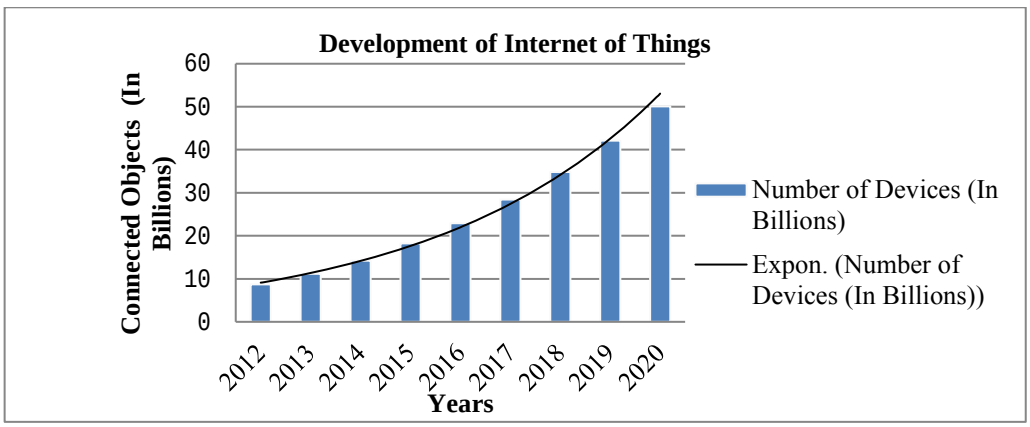

Figure 1: Development of Internet of Things.

3. INTERNET OF THINGS APPLICATIONS

There are wide ranges of applications of internet of things that are linked with our day to day life which includes smart cities, home transportation, health care sector, energy, and smart environment.

Figure 2: Smart Cities Aspect.

3.1 SMART CITIES

Many cities across the world are developed into smart cities with the advanced applications of internet of things, including New York, Toyoko, Shanghai, Singapore Amsterdam, and Dubai. [13] There is a need for careful planning in implementation and monitoring stages of such projects. It also requires support and cooperation from the citizens to implement this new modern technology called internet of things in all the aspects. With the help of internet of things, the infrastructure of the cities can be improved. Advancing the public transportation will decreases the traffic congestion and further reduces the road traffic accidents thereby ensuring the safety of the citizens. [14] Incorporating all the systems (Figure 2) in the country such as health system, transportation and weather monitoring station under one roof can be achieved by the internet of things. In addition to that, it enhances the public access of various databases such as airport, railway, and transportation. These all application will further strengthen the Information and communication system and make it as a smart city. [15, 16]

3.2 SMART HOME AND BUILDINGS

There is extensive range of electronic devices such as television, mobile devices, and several other appliances are supported at the home level with the high-end technology called WIFI. [17] As a result of easy accessibility and affordability wifi has become the regular part of home IP network. Since the usage of the smartphone and tablets has enormously increased over the period of years that simultaneously increased the adoption of WIFI at the home level. For example, the online streaming services or the network at the individual house level and the particular device functionality can be controlled over the network. [18] The gateway is one of the channel through which the internet from the system can be connected to the mobile and vice versa with the help of applications of internet of things. [19] Now there is a trend of incorporating this smart technology into the basic infrastructure of various sectors such as health care industry, entertainment business, and several others. The energy monitoring and the wireless sensor monitoring are the most novel applications that are widely practiced across all the sectors. [20] Through the recent innovative applications of internet of things many devices and objects at the individual home and at the commercial sites can be operated smartly, Figure 3.

*Corresponding author (Vijayasaro) E-mail: viji.saro17@gmail.com Volume 10 No.2 ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/233.pdf DOI: 10.14456/ITJEMAST.2019.23

Figure 3: Smart Home Applications

3.3 SMART HEALTH

The physiological condition of the patients admitted in the hospitals can be monitored by using the applications of internet of things. Health-related parameters are collected by using the sensors and through the gateway, it can be communicated and it is analyzed and further stored at the cloud, Figure 4. Furthermore, the analyzed data can be shared with the stakeholders, partner organization and to the caregiver of the patients in a wireless manner. [24] This substitute's conventional method of routine monitoring of vital signs of the patients by the clinician. Thereby it improves the quality of clinical care provided to the students and also it reduces the cost associated with the traditional way of monitoring the patients at the hospital. This also provides an electronic data which can be used for research and development purpose. [25]

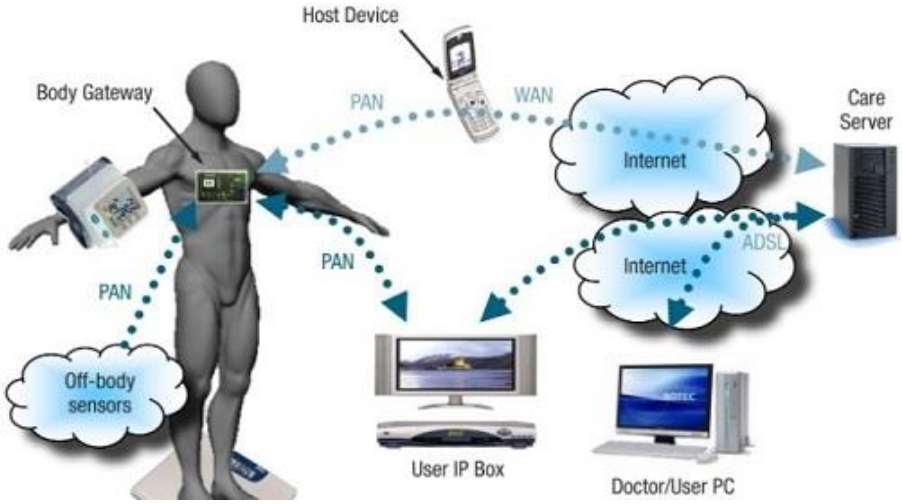

Figure 4: Smart Applications in Health care

3.4 SMART TRANSPORTATION AND MOBILITY

Enhancing the transport facility in the country will improve the standard of living of the people. Observing and cautioning the condition in the road is one of the main significant transformations that have happened due to the advanced high-end technology named internet of things, Figure 5. [26] The crowdsourcing and participatory sensing is the two main major important principles that are used in the notion of smart transportation and mobility. The users started accessing the smartphones for finding the routes of their destination. [27] The three key concepts that are present in the smart transportations are transportation analytics, transportation control, and vehicle connectivity respectively. Demand prediction and anomaly detection can be carried out by using the transportation

analytics. The transportation control provides information regarding the traffic management, speed control and route of the vehicles.

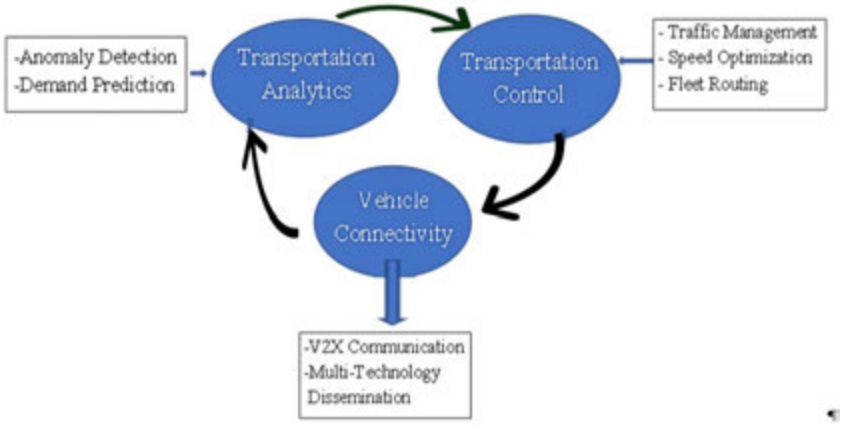

Figure 5: Smart Transportation Application

4. CASE STUDY SYSTEM ARCHITECTURE

This case study describes a high security and privacy necessities for using the gateway and for reducing the energy consumption. The main objective of the paper is to use the gateway for the security and for connecting two devices together. This paper also explores nRF protocol used for fastest transmission of data to alert the population during natural disasters. This case study only focuses on monitoring two environmental parameters through the wireless network using nRF protocol. There is a need for further study that can measure and monitor several other environmental factors by using various wireless network sensors.

4.1 BLOCK DIAGRAM

In this section, we explain about block diagram for temperature and humidity monitoring (Figure 6). Here we are using ATMEGA328 microcontroller as a heart of the paper. It belongs to Arduino family [28,29]. It needs advanced version of embedded C for programming. DHT22 as a temperature and relative humidity sensor. It is low-cost digital sensor to acquire data and fed data to microcontroller. When compared to Zigbee, WIFI, nRF2401 protocol is cost-efficient, easy to use with sensors and microcontroller. Using nRF transmission protocol sends the data to the gateway. From the gateway, data send to cloud by using the HTTP based wifi.

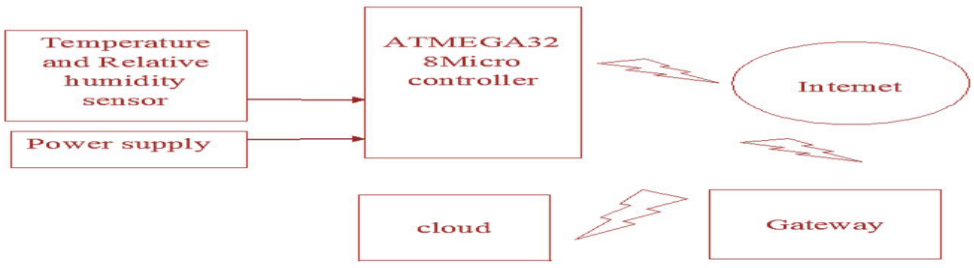

Figure 6: Block diagram of the paper

4.2 ATMEGA328 MICROCONTROLLER

Atmega328 (Figure 7) is very popular device in electronics because of its extraordinary characteristics. Microcontroller is the heart of the real-time embedded system. It belongs to Atmel and is Harvard architecture. Arduino is open source prototype, circuit board provides Arduino IDE

which can be programmed and ready-made software.

Arduino IDE is developed circuit board for simply writing software code on that board. It does not want extra hardware for developing code on to the board. [30, 31]

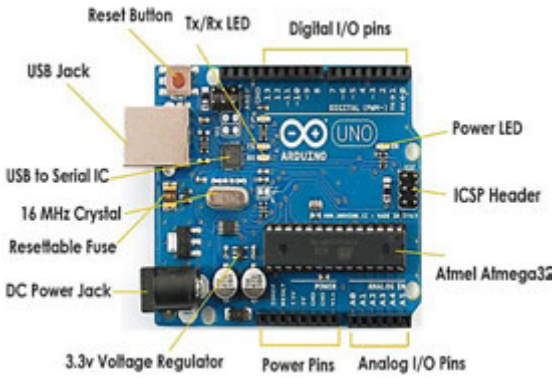

Figure 7: ATMEGA328 Microcontroller board diagram

4.3 DHT22 SENSOR

It is Low-cost sensor, high reliability, excellent stability, also named as AM2302. By using the DHT22 sensor (Figure 8), microcontroller can read temperature and humidity values as digital output. The surrounding air and spits out a digital signal on the data pin is measured by using the capacitive humidity sensor and a thermostat. There is no necessity of using the analog pins. Sensors output will be printed to serial monitor. [32]

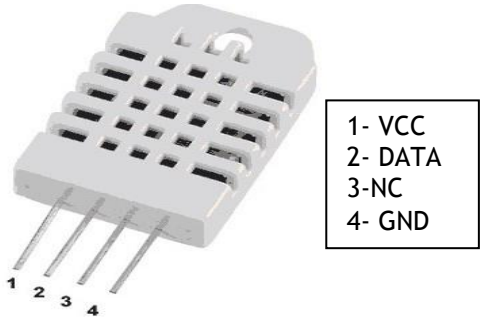

Figure 8: DHT22 Sensor and Pin Assignments.

4.4 WIRELESS COMMUNICATION

In IOT projects wireless module plays a vital role in development of the project. In this paper, we use two platforms for data transmission. They are nRF transmission, IEE802.11. By using nRF transmission (Figure 9), sensed data can store in microcontroller and send to gateway and in gateway, it acknowledges the data what is happening in gateway. From the gateway, the data send to the cloud by using ThingSpeak software platform. It is open source platform and it needs the open source access for IoT applications [38].

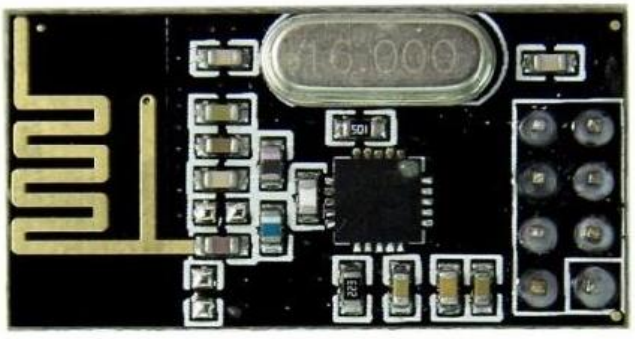

Figure 9: NRF2401 board

The nRF24L01 is an ISM brand which is a radio receiver made of a single chip and it belongs to the series of 2.4 GHz radio module. [39]The primary purpose of designing the nRF24L01 is to have an extraordinary speediness in communications with maximum rate of 2Mbit/Sec at a very minimal cost and with less consumption of electricity. A completely incorporated frequency synthesizer, a power amplifier, crystal oscillator, demodulator, modulator, and enhanced shock burst protocol engine are part of the transceiver. Further, a modern recent on-chip hardware solution named "Multicenter" is also portion of nRF24L01 that can concurrently support maximum of six wireless communication devices. This is the uniqueness of nRF24L01 through which the wireless personal area networks can be built in an extensive variety of applications. [40] The printed circuit board that is present in this wireless sensor network node is about two inches in diameter and is circular in shape [41].

4.5 IMPLEMENTATION

Depends upon the block diagram, implementation model designed with flow chart and circuit hook up diagram. It explains the functionalities of the example case study and defines each module shows how to develop in implementation.

4.5.1 FLOW CHART

Based on block diagram modules (Figure 10), we frame the implementation flowchart below. The flowchart shows how interfacing with sensors and their functionalities. In this implementation model, we used ATMEGA328 board with nRF module is an embedded device for sensing and storing the data in cloud. Internet gateway used for security purpose in the IOT applications. Gateway used as proxy server and checks the status needed data retrieving and whether correct user name password given. From the gateway send the data by ThingSpeak software to the cloud.

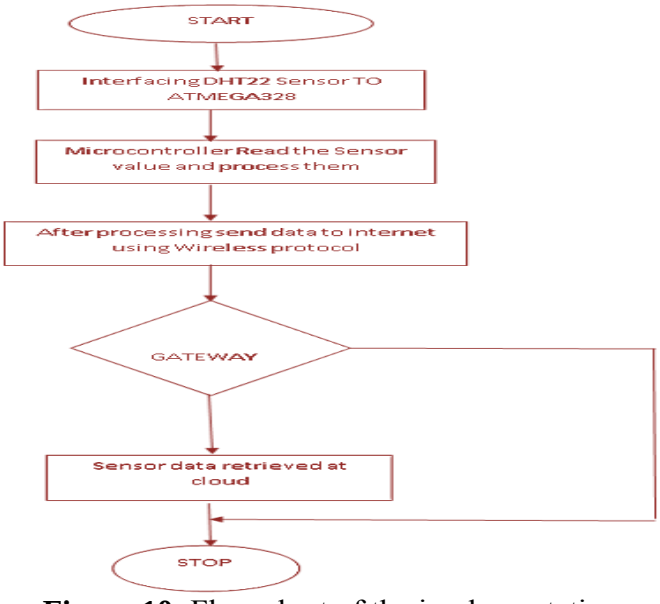

Figure 10: Flow chart of the implementation

4.5.2 CIRCUIT DIAGRAM

Figure 11 shows the circuit diagram of interfacing ATMEGA 328 with DHT22 sensor. The sensor send corresponding parameter value with the help of its features and then microcontroller processes and stores the data. The stored data then retrieved through wireless protocol to cloud.

*Corresponding author (Vijayasaro) E-mail: viji.saro17@gmail.com Volume 10 No.2 ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/233.pdf DOI: 10.14456/ITJEMAST.2019.23

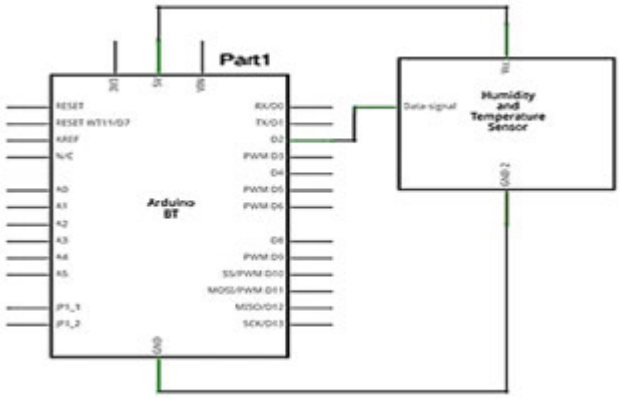

Figure 11: Interfacing diagram between ATMEGA328 and DHT22 sensor.

4.5.3 PROTOTYPE

Figure 12 shows the hardware prototype with gateway for temperature and relative humidity sensor.

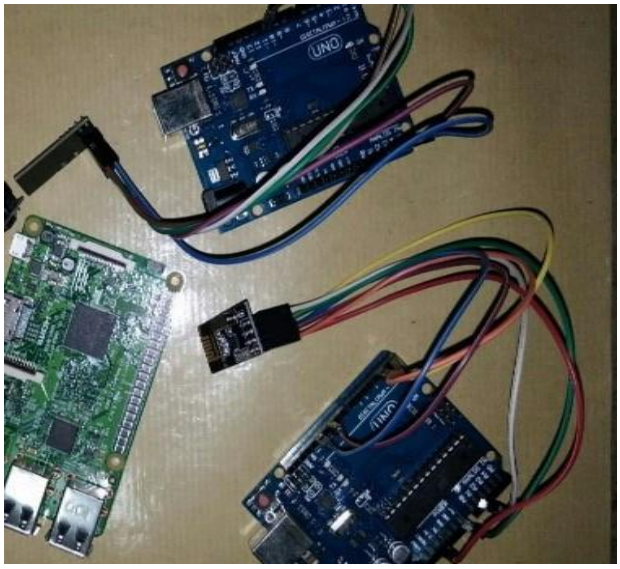

Figure 12: Hardware setup.

5. Results and Discussions

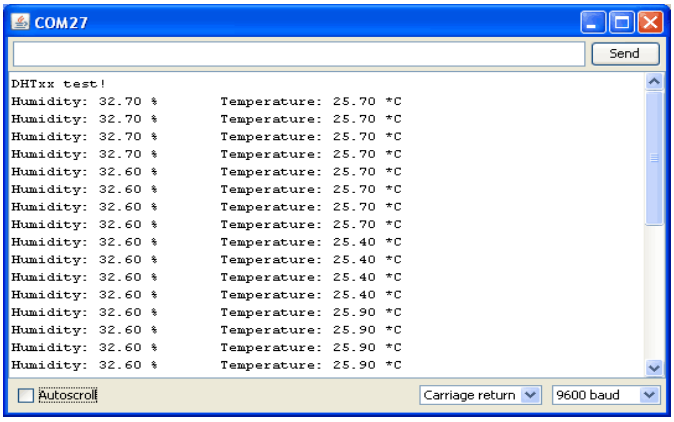

Figure 13: Output in Serial Monitor.

5.1 Output in ARDUINO IDE Serial Monitor

Figure 13 shows the temperature and relative humidity values of microcontroller after sensing the data. The output data is automatically updated to the internet if proper connection established.

The parameters can be analyzed by using the output that are stored in the server and it can also be used for the purpose of systematic observation.

5.2 OUTPUT IN ThingSpeak™ DOMAIN

Figure 14 shows the output of the cloud for environmental parameters such as temperature and relative humidity measurement. The Cloud has capability to monitor and control the whole applications.

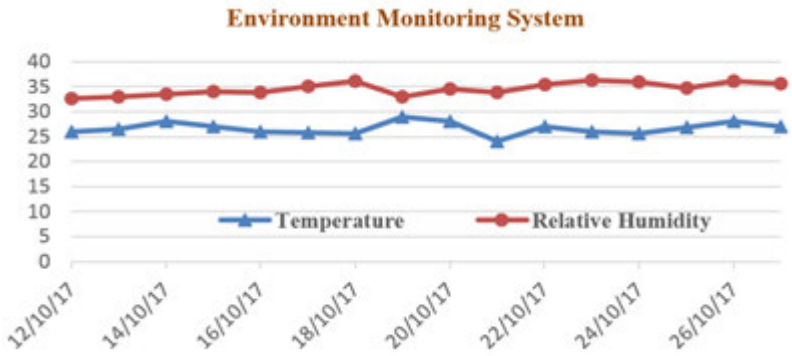

Figure 14: Output to the cloud

6. CONCLUSION

In this paper, we explained about basics of innovative concept named IoT. IoT can be widely used in all the departments. By the year 2025 people all over the world satisfy their needs with the help of this novel technology. We designed a case study has advantage, high security and privacy requirements using gateway and low power consumption using communication protocol. Environmental monitoring mainly for creating awareness to the people how people affected due to natural disasters. We focused only temperature and relative humidity, in future we use water level sensor, pressure sensor, LDR sensor, sound sensor, CO_2 sensor. Furthermore, we are trying to implement both software and hardware Gateway for better security. This idea is the novel approach for saving energy and to provide security in low cost.

7. REFERENCES

[1] Rafiullah Khan, Sarmad Ullah Khan, Rifaqat Zaheer and Shahid Khan, "Future Internet: The Internet of Things Architecture, Possible Applications and Key Challenges," in Proceedings of Frontiers of Information Technology (FIT), 2012, pp. 257-260

[2] G. Mois, T.Sanislav and S.C. Folea, Analysis of Three IoT-Based Wireless Sensors for Environmental Monitoring, *IEEE Transactions on Instrumentation and Measurement.*

[3] Saranya C. M., Nitha K. P., Analysis of Security methods in Internet of Things. International Journal on Recent and Innovation Trends in Computing and Communication, 3(4), 2015.

[4] D. Giusto, A. Iera, G. Morabito, L. Atzori (Eds.), The Internet of Things, Springer, 2010. ISBN: 978-1-4419-1673-0.

[5] S. Misra et al., Security Challenges and Approaches in Internet of Things. Springer Briefs in Electrical and Computer Engineering, 2016.

[6] Suwimon Vongsing thong and Sucha Smanchat. A Review of Data Management in Internet of Things. KKU Res. J. 2015.

*Corresponding author (Vijayasaro) E-mail: viji.saro17@gmail.com Volume 10 No.2 ISSN2228-9860 eISSN1906-9642 http://TUENGR.COM/V10/233.pdf DOI: 10.14456/ITJEMAST.2019.23

[7] Sapandeep Kaur, Ikvinderpal Singh. A Survey Report on Internet of Things Applications. International Journal of Computer Science Trends and Technology, 4(2), 2016.

[8] Patrick Guillemin, et al., Internet of Things Position Paper on Standardization for IoT technologies. European research cluster on the internet of things; January 2015.

[9] Jayavardhana Gubbia, Rajkumar Buyyab, Slaven Marusic, Marimuthu Palaniswami. Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems 29 (2013) 1645-1660.

[10] Surabhi Kejriwal and Saurabh Mahajan. Smart buildings: How IoT technology aims to add value for real estate companies The Internet of Things in the CRE industry. 2019. https://dupress.deloitte.com/dup-us-en/focus/internet-of-things/iot-commercial-real-estate-intelligent-building-systems.html (Accessed February 2018).

[11] Grandinetti, Lucio. Pervasive Cloud Computing Technologies: Future Outlooks and Interdisciplinary Perspectives: Future Outlooks and Interdisciplinary Perspectives. IGI Global, 2013.

[12] International Cooperation Unites IEEE and CCSA For New "Internet of Things" Workshop, 2012. Available from http://standardsinsight.com/iot/iotworkshop (Accessed February 2018).

[13] Thingworx. ThingWorx Platform & Ecosystem Solutions for Smart Cities. 2018. https://www.thingworx.com/ecosystem/markets/smart-connected-systems/smart-cities/ (Accessed February 2018).

[14] Eiman Al Nuaimi1 et al., Applications of big data to smart cities. Jo*urnal of Internet Services and Applications* 2015. http://www.7wdata.be/article-general/how-big-data-and-internet-of-things-builds-smart-cities (Accessed February 2018).

[15] Murray, M. Minevich, and A. Abdoullaev. Being smart about smart cities. KM World, October 2011.

[16] Farheen Fatima, et al., Internet of things: A Survey on Architecture, Applications, Security, Enabling Technologies, Advantages & Disadvantages. International Journal of Advanced Research in Computer and Communication Engineering, 4(12), 2015.

[17] http://www.connected-living.org/content/4-information/4-downloads/4-studien/20-mind-commerce-smart-homes-companies-and-solutions-2014/mind-commerce_smart-homes-companies-and-solutions-2014_glo_12-2014.pdf (Accessed February 2018).

[18] http://www.gsma.com/connectedliving/wpcontent/uploads/2012/03/vision20of20smart20home20report.pdf (Accessed February 2018).

[19] Jukka Suhonen. Experiences and Future Plans for WSN-enabled Service Development in Home Environment. Realin white paper 2013.

[20] Litos Strategic Communication. The SMART GRID: an introduction. Prepared for the U.S. Department of Energy http://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf

[21] Smart Grid enabling energy efficiency and low-carbon transition, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321852/Policy_Factsheet_-_Smart_Grid_Final__BCG_.pdf

[22] Ramyar Rashed Mohassel et al., A survey on Advanced Metering Infrastructure. *International Journal of Electrical Power & Energy Systems* 63 (2014) 473-484.

[23] David Niewolny. How the Internet of Things Is Revolutionizing Healthcare. https://cache.freescale.com/files/corporate/doc/white_paper/.

[24] Bill Chamberlin. Healthcare Internet of Things: 18 trends to watch in 2016. IBM Center for Applied Insights. https://ibmcai.com/2016/03/01/healthcare-internet-of-things-18-trends-to-watch-in-2016

[25] Vahid Mirzabeiki. An Overview of the Freight Intelligent Transportation Systems; Division of Logistics and Transportation, Chalmers University of Technology.

http://www.bth.se/tek/intelligent_gods.nsf/bilagor/Mirzabeiki,2010,ITS%20World%20Busan_pdf/$file/Mirzabeiki,2010,ITS%20World%20Busan.pdf

[26] Manoop Talasila, Reza Curtmola, and Cristian Borcea. Mobile Crowd Sensing; New Jersey Institute of Technology. https://web.njit.edu/~mt57/publications/Chapter4.pdf

[27] Programming Aurdino Getting started with sketches. McGraw Hill, Nov, 2011 (Accessed February 2018).

[28] Quiroz, Juan Silva, et al. "El desarrollo de la competencia digital docente durante la formación del profesorado." Opción34.86 (2018): 423-449.

[29] S.Anusha, M.Madhavi, R.Hemalatha. Home automation using atmega328 microcontroller and android application. International Research Journal of Engineering and Technology, 2(6), 2015.

[30] R.Hari SUDHAN et al. Arduino atmega-328Microcontroller. International journal of innovative research in electrical, electronics, instrumentation and control engineering. 3(4), April 2015.

[31] Digital-Output Relative Humidity & Temperature Sensor/Module DHT22 (DHT22 Also Named as AM2302), Aosong Electron. Co., Ltd., Guangzhou, China, 2014.) (Accessed February 2018).

[32] Adafruit, Sensor, Temperature, DHT22 Temperature-Humidity Sensor, https://www.adafruit.com/product/385) (Accessed February 2018).

[33] Nordic Semiconductor ASA, Production Specifications, June 2004 https://www.sparkfun.com/datasheets/RF/nRF2401rev1_1.pdf) (Accessed February 2018).

[34] Nordic Semiconductor, Devzone Blog Feed, http://www.nordicsemi.com (Accessed February 2018).

[35] Anuj Gour and PreetJain.Design of Wireless Audio Exchange Based on nRF module. International Research Journal of Engineering and Technology (IRJET). 2(8), 2015.

[36] Thingspeak. (2018). What is IoT? https://thingspeak.com (Accessed February 2018).

[37] Ultra-low power wireless solutions from Nordic semiconductor. http://www.nordicsemiconductor.com/nrf24L01(Accessed February 2018).

[38] Musilim, A. A., Nwagwo, A., & Uche, O. K. (2017). Effect of Baffle Cut Sizes on Temperature and Pressure Drop at Various Mass Flow Rate in a Shell and Tube Heat Exchanger. IJMRA, 6(1).

[39] S. S. Sonavane, V. Kumar and B. P. Patil. Component Choice for Low Power Wireless Sensor Networks Node. International Journal of Computer, Information Technology and Engineering (IJCITAE), 2(1), July-2008, Series Publications.

[40] Abid Rahim, Zeeshan Ali, Raushan Bharti & Syed Sabeel N.S.P. Design and Implementation of a Low Cost Wireless Sensor Network using Arduino and nRF24L01(+).International Journal of Scientific Research Engineering & Technology, 5(5), 2016.

Vijayasaro.V is associated with Department of Electronics and Communication Engineering, PRIST University, Thanjavur, INDIA.

Niveathasaro.V is associated with Department of Electronics and Communication Engineering, Mahath Amma Institute of Engineering and Technology, Pudukkottai, INDIA.