

PAPER • OPEN ACCESS

Design and Implementation WSN Based on Raspberry Pi for Medical Application

To cite this article: Bahaa Faiz Noory Mohsin Alabassby *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **518** 052022

View the [article online](#) for updates and enhancements.

Design and Implementation WSN Based on Raspberry Pi for Medical Application

Bahaa Faiz Noory Mohsin Alabassby¹, Jinan Fadhil Mahdi¹ and Mohammed Aboud Kadhim²

¹Electrical Engineering Technical College, Middle Technical University, Baghdad, Iraq.

²Institute of Technology, Middle Technical University, Baghdad, Iraq.

Email: bahaabja@gmail.com¹

Abstract. In the last decade the healthcare monitoring schemes have drawn significant considerations of the researchers. With over a decennary concerning muscular lookup or improvement, wireless sensor network science has been rising as much an achievable solution in imitation of numerous revolutionary applications. In that paper, we outline a Wi-Fi sensor network blueprint as we bear advanced the usage of open-source hardware platforms, Arduino yet Raspberry Pi. The scheme is affordable yet very scalable each of phrases of the kind over sensors or the range concerning sensor nodes, who makes it pleasant applicable because of a large choice about functions associated to environmental monitoring. Whole plan construction then the diagram concerning hardware or software elements are offered into specifics in this paper. Some sample outgiving or excuse results are also to show the usefulness over the dictation toughness Moreover working with the intelligent backend scheme construction this scheme can too offer instant physician information in situation if emergency situation occurs without doctors near the side. The outcome of the study offers a present medical care through whole hospital, and the recently invented tag may bring an important change to typical health care process chiefly in patient care.

Keywords: Agriculture, Environment monitoring, IoT, Raspberry Pi, WSN.

1. Introduction

Healthcare is affecting from sensitive replies to serious environments to a preemptive method described by initial detection, avoidance and long-term healthcare organization. In this structure, health situation monitoring and wellness management are appreciated as important suppliers to single healthcare and wellbeing [1]. This is chiefly significant in advanced countries with a important aging people, where information technology be able to be working to meaningfully advance the management of chronic situations and, so, total feature of life [2]. With above a consume regarding lesson yet improvement of wi-fi science yet sensor development, Wireless Sensor Network science has been flourishing as much proficient then economical answer because of a variety of software areas. Initial job of wi-fi community then sensor network have been submerged regarding the boom of allowing technologies through addressing severa exams equal as much routing, communication, OS because sensor networks, and middleware [3-5]. The appropriate use of WSNs be able to reduction defeat rate and growth proficiency



in any manufacturing. Environment monitoring scheme gets data from state and directed it to central scheme to produce signals, messages or any other output. The scheme is capable of monitoring or measuring parameters similar temperature, humidity, pressure and characteristic of gasses like oxygen, CO₂ etc. These parameters are significant in applications similar industry, Green house, weather forecasting and smart homes [6]. This action originates as much the result over instruction yet study actions into the tools for measurement area then its integration into mechatronic schemes. This resulted from the quintessential to have a limit plan to that amount allows the integration of diverse sensor kinds, both sensors with digital interfaces and basically analog sensors, yet up to expectation lie capable in imitation of lie in reality extended, integrating unique sensors then modern features. Academic rule solutions often include the uses over Arduino, Raspberry Pi yet ignoble development boards permanency [7, 8]. Though, the elect clarification is based concerning entrenched lifestyle electronics among directive in imitation of take advantage of its integration possible among manufactured worried along options including matter need goals, although permitting the simplicity concerning development now not determined within commercial solutions. The superior schedule stay able in conformity with stay certainly modified in accordance with integrate custom-built sensors for diverse resolutions, wight also a constructing board because of the increase regarding sordid far flung monitoring options [9]. These schemes may be back because of numerous advice actions of distinguishable areas, equal namely equipment because of measurement, control, mechatronics, civilian engineering and thermodynamics fields. The design would possibly even stand ancient namely a tool because of information mining, the interdisciplinary field concerning pc science. They enable the instruction over the versions as environmental parameters involvement dependent regarding outdoor environments, permitting, because of sample, the evaluation on buildings' environments, highlighting the influence concerning the constructing materials, layout strategies yet forecasting seasonal then topical disturbances. Environmental Monitoring Applications [10, 11]. The scheme designed through authors incorporates regarding open-source hardware platforms, Arduino, then Raspberry Pi. System development used to be low-priced yet extremely scalable between phrases about variety and sum about sensor nodes. They prepared schedule at the Department concerning Electrical Engineering office location about the UNT Discovery Park facility. The Temperature yet humidity rule blueprint geared up among it bill used to be designed along Arduino, Raspberry Pi, XBee, and a range regarding open-source software packages. The blueprint was designed after combine the gateway node on WSN, web server then database server between one individual compact, low-power, credit-card-sized computer Raspberry Pi. The XBee module summarizes the 802.15.4 radio transceiver and the ZigBee protocol stack. The complicated mesh network is mechanically made deprived on thrusting beyond person utility jogging over microcontroller board. into permanency [12] attainable an design construction in imitation of monitor and control situation parameters comparable temperature, humidity, then pressure. The scheme was then designed after offer capabilities comparable monitor state of affairs parameters then bust partial rule job comparable switch gadgets ON/OFF from internet. The sensing nodes between blueprint are old feel statistics and rule nodes bear been designed after provoke rule action. The brain rule was based totally concerning ARM11 Raspberry Pi board. Embedded C intention used to be back in imitation of compile Software about government node. in [13] sliced regarding a intention layout because Hazardous Environment rule using Wireless communication. The plan was once designed to gain records fulfillment because parameters kind of temperature, current, voltage, fire, lotos level, and poisonous gas leakage. Scheme structure utilizes Raspberry Pi, RS232, microcontroller, shifter, encoder, decoder, android edge and Linux terminal, breath sensor, Temperature Sensor, Opt coupler because of lotus degree sensor, potentiometer. This paper defines the layout or implementation of as much WSN within enterprise rule the usage of Raspberry Pi. Scheme avoids humans beyond dangerous gases, high voltage yet high present day. in [14] did study over an prandial state of affairs power server blueprint with the aid of Wireless Sensor Networks. The blueprint used to be recommended because prandial state of affairs rule server scheme. The plan was old in conformity with screen outside prandial manufacturing state of affairs the use of WSN technology. The statistics drawn up

is every respecting state of affairs then land information. Scheme collects picture statistics finished CCTVs or collects place facts made GPS modules. It was once predictable in imitation of upward thrust albumen yields yet boost quality among prandial discipline via supportive the selection regarding producers[15-17].

2. Models System Design

The construction of the suggested scheme is a multi-tiers scheme; the first tier is the WBAN, as clarified in Figure. 1 [18]. The WBAN really is signified by body sensors and controller device. Temperature and heart rate sensors are used for patient's health monitoring in this work, though Arduino Uno is used as a microcontroller device. The number and the kind of the sensor nodes that are used to monitor the patient depend on his/her state.

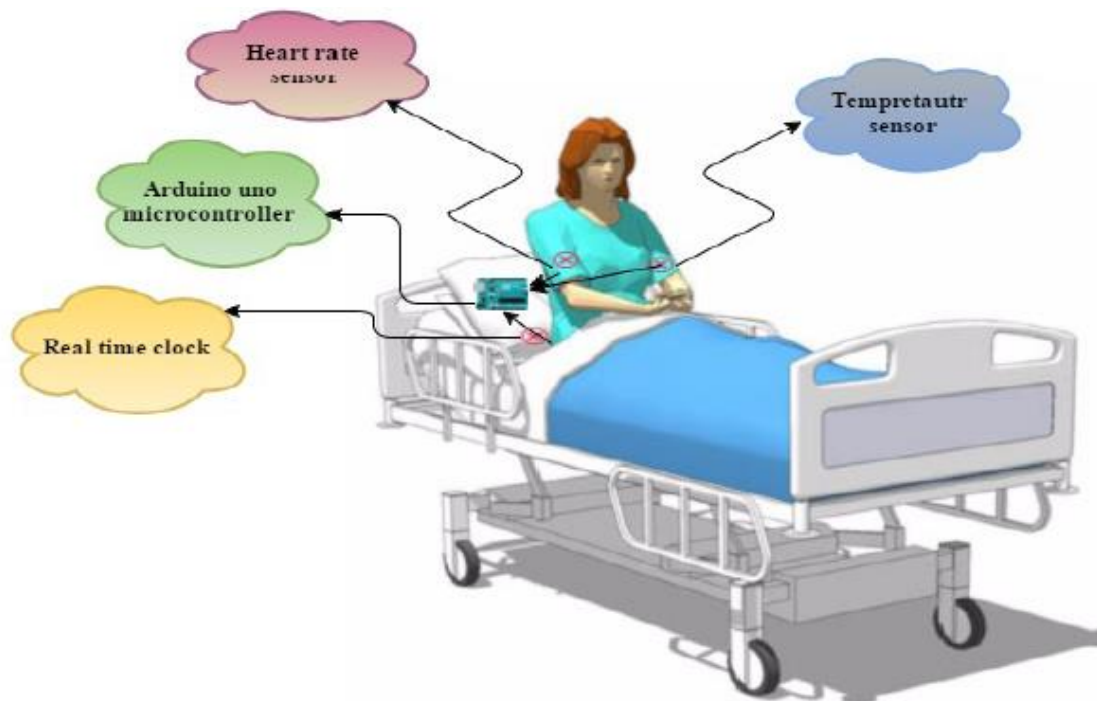


Figure 1. Wireless Body Area Network [19]

In this work collect the real time signals from the human body display data for heart rate. The system mainly consists of Raspberry pi, Arduino, pulse hart rate ,ECG Sensor and Temperature sensor (LM35), Initially the L, R, F of ECG sensor connected to body on the chest then the sensor will collect the ECG signal of a body and send to Arduino then transmit to Raspberry pi by use Xbee low power (2mw). Raspberry pi resave data, save and send ti to the doctor in any place on world by web and teemveiw program. Figure 1 show Architecture diagram.

Raspberry Pi : The Raspberry panel is an integrated computer and is made of one electronic chip contains traditional computer components it is processor CPU single core with speed 700 MHz and processor CPU dual core with speed 250 MHz enable to play HD movies And 3D games with random memory up to 512 Mb, by adding to the digital control outputs that can control electronic and electrical parts , such as microcontroller, all these components on a chip small what is known as the System on

Chip and is running this computer Linux System open source. The raspberry plate is characterized by 6.8cm x 5.4cm and a 45 gram and Power consumption less than 3 watts making it one of the lightest computer panels on the planet [20]. Arduino: Arduino Based Zigbee Development Platform is an 8 bit improvement stage and gives intends to the code advancement. It depends on ATmega328P AVR microcontroller and gives comprehension of the considerable number of essentials of 8 bit microcontrollers. The Arduino is planned for remote applications [21]. The client can transfer outlines (program) with a USB link, or by utilizing an altered USB-to-Xbee connector, for example, Arduino Transmitter (Base); the client can transfer the program through remote utilizing Xbee S2c. Utilizing the stage a scope of undertakings in different areas like remote interchanges, mechanical technology, shopper hardware and so on can be structured. Zigbee : The XBEE 2mW Wire Antenna S2C, the latest of its sort in Series 2, offers point to multipoint contraption arrange easily, giving fiscally keen remote responses for electronic gadgets. They are interoperable with other ZigBee feature set gadgets, including gadgets from various venders [22]. ECG Sensor (AD8232): It is complete integrated ECG single front together with a lower control usage upto 3.5V, a hundred and seventy micro Amperes. It is an built-in sign conditioning obstruction for ECG and sordid bio potent metering applications. It is created after detect, filter, or make bigger small guts signals within the occurrence over noisy conditions, Such as those as happen by using putting the staff remotely then because of rate [23]. Pulse Sensor: is a cork then lead mettle dimension sensor because of Arduino. It may stay old via students, athletes, makers, then recreation & cell developers whoever want according to easily incorporate live heart-rate data within their projects. Pulse Sensor provides blooming and maze cast circuitry in accordance with the hardware. It's incredibly faster yet simpler in conformity with find reliable pea readings. Pulse Sensor manufactory with a 3V Arduino stability [24]. Temperature sensor (LM35): It is a sensor aged to survey temperature. The LM35 arrangement are rigor integrated anus fire sensors, whose spawn voltage is blankly like in accordance with the Celsius (Centigrade) temperature. It gauges temperature extra precisely than thermistors. It is constant then does no longer experience oxidation. It does not require spawn voltage to keep superior [25].

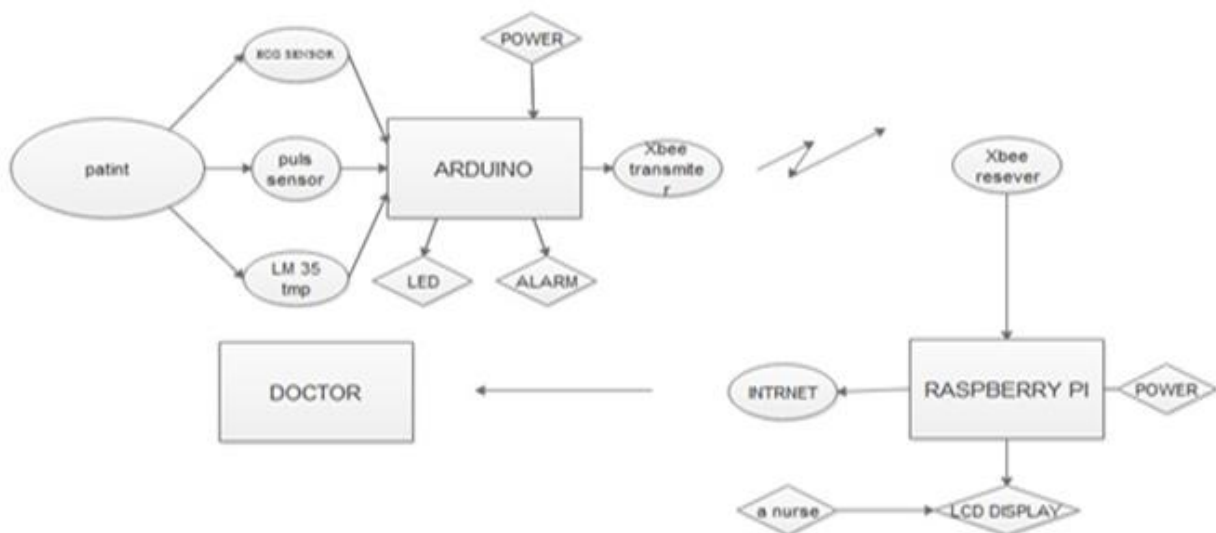


Figure 2. Architecture diagram for models system design

3. System Implementation and Results Analysis

The scheme components are connected together; see Figure 3. Biomedical sensors measured the body vital sing. The Sensory data are processed by the microcontroller, then the date and time are added to the sensory data to produce the message. The message is transmitted continuously in real time via Bluetooth module to the Raspberry Pi. Raspberry Pi represents the system base station; it's containing the database where the data are stored.

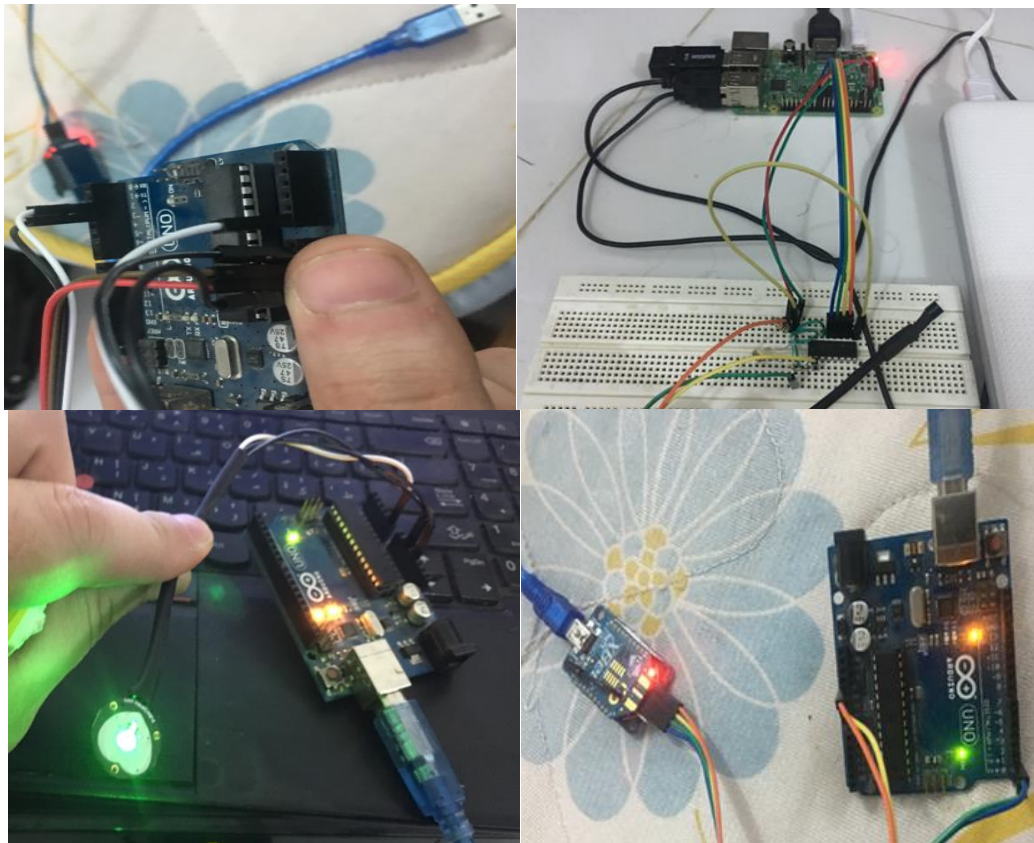


Figure 3. Implantation hardware systems



Figure 4. Experimentally checking heart rate

The results after implementation to the system show that the sensory data are transmitted in real time, with high accuracy. The previous stored data are also displayed when the doctor selects the patient, so this helps the doctor to follow patient's state, see Figures. 5, 6 and 7 which shows the analysis of temperature and pulse rate data, respectively. The normal outcome is Raspberry Pi and Arduino gathers and stores the restorative information through the sensors appended. The gathered information is exchanged to the specialist's side through IoT that helps in enhancing the strength of patients. Figure.5 shows the rate of the human heart beats, Temperature body, and displays it on the monitor screen. The signal from pulse rate sensor and Im35 sensor is Read every 6 seconds and the values updated automatically.

```

pi@raspberrypi: ~
python: can't open file 'example.py': [Errno 2] No such file or directory
pi@raspberrypi:~$ sudo python mcp3008_tmp36.py
-----
Light : 727 (2.35V)
Temp  : 68 (0.22V) 16.47 deg C
-----
Light : 726 (2.34V)
Temp  : 67 (0.22V) 15.49 deg C
-----
Light : 726 (2.34V)
Temp  : 67 (0.22V) 15.49 deg C
-----
Light : 743 (2.4V)
Temp  : 69 (0.22V) 17.45 deg C
-----
Light : 744 (2.4V)
Temp  : 73 (0.24V) 21.36 deg C
-----
Light : 744 (2.4V)
Temp  : 73 (0.24V) 21.36 deg C
-----
Light : 751 (2.42V)
Temp  : 73 (0.24V) 21.36 deg C

```

Figure 5. shows the rate of the human heart beats, Temperature body, and displays it on the monitor screen

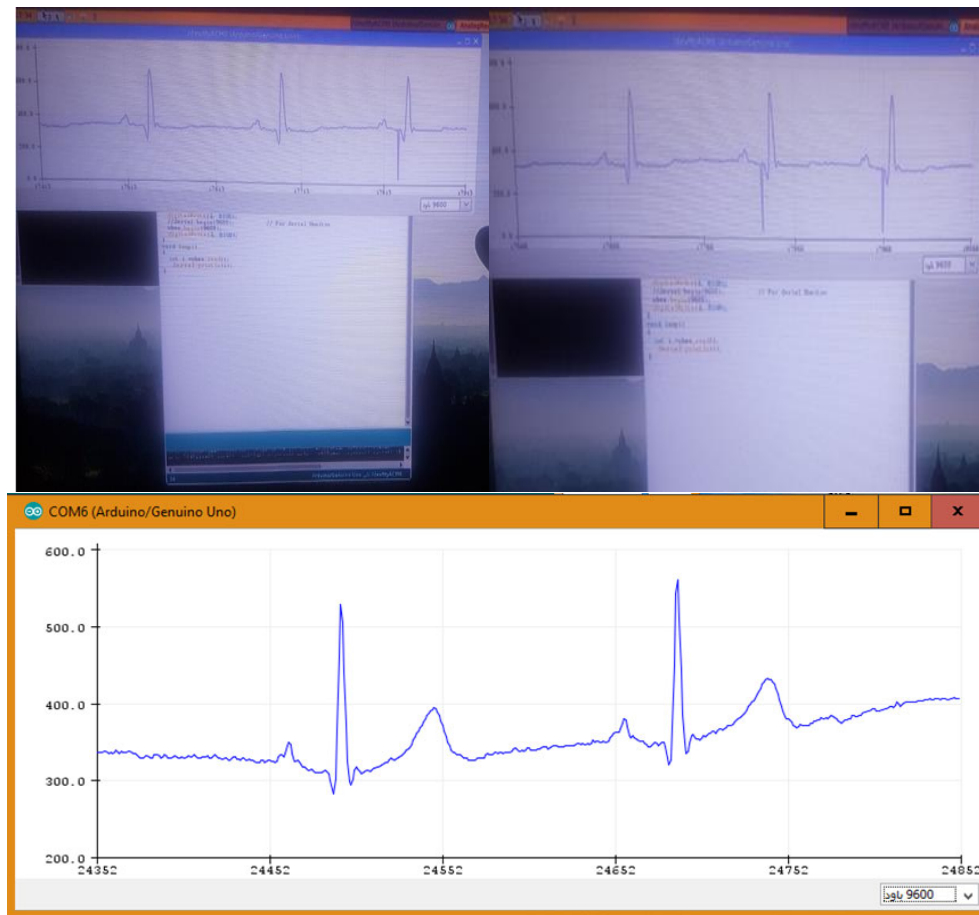


Figure 6. shows the output of the electrocardiogram (AD8232) a degree with time on the screen.

4. Conclusion

This scheme ideas the doctors and the rest medical staff the opportunity to access any patient at any time and at any place. The medical staff might understand the last updating of the patient state, consequently they monitor the patients continuously without the essential to be signified physically beside them. A remote human services checking framework by methods for utilizing cell phones and sensors can be actualized in a worldwide system with the assistance of Arduino and Raspberry Pi. The gadgets and IoT assembles and share data with one another, making it conceivable to gather, investigate and screen information all the more precisely. Along these lines IoT can be utilized for observing the patient and giving administrations in a convenient way. The suggested system be able to be developed and got out by using other intrusive and in adding non-obtrusive sensors for grabbing important medicinal potentials of a patient. This be able to be furthermore divided, put away and exchanged on a worldwide stage. Mega Arduino can likewise be used that is fit for interfacing numerous sensors in the meantime. This will help representative outcomes parallel with the aim that ease of suggestion and effective be able to be fortified.

References

- [1] N. K. H. Hassan J. Hassan, 2017 "Implementation of Wireless Area Network for Patient Monitoring System," *Iraqi Journal of Computers, Communication and Control & System Engineering (IJCCCE)*, Vol. **17**, No. 1.
- [2] P. A. S. S. Chetan T. Kasundra, 2015 "Raspberry-Pi Based Health Monitoring System," *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, Vol. **4**, Issue 8.
- [3] D. S. S. K. Rameshwari B Yadav, Ms. Supriya C Padwal, 2017 Environment Monitoring using Wireless Sensor Network for Agricultural Application, *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Vol. **5**, Issue V.
- [4] Mihai T. Lazarescu, 2013 Design of a WSN Platform for Long-Term Environment monitoring for IoT Applications, *IEEE Journal on Circuits and Systems*, Vol. **3**, NO. 1.
- [5] U. S. Akshay Deshmukh, A low cost environment monitoring system using raspberry Pi and arduino with Zigbee, *International Conference on Inventive Computation Technologies (ICICT)*, 2016.
- [6] I. a. A.-D. Al-Adwan, Munaf, S. N, 2012The Use of Zigbee Wireless Network for Monitoring and Controlling Greenhouse Climate, *International Journal of Engineering and Advanced Technology (IJEAT)*, Vol. **2**(1),pp. 35-39.
- [7] R. T. P. J. Sousa , P. Abreu and M. T. Restivo, 2017 "N Sensor – Wireless Sensor Network for Environmental Monitoring," *Wireless Sensor Network for Environmental Monitoring*, vol. Vol. **11**, No. 5.
- [8] M. V. P. P. Dr.M.S.Chavan, Sayali Chavan,Sharikmasalat Sana,Chailatli Shinde., 2018 "Design and Implementation of IOT Based Real Time Monitoring System for Aquaculture using Raspberry Pi," *International Journal on Recent and Innovation Trends in Computing and Communication*, Vol. **6** (3), 159 - 161.
- [9] D. M. K. Priyanka S Lonare, 2016 A Raspberry Pi Based Global Industrial Process Monitoring through Wireless Communication, *International Journal of Advanced Research in Computer and Communication Engineering* Vol. **5**(9).
- [10] L. M. K. E. Kanagaraj, A. Zakaria, R. Gunasagaran, and A. Y. M. Shakaff, 2015 Cloud-based remote environmental monitoring system with distributed WSN weather stations, in *SENSORS, IEEE*, 2015, pp. 1-4.
- [11] L.-w. Chen, 2016 Network Service Method under Cloud Environment of Wireless Sensor Networks in Disaster Situation, *Int. Journal of Online Engineering (iJOE)*, Vol. **12**, No.11, pp. 16-21.
- [12] D. R. S. Er.Satvir Singh, 2015 Design of Environment Monitoring and Control System, *International Journal Of Engineering and Computer Science*, Vol. **4** (5), 11980-11984.
- [13] S. P. Nivedha.S, Abhirami.N, Jyothi.A.P, Darwin Britto.R, 2016 Raspberry Pi Based Hazardous Environment Monitoring Using Wireless Communication, *ITSI Transactions on Electrical and Electronics Engineering (ITSI-TEEE)*, Vol. **4**, No. 3.
- [14] S. C. Hwang J, Yoe H, 2010 study on an agricultural environment monitoring server system using Wireless Sensor Networks, *Sensors (Basel)*; **10**(12): 11189–11211.
- [15] "Lancet Global regional and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study. 2015;388(10053):1459–1544. doi:10.1016/S0140-6736(16)31012-1.."
- [16] "Global Atlas on Cardiovascular Disease Prevention and Control. *World Health Organization in collaboration with the World Heart Federation and the World Stroke Organization*. 3–18.
- [17] "Lancet Global regional and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study. 2013;385(9963):117–71. doi:10.1016/S0140-6736(14)61682-2.

- [18] N. A. A. Abidoye, A. Adesina, K. Agbele and H. Nyongesa, 2011 Using Wearable Sensors for Remote Healthcare Monitoring System, *Journal of Sensor Technology*, Vol. **1**, pp.22-28,,".
- [19] N. K. H. Hassan J. Hassan1, 2017 Implementation of Wireless Area Network for Patient Monitoring System, *Iraqi Journal of Computers, Communication and Control & System Engineering (IJCCCE)*, Vol. **17**, No. 1.
- [20] E. U. Gareth Halfacree, Raspberry Pi User Guide, *SBN: 978-1-118-46449-6 August 2012 264 Pages Book*, 2012.
- [21] V. a. S. A. Vippalapalli, Internet of things (IoT) based smart health care system. *Signal Processing, Communication, Power and Embedded System (SCOPES), 2016 International Conference on, IEEE.*, 2016.
- [22] D. International, *XBee®/XBee-PRO S2C Zigbee® RF Module Getting Started Guide* May 2018.
- [23] sparkfun, "*AD8232 Heart Rate Monitor Hookup Guide*" 2018.
- [24] m. i. Technology, "*Pulse Sensor With Arduino Tutorial*" 2018.
- [25] P. Navdeti, et al., 2016 "Patient parameter monitoring system using Raspberry Pi." 5(3).