International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-9 Issue-1, October, 2019

Weather Prediction using Multiple IoT Based Wireless Sensors

Heeralal Kumar Sah, S. M. Koli

Abstract: ***Environmental monitoring has become extremely important due to recent changes in the climate. It is important for ensuring a safe and wealthy life of both humans and artifacts. This field is based on remote sensing and wireless sensor networks for gathering data about the environment. Recent advancements, for example, the vision of the Internet of Things (IoT), the distributed computing model, and digital physical frameworks support the transmission and management of huge amounts of data relating to the trends determined in environmental parameters. In this context, the paper presents three different IoT-based wireless sensors for weather prediction and environmental monitoring: one employing User Datagram Protocol (UDP)-based Wi-Fi communication, second communicating through Wi-Fi and Hypertext Transfer Protocol (HTTP), and a third one using Bluetooth communication. The system consists of three different wireless sensor nodes based on Node-MCU Wi-Fi module or Arduino microcontroller that is connected to the internet, and a firebase cloud server, which provides information storage and delivery to remote clients. In addition, to view the result output in an effective and user friendly manner, MIT App Inventor is used to develop applications for Android phones using a web browser and either an associated phone or the on-screen phone person. The system conducts a lookup table which contains the value of temperature, humidity, real time rain, and a level of carbon monoxide (CO) and are used to predict the current environmental conditions.***

Keywords: ***cloud server, environmental monitoring, IoT, weather predictions, Wireless Sensor Network***

I. INTRODUCTION

In the last few years, the environmental care has become one of the biggest concerns for almost every country. Over the most recent couple of decades, the degree of industrialization has been expanding with no control. Hence, there is a growing concern over environmental issues like global warming, energy conservation, efficient energy usage, radiation etc. Wireless Sensor Networks (WSN) has given a viable solution to these issues. This is the sector where Wireless Device Networks (WSNs) square measure was used for the first time. Their main role comprises of perception and recording of the physical world, the account of the physical amounts of the climate and sorting out the gathered data at a focal area. WSN consists of an outsized range of inexpensive, low-power tiny sized multifunctional wireless detector nodes, with sensing, gathering and computation capabilities, which might be communicated over a brief distance via a wireless medium and collaborate to finish a standard task. WSN is for the most part conveyed in unattended and brutal situations. In any case, a few limitations limit their application somewhat. These requirements incorporate confined measure of vitality, restricted correspondence extend, low data transfer capacity, constrained handling capacity and capacity in every hub. Execution of a sensor hub is profoundly subject to the viable and effective utilization of these accessible restricted assets that prompts most extreme lifetime of the WSN. One essential worry on remote transmission is that the power utilization. WSNs measure environmental conditions such as temperature, humidity, sound, pollution (such as CO, CO2, SOx) levels, wind pressure, rainfall, light intensity etc. These are like remote specially appointed systems, in the sense they depend on remote availability and unconstrained arrangement of systems with the goal that the sensor information can be moved remotely. Water and air quality are basic components to keep up the balance between human improvement and a sound situation. In this unique situation, ecological checking speaks to a crucial instrument for social event applicable data about the environment, prompting new learning and understanding, and eventually for actualizing adjustment and alleviation activities that address the corruption of the biosphere. Climate expectation is to foresee the states of the air for a given area and time. Individuals have attempted to foresee the climate conjectures casually for centuries and officially since the 19th century. Climate estimates are made by gathering quantitative data with respect to the current situation with the environment at a given spot and utilizing meteorology to extend how the air will change. This paper shows the structure subtleties, the advancement, and investigation of three distinct methods that empower to accomplish Internet associated answers for observing and anticipating condition at remote areas: one utilizing UDP-based Wi-Fi communication, second one dependent on the HTTP convention, and a third one comprising of Bluetooth. Being furnished with Internet association abilities, the created methods speak to a piece of the Internet of Things (IoT), the vision that "enables individuals and things to be associated Anytime, Anyplace, with something and Anyone, in a perfect world utilizing Any way/arrange and Any administration". The Internet of things (IoT) is the arrangement of physical devices, vehicles, home devices, and elective things embedded with contraptions, programming, types of gear, sensors, actuators and accessibility of these things to join, assemble and exchange information, making entryways open for progressively direct mix of the physical world into PC based systems, realizing viable improvements, financial inclinations, and reduced human efforts.

Revised Manuscript Received on October 30, 2019.

* Correspondence Author

Heeralal Kumar Sah, P.G. Student, Department of E&TC Engineering, Dr. D. Y.Patil School of Engineering, Charholi(bk), Pune, MH, India, hkhas99964@gmail.com

Dr. S. M. Koli, Professor, Department of E&TC Engineering, Dr. D.Y.Patil School of Engineering, Charholi (Bk), Pune, MH, India, sanjay.koli@dypic.in

II. LITERATURE SURVEY

Several solutions for monitoring different environmental parameters, which are based on wireless nodes, have been proposed earlier. In this paper the solution described particular attention to the data storage and safety, even though conceived with a similar approach. The engineering proposed by Luca Lombardo et al., depended on numerous level information stockpiling, which gives solid information wellbeing [1]. To be explicit, it gives the opportunity to recover the whole estimating history of the observed site, maintaining a strategic distance from any issues associated with cabling and system connection break. In the paper named as "Remote Sensor Network application for water quality checking in India" [2] point of creator Dr. SeemaVerma and prachi is to talk about prerequisite and appropriateness of WSN for water quality observation. Paper [3] presents the advancement of a continuous Wireless Sensor Network for any natural information expectation utilizing credulous forecast model. The created framework was forced on intranet; low gauge metric blunder result acquired demonstrates the exactness of the innocent model.

I.F. Akyildiz et al. depicted the idea of sensor systems, which has been made suitable by the union of smaller scale electro-mechanical frameworks innovation, remote correspondences, and advanced hardware. From the outset, the detecting errands and furthermore the potential detecting component systems applications were investigated, and an audit of things affecting the arranging of detecting component systems was given. At that point, the correspondence plan for detecting component systems was made open, and furthermore the calculations and conventions produced for each layer inside the writing were investigated Open investigation issues for the finish of sensor systems were likewise talked about. Remote little detecting component systems were known commonly for the first essential advancements of the 21st century. There is a historical backdrop of concentrate in the field of detecting systems in the course of recent decades, including two significant projects of the Defence Advanced Research Projects Agency (DARPA) crossing this period: the Distributed sensor Networks (DSN) and the Sensor Info Technology (Sens IT) programs. The innovation drifts that effect the occasion of detecting component systems territory unit were evaluated and new applications like framework security, surroundings watching, and control zone unit were presented. The specialized difficulties kept detecting component arrange improvement, which included system revelation, the executives and directing, agreeable sign and learning process, entrusting and questioning, and security.

This paper introduces the arranging subtleties, the occasions and furthermore the examination of 3 totally various sensors that allows the achievement of net associated answers for viewing the surroundings intently at remote areas. Three sensors utilized in this examination are: one utilizing UDP-based Wi-Fi correspondence [4], second dependent on the HTTP convention and the third one comprising in power collecting Bluetooth Smart Being given Internet association abilities, the created sensors speak to a piece of the IoT, the vision that "enables individuals and things to be associated Anytime, Anyplace, with something and Anyone, in a perfect world utilizing Any way/organize and Any administration". Donno et al., proposed an answer where self-controlled Radio recurrence (RF) distinguishing proof labels, furnished with temperature, light, and quickening sensors, were utilized. The gadget has the ability to harvest RF vitality and its activity has been legitimate through 2 genuine examinations, in which the obtained information is gathered by a host PC with the assistance of a peruser reception apparatus. The plan accomplished a transmission scope of up to 10 and 20 m in completely detached and battery-helped latent modes separately. The proposed framework can be utilized for observing the encompassing or outside climate parameters, and, if the host PC is furnished with an Internet association, it tends to be a piece of an IoT-based arrangement. In [5] re-examining the advancement of Wi-Fi sensors sending temperature and relative moistness estimations to a base station utilizing UDP. A battery lifetime of two years with a twenty minutes estimation cycle was accomplished. This empowered the improvement of a gadget utilizing HTTP, for exploring the power proficiency of this progressively solid arrangement, from the correspondence purpose of. J.Ramprabu portrayed a periodic worth and comprehensive way to deal with the water quality recognition drawback for drink dispersion frameworks moreover concerning customer destinations. His methodology was to create detecting component hubs for constant and in-pipe watching, evaluation of water quality on the fly and to figure the measure of water conveyed.

Remote Sensor Networks (WSNs) have accomplished far reaching pertinence in water quality recognition. In any case, existing WSN-based recognition frameworks aren't sufficient for watching the lake and lake water, town water dissemination and water supply. In addition, these structures can't be reused in elective recognition applications since they utilize static and application explicit locator hubs and aren't dynamic to the regularly evolving needs. Thus, author of paper [6] introduced a reusable, self-configurable, and vitality efficient WSN-based water quality watching framework that incorporated a Web-based data entrance and a rest arranging system of detecting component hubs. The working environment and reproduction results demonstrated that the structure would screen the water quality occasionally and in this manner, the rest programming component would build the system timeframe, a few times over. Discovering designs in goliath, genuine, spatio/worldly information keeps on attracting high intrigue (e.g., Merchandise deals over house and time, designs in portable clients; gadget systems total operational data from vehicles or maybe from people with wearable PCs). Anastassia Ailamaki et al., portray an interdisciplinary research exertion to couple information disclosure in huge natural databases with organic and compound sensor systems, so as to reform drinking water quality and security basic leadership. They portrayed a dissemination and activity convention for the position and use of set up natural sensors by consolidating (I) new calculations for spatial transient preparing, (ii) better approaches to speak to water quality and security elements, and (iii) a tasteful choice investigation system. The work planned in [7] by S. Kavi Priya et al., was the event of low priced, mostly fuzzy based water quality watching system victimization of wireless sensing element networks that is capable of measuring physiochemical parameters of water quality like hydrogen ion concentration, temperature, conductivity,

oxidation-reduction potential, and turbidity. Late progression in remote interchanges and physical science has empowered the occasion of modest finder systems. The identifier systems will be utilized for differed application regions (e.g., wellbeing, military, home and so forth.). For various application regions, there are diverse specialized issues that analysts are at present attempting to determine. The present best in class of sensor systems is caught in this article, where arrangements are talked about under their related convention stack layer areas. The article displayed in [8] additionally brought up the open research issues and proposed to start new interests and improvements in this field. One of the prompt advantages brought by the securing of such physical legitimacies, similar to soil dampness, temperature, and saltiness, can be found in horticulture, where critical water asset reserve funds can be accomplished [9-10]. Wireless sensing elements and sensor networks are utilized with success in the implementation of solutions, giving happiness to numerous fields, together with environmental watching, natural disaster bar, current utilization viewing in enormous structures, observing frameworks for the dosimetry of radiology administrators in medicinal services applications.

III. PROBLEM STATEMENT AND OBJECTIVE

1. Environmental monitoring and prediction has become extremely important due to recent changes in climate. It is important for ensuring a safe and wealthy life of both humans and artifacts.
2. The sudden climatic change impacts the environment in the form of pollution, temperature, humidity, rain, and heavy thunderstorms etc. thus greatly affecting thousands of people by causing critical diseases, which frazzle their life.
3. In this context, the proposed system has three IoT based solutions for providing environmental monitoring and weather prediction.
4. The earlier system limits the monitoring region.
5. This system is simpler and less costly as compared to the earlier systems.

OBJECTIVES

1. To monitor environmental conditions like temperature, humidity, real time rainfall and level of carbon monoxide (CO) gas using three different IoT based wireless communications.
2. To predict the weather conditions and update those along with the sensor value on the cloud server.

IV. METHODOLOGY

The proposed system is simpler and uses advanced technology. It is based on sensor data collection that is uploaded to cloud server by three different technologies (UDP, HTTP and Bluetooth) and result is shown in the mobile app taken from the firebase cloud server. The block diagram of the proposed system is shown below in fig.1.

The block diagram consists of three different nodes. Each node contains four sensors (such as temperature, humidity, rain, and CO sensors) and communicates to a cloud server through three different protocols. Google Firebase was used as cloud server, which stores the data collected by the sensors and displays in mobile app. For determining temperature and humidity of the atmosphere, we used temperature and humidity sensors (DHT11), which helped in predicting environmental conditions. CO sensor (MQ-7) was used for determining level of carbon monoxide in the environment, whereas a rain sensor was used for detection of rains. The system was placed in 3 different locations and data from each location was collected by the server as shown in figure1. The server stored and displayed the current values of all four parameters. A look up table was generated which had the values of temperature and humidity and was used for predicting the current environmental conditions by comparing the data. The data for only these two parameters was used as these are the basic and important elements of environment. For example, if humidity is more and temperature is less then the chances of rains are more, if humidity is less and temperature is more then the chances of rains are less, if humidity is moderate and temperature is also moderate then the weather is clear etc. Presence and absence of real time rain was determined by rain sensors.

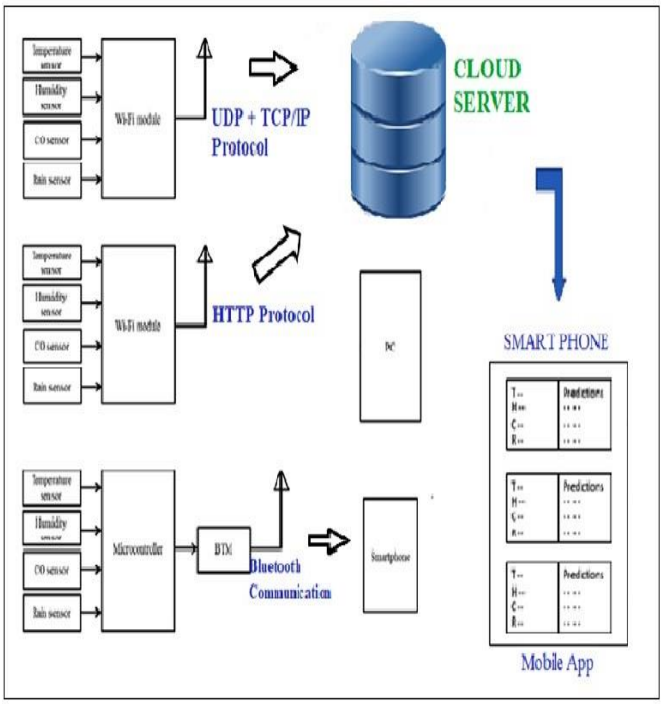

Fig. 1. Block Diagram Of Proposed System

The system was placed at three different locations and each location used different protocol for transmission of data. First place used UDP+TCP/IP protocol to communicate with the server. It transferred data to mobile using the rules setup by TCP/IP protocols. The system at the second place used HTTP protocol to communicate with the webpage. The data was automatically updated at every 5sec. A webpage was developed to receive and transmit data using this protocol. The system placed at the third location used Bluetooth module to transmit data on mobile. This system used Bluetooth protocols and communicated with the mobile app according to these protocols. Further, Smartphone transferred the data to webpage or mobile app using the mobile internet.

IMPLEMENTED SYSTEM

A. Node-1 uses User Datagram protocol (UDP) and TCP/IP protocol to communicate to cloud server.

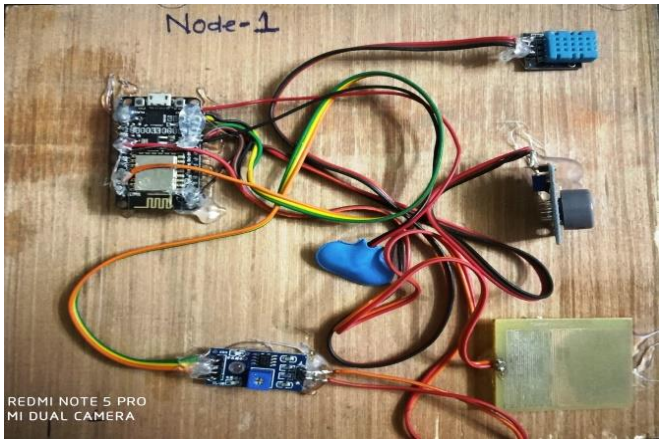

Fig. 2. Node - 1 uses UDP+TCP/IP protocol

B. Node-2 uses Hyper Text Transfer Protocol (HTTP) to communicate to cloud server. Request through a webpage is made to receive the data.

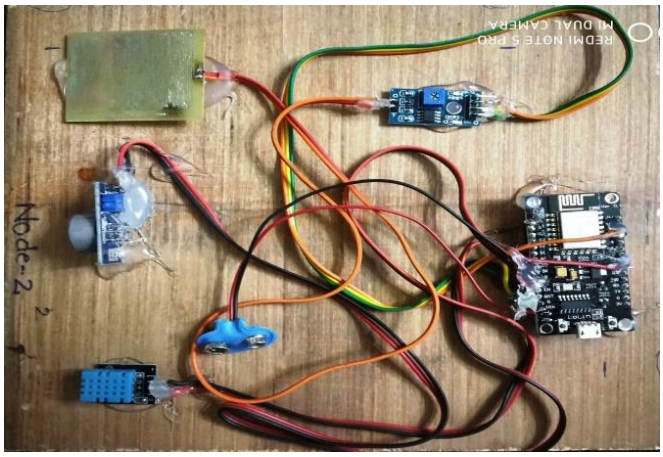

Fig. 3. Node - 2 uses HTTP protocol

C. Node-3 uses Bluetooth communication to communicate to cloud server through Smart phone. An app is used to interface the Smartphone Bluetooth and internet connection.

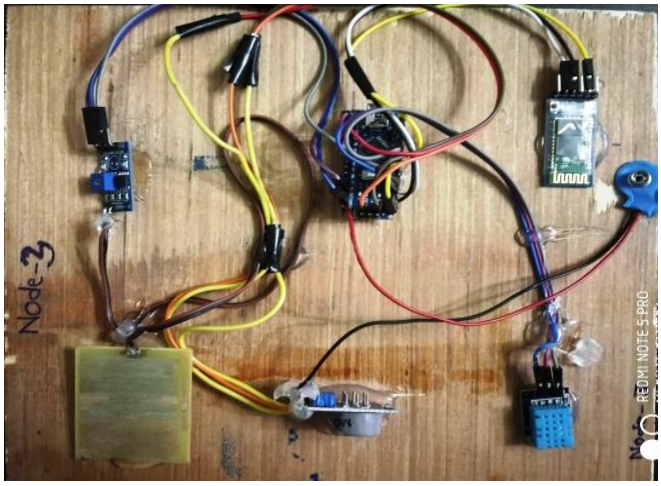

Fig. 4. Node - 3 uses Bluetooth Communication

V. RESULTS AND DISCUSSIONS

A. Sensor Data Recorded on different Days And their Predicted Value:-

Table- I: Output Result

Date	Temp (°C)	Relative Hum. (%)	Conc. of CO (ppm)	Rain status (Digital Value)	Prediction
10-Mar-19	32	54	115	0	sunny weather
11-Mar-19	32	57	116	0	sunny weather
18-Mar-19	33	43	109	0	sunny weather
19-Mar-19	33	43	108	0	sunny weather
27-Mar-19	27	95	115	1	It's Raining
28-Mar-19	32	65	116	0	clouded
29-Mar-19	33	70	135	0	clouded
31-Mar-19	32	42	112	0	sunny weather
4-Apr-19	31	43	109	0	sunny weather
5-Apr-19	31	78	108	0	clouded
10-Apr-19	30	43	105	0	sunny weather
11-Apr-19	32	34	106	0	sunny weather
12-Apr-19	32	78	138	0	clouded
13-Apr-19	31	43	128	0	sunny weather
14-Apr-19	31	43	116	0	sunny weather
15-Apr-19	31	45	143	0	clouded
16-Apr-19	30	48	121	0	clouded
17-Apr-19	30	43	117	0	sunny weather
18-Apr-19	30	60	110	0	Partly clouded
19-Apr-19	29	58	111	0	Partly clouded
22-Apr-19	11	96	108	1	It's Raining
26-Apr-19	30	60	109	0	Partly clouded

B. Graphical Representation Of Sensor Data On Different Days :-

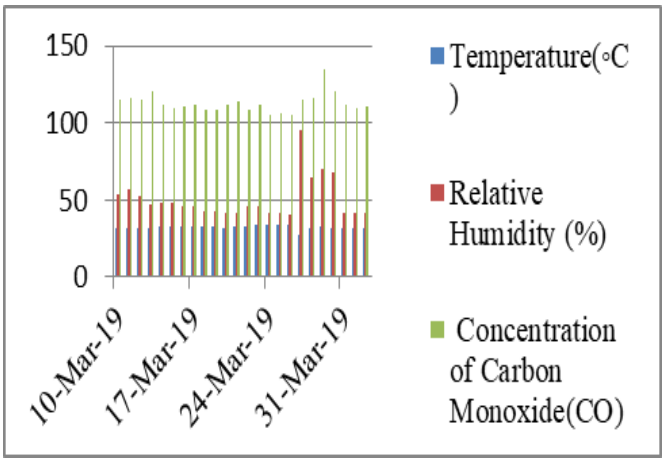

Fig. 5. Graphical Representation of Output Result

C. Final Results Showing in Mobile App:-

Fig. 6. Result Displays in Mobile app

VI. FUTURE SCOPE

With some modifications in basic system a developed system can be used in following areas:

1. Industrial Sensing
2. Infrastructure Security
3. Traffic Control
4. Environment and Habitat Monitoring

VII. CONCLUSION

This paper has presented three different techniques for implementing IoT-based solutions for environmental monitoring and prediction: one utilizing User Datagram Protocol (UDP)-based Wi-Fi communication, second utilizing imparting through Wi-Fi and Hypertext Transfer Protocol (HTTP), and the third one utilizing Bluetooth communication. The system was designed, developed, and analyzed and all of them were manufactured with discrete parts and gave simple access to the Internet utilizing least extra equipment and programming assets. The examination of the three usages uncovered the way that all three technologies are suited for successful environmental monitoring applications. The prediction was done on the basis of data collected from the sensor the experiments were carried out at Viman Nagar area in Pune for various environmental conditions. The results displayed in mobile application were in the form of data value and prediction. With the promising results, this technology has proved to be efficient and would encourage the development of systems in future

ACKNOWLEDGMENTS

The authors would like to appreciate the efforts from the editors and reviewers. This research did not receive any other specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Luca Lombardo, Simone Corbellini Marco Parvis, Ahmed Elsayed, Emma Angelini, and Sabrina Grassini, “Wireless Sensor Network for Distributed Environmental Monitoring”, IEEE Transactions On Instrumentation And Measurement 1.
2. Dr.SeemaVerma, Prachi, “Wireless Sensor Network application for water quality monitoring in India”, 2012 National Conference on Computing and Communication Systems (NCCCS), 978-1-4673-1953-9/122012 IEEE.
3. Idakwo Monday A., Umoh I.J., Man-yahaya S, “Real Time Wireless Sensor Network for Environmental Data Prediction and Monitoring”, International Journal of Scientific & Engineering Research, (IJSER)Volume 8, Issue 1, January-2017.
4. G. Mois, T. Sanislav, and S. C. Folea, “A cyber-physical system for environmental monitoring,” IEEE Trans. Instrum. Meas., vol. 65, no. 6, pp. 1463–1471, Jun. 2016.
5. M. Hulea, G. Mois, S. Folea, L. Miclea, and V. Biscu, “Wi-sensors: A low power Wi-Fi solution for temperature and humidity measurement,” in *Proc.* 39th Annu. Conf. IEEE Ind. Electron. Soc. (IECON), Nov. 2013, pp. 4011–4015.
6. AppalarajuYarra, Siva Krishna Kotha, “Water Quality Monitoring system based on Wireless Sensor Network”, International Journal of Scientific Development and Research (IJSDR), 466 June 2017 Volume 2, Issue 6.
7. Kavi Priya1, G. Shenbagalakshmi, T. Revathi, “Design of smart sensors for real time drinking water quality monitoring and contamination detection in water distributed mains”, International Journal of Engineering & Technology, 7 (1.1) (2018), 47-51.
8. Ian F. Akyildiz, Weilian Su, Yogesh Sankarasubramaniam, and ErdalCayirci, “A Survey on Sensor Networks”, IEEE Communications Magazine August 2002 0163-6804/02/$17.00 © 2002 IEEE 102.
9. S. Mukhopadhyay, “Research activities on sensing, instrumentation, and measurement: New Zealand perspective,” IEEE Instrum. Meas. Mag., vol. 19, no. 2, pp. 32–38, Apr. 2016.
10. N. Harris, A. Cranny, M. Rivers, K. Smettem, and E. G Barrett-Lennard, “Application of distributed wireless chloride sensors to environmental monitoring: Initial results,” IEEE Trans. Instrum. Meas., vol. 65, no. 4, pp. 736–743, Apr. 2016.

AUTHORS PROFILE

Heeralal Kumar Sah has received his AMIE (Associate Member of the Institution of Engineers) degree from the Department of Electronics and Communication Engineering at the Institution of Engineers (India), headquartered at Kolkata West Bengal, India in 2014. He is perusing Master of Engineering (M.E) in VLSI and Embedded System at the Department of Electronics and Telecommunication Engineering at Dr. D. Y. Patil School of Engineering, Pune. His current research interests are mainly in the embedded system design, IoT and optimization of wireless sensor networks.

S. M. Koli has received his B.E. degree from the Department of Electronics Engineering at the Shivaji University, Kolhapur, Maharashtra, India in 1997, M. Tech. degree from the Department of Electronics and Telecommunication Engineering at Dr. Babasaheb Ambedkar Technological University, Lonere, Maharashtra, India in 2006 and Ph.D. degree in the Department of Engineering and Technology, at Sant Gadage Baba Amravati University, Amravati, Maharashtra, India in 2015. He is currently working as Professor in E&TC at the Department of Electronics and Telecommunication Engineering at Dr. D. Y. Patil School of Engineering, Pune. His research interests are mainly in the wireless domain, cross-layer design and optimization of wireless networks.