International Journal of Multidisciplinary Engineering in Current Research - IJMEC
Volume 9, Issue 9, September-2024, http://ijmec.com/, ISSN: 2456-4265

# IOT-ENHANCED HEALTHCARE: SMART MONITORING FOR IMPROVED PATIENT OUTCOMES

**Ms. Nazima Begum [*1], Dr. G. Ravi Kumar [*2], Dr. Shaik Saidulu [*3]**

[*1] PG Scholar (Embedded Systems), Dept. of ECE, Shadan College of Engineering and Technology
nazimabegum86@gmail.com

[*2] Professor, Dept. of ECE, Shadan College of Engineering and Technology
ravikumar.g034@gmail.com

[*3] Professor, Dept. of ECE, Shadan College of Engineering and Technology
sk.saidulu@gmail.com

***Abstract:*** *Biomedicine is not lagging behind, but is really benefiting from the rapid advancements in engineering, even if our world is being more mechanized. The fast growth of technology like the Internet and the Internet of Things (IoT) has made significant improvements in healthcare and led to innovations in the field. Health monitoring systems that rely on the Internet of Things (IoT) have lately been the center of a lot of research and development. People coping with chronic illnesses or residing in remote areas may find that these systems make healthcare more accessible and of higher quality. In terms of functionality, performance metrics, and hardware and software components, existing health monitoring systems based on the Internet of Things (IoT) have certain commonalities and have some variances. All of these systems rely on sensors to measure patients' vital signs, but the sensors employed in them are various models and types with varied specs and levels of accuracy. Here for review is an article that offers a new approach to the current situation with the goal of making it better. By allowing for constant and remote monitoring of patients' vitals, our technology facilitates the early detection and treatment of potential health issues. Several sensors affixed to the patient's body may be used to gather data using this system, which makes use of two widely used microcontrollers, the Arduino Nano and the Wemos D1 Mini. The data is then wirelessly sent to a central monitoring station for further processing. On top of that, our technology offers a substantial decrease in the necessary funds as compared to previous versions. Numerous healthcare monitoring systems have been set up at various healthcare facilities, including hospitals. The importance of portable healthcare monitoring devices equipped with state-of-the-art technology has grown in several places throughout the globe. Within the framework of the Internet of Things (IoT), our concept introduces an automated healthcare system capable of real-time monitoring of a patient's vital signs and the room's environmental parameters. This system gathers information about the hospital's environment through the use of sensors. Some examples of these sensors include those that monitor the heart rate and body temperature. In the traditional model, doctors and other medical professionals play an important role; they must be physically present with patients to make diagnoses and provide treatment recommendations. But there are two major challenges that this approach brings that need fixing. First things first: the patient must have a doctor or other medical professional physically present with them at all times. Furthermore, patients undergoing treatment with biomedical equipment are obligated to stay in their hospital beds for extended durations. To tackle these*



**DOI: https://doi-ds.org/doilink/09.2024-48949385**

*issues, we aim to provide patients with the knowledge they need to identify illnesses and take preventative measures. We also offer an accessible and reliable patient monitoring system (PMS). Sending the patient's vitals data via a wireless link is one of our system's primary aims. To do this, our project employs an Arduino Board, which functions as an IoT device. Thus, we are able to link up with a pair of sensors and collect vital signs from patients. Medical providers and caregivers have access to these transmitted features after they are uploaded to the cloud. Our initiative aims to provide patients with prompt and effective medical treatments by connecting, collecting, recording, evaluating, and exchanging data related to their health status. Vital indicators include the patient's pulse, blood pressure, temperature (both internal and external), and breathing rate. Furthermore, this encompasses the surrounding temperature. In the case of a patient emergency, our system can notify the doctor and provide detailed information about the patient's current state.*

***Keywords.*** *Arduino UNO, ESP8266, Lm35, Heartbeat Sensor.*

## 1. INTRODUCTION

The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings. Likewise, countless ordinary users are being served from the advantages of the M-Health (Mobile Health) applications and E-Health (health care supported by ICT) to improve, help and assist their health.

In this proposed work the vital parameters such as temperature, EEG and heart beat readings which are monitored using Arduino Uno. These sensors signals are sent to Arduino Uno via amplifier circuit and signal conditioning unit (SCU), because the signals level is low (gain), so amplifier circuit is used to gain up the signals and transmit the signals to the Arduino Uno. Here patients body temperature, EEG and heart rate are measured using respective sensors and it can be monitored in the screen of computer using Arduino Uno connected to a cloud database system as well as monitored anywhere in the world using internet source.

The proposed method of patient monitoring system monitors patient's health parameters using Arduino Uno. After connecting internet to the Arduino uno, it is connected to cloud database system which acts as a server. Then the server automatically sends data to the receiver system. Hence, it enables continuous monitoring of the patient's health parameters by the doctor. Any abrupt increase or decrease in these parameter values can be detected at the earliest and hence necessary medications can be implemented by the doctor immediately.

## 2. EXISTING METHOD:

The health care represents one of the top challenges that every country is facing today. Although health care industry invest heavily in IT, yet the promised improvement in patient safety and productivity has not been realized up to the standards even today organizations still rely on paper medical records & hand return notes to inform hand make decisions. Digital information is siloed between departments and applications.

Sharing of patient data among clinicians, departments & even patients is rare and complex. Embracing IoT tech. in health care may be an answer to enabling healthcare organization to focus their efforts on clinical relevant services and patient outcomes which will make health monitoring diagnostics treatment in more timely & convenient manner with the reduced cost

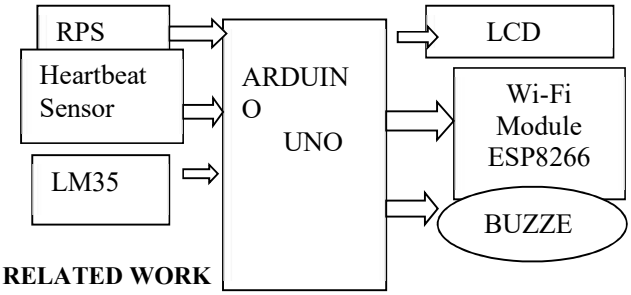


**DOI: https://doi-ds.org/doilink/09.2024-48949385**

## 3. PROPOSED METHOD:

The IOT can bring multiple benefits to healthcare through the use of sensors, intelligent equipments, etc. The Internet of Things (IoT) is a new concept that allows users to connect various sensors and smart devices to collect real-time data from the environment. However, it has been observed that a comprehensive platform is still missing in the e-Health and m-Health architectures to use smartphone sensors to sense and transmit important data related to a patient's health. In this project our contribution is twofold. Firstly, we critically evaluate the existing literature, which discusses the effective ways to deploy IoT in the field of medical and smart health care. Secondly, we propose a new semantic model for patients' e-Health. The proposed model named as 'IOT-Healthcare' makes use of the sensor layer, the network layer, the Internet layer and the services layer. All layers cooperate with each other effectively and efficiently to provide a platform for accessing patients' health data using smart phones.

**Block diagram**




## 4. RELATED WORK

A wireless smart sensor platform targeted for instrumentation and predictive maintenance systems is presented. The generic smart sensor platform with „plug-and-play" capability supports hardware interface, payload and communications needs of multiple inertial and position sensors, and actuators, using a RF link for communications, in a point-to-point topology. The design also provides means to update operating and monitoring parameters as well as sensor/RF link specific firmware modules „over-the-air". Sample implementations for industrial applications and system performance are discussed. In this project has used on Zigbee. This cost is too high and the WSN are controlled by remote access. Radio Frequency Identification and Wireless Sensor Network are two important wireless technologies that have wide variety of applications and provide limitless future potentials. However, RFID and sensor networks almost are under development in parallel way. Integration of RFID and wireless sensor networks attracts little attention from research community. This paper first presents a brief introduction on RFID, and then investigates recent research works, new products/patents and applications that integrate RFID with sensor networks. Four types of integration are discussed. They are integrating tags with sensors, integrating tags with wireless sensor nodes, integrating readers with wireless sensor nodes and wireless devices, and mix of RFID and sensors. New challenges and future works are discussed in the end. RFID readers have relatively low range and are quite expensive, we envision that the first applications will not have RFID readers deployed ubiquitously. The applications which allow mobile readers to be attached to person"s hands, cars or robots will be good candidates.

## 4. ARDUINO


Overview:



DOI: https://doi-ds.org/doilink/09.2024-48949385

Arduino Uno is a microcontroller board subject to the ATmega328P (datasheet). It has 14 pushed information/yield pins (of which 6 can be utilized as PWM yields), 6 essential information sources, a 16 MHz completed resonator (CSTCE16M0V53-R0), a USB alliance, a force jack, an ICSP header, and a reset button. It contains all that ordinary to help the microcontroller; on a crucial level interface it to a PC with a USB association or force it with an AC-to-DC connector or battery to begin. You can intrude with your Uno without anguishing essentially overachieving something mistakenly, most central outcome possible you can trade the chip for two or three dollars and start once more. "Uno" suggests one in Italian and was picked to stamp the presence of Arduino Software (IDE) 1.0. The Uno board and structure 1.0 of Arduino Software (IDE) were the reference sorts of Arduino, direct made to unendingly current deliveries. The Uno board is the first in the headway of USB Arduino sheets and the reference model for the Arduino stage; for a sweeping once-over of current, past, or old sheets see the Arduino report of sheets. • Physical contraptions and sensors Physical contraptions and sensors can amass and see sagacious and multidimensional data, and check of the target state of a function uninhibitedly without human mediation. Besides, when contraptions capacity to get data with presented understanding, gadgets can act and respond. Condition setting will at that point be changed and the contraptions will reach out of the blue. In that limit, this assortment structure will be rehashed perseveringly. • Connection and foundation Association and foundation, for example, cloud, security, covering ceaselessly, security, insistence, and controlling, pull in interminable, solid information and data stream and assessment circles.

5. **NODEMCU**

The WI-FI module used in this project is ESP8266. It follows TCP/IP stack and is a microchip which is less in cost. This microchip allows microcontroller to connect to a WI-FI network, by using Hayes style command connections are done or made through TCP/IP connection. ESP8266 has 1MB of built in flash, single chip devices able to connect WI-FI. Espressif systems are the manufacturers of this module, it is a 32 bit microcontroller. There are 16 GPIO pins in this module. This module follows RISC processor. It has 10 bit DAC. Later Espressif systems released a software development kit(SDK) which is used to programme on the chip, so that another microcontroller is not used. Some of the SDK's are Node MCU, Arduino, Micro Python, Zerynth and Mongoose OS. SPI, I2C, I2S, UART are used for communicating between two sensors or modules.

**Figure 4 :** Wi-Fi module

6. **LCD**

LCD (Liquid Crystal Display) is such a level board show which utilizes fluid noteworthy stones in its major sort of development. LEDs have a gigantic and moving methodology of usage cases for clients and connections, as they can be customarily found in telephones, TVs, PC screens, and instrument sheets.

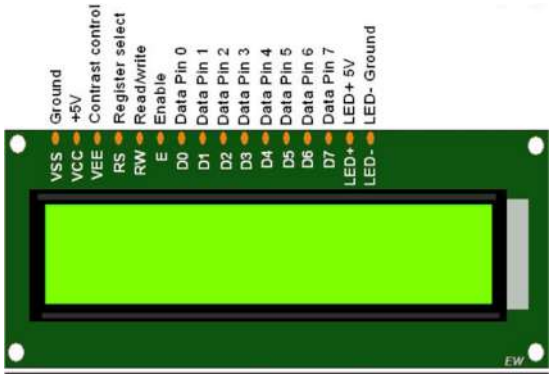
LCDs were a basic ricochet the degree that the development they eliminated, which breaker light-passing on the diode (LED) and gas-plasma shows. LCDs permitted partners to be all-around more meager than the cathode bar tube (CRT)



DOI: https://doi-ds.org/doilink/09.2024-48949385

development. LCDs eat up liberally less force than LED and gas-show shows since they search after the standard of deterring light instead of delivering it. Where a LED emanates light, the fluid tremendous stones in an LCD pass on a picture utilizing foundation edification.

As LCDs have supplanted dynamically sorted out superstar drives, LCDs have started being eliminated by new presentation improvements, for example, OLEDs.




**7. IoT Technology and Applications**

IoT development speedily assist the IoT application that focused on the heap industry and specific users, while networks and devices allow connectivity of physical things. IoT application gives reliable vital device-to-human and device-to-device communication. IoT device applications need to ensure that information is received and properly acted according to a suitable specific way, a simple example is that of logistic application monitoring that has the transported status of goods such as organic products, fresh products, meat and dairy terms. Furthermore, during logistics, quality control of climate change, shock and humidity is regularly monitored and suitable movements are strategically and naturally made to preserve goods spoilage from a long distance when connection is out of courage. To claimed that "some examples of IoT applications in existence can be found in Smart Environment, Smart Greenhouse, Smart Cities, Smart Water, Smart Metering, Security and Emergency, Industrial Control, Home Automation and Electronic Health". 'IoT' is therefore stationed on devices that can examine sensed data and then transmit it to the user. K. IoT Challenges As stated in a previous study, there are some challenges that IoT design would face in the coming future generation. All the devices, nodes connected in associate in nursing IoT design needs to have terribly low latency over reliable links. Because of the vast variety of IoT devices and the use of various frequency bands, there would be a crisis in spectrum house. Although IoT devices are expanding on a daily basis that consumes terribly lesser power, still there'll be a big quantity of greenhouse gas emission because of all of these devices. Finally, IoT architecture not solely must be price effective however additionally they have to be capable of supporting heterogeneous applications and devices. As stated above on IoT challenges, IoT applications will have some more basic needs to tackle, for example, Device addressing, Security, Scalability, Mobility, Anchor-less sending and so on. As mentioned, IoT applications contains numerous heterogeneous devices, and however, content security is a key concern that plays a great roles. A previous study has indicated the challenges of both IoT and ICN in their past study, this past study endeavours to combine them where IoT illustrate the different challenges and on the other hand, ICN illustrates the positive solutions. Nonetheless, their study explained initially how different ICN features can address IoT issues and after that, some use cases and contextual investigations are examined

**HEARTBEAT SENSOR**

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy.In order to measure the body temperature, we use thermometers and a


DOI: https://doi-ds.org/doilink/09.2024-48949385

sphygmomanometer to monitor the Arterial Pressure or Blood Pressure.

Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor. Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography, But the easier way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat.

In this project, we have designed a Heart Rate Monitor System using Arduino and Heartbeat Sensor. You can find the Principle of Heartbeat Sensor, working of the Heartbeat Sensor and Arduino based Heart Rate Monitoring System using a practical heartbeat Sensor. Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute.

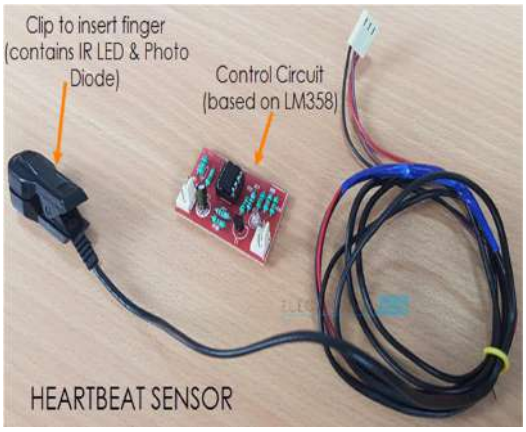



Fig Heart beat sensor

**TEMPERATURE SENSOR**

LM35 is a precision IC temperature sensor with its output proportional to the temperature (in $C^{o}$). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor. It also possesses low self-heating and does not cause more than 0.1 $C^{o}$ temperature rise in still air.

The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every $C^{o}$ rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ $C^{o}$.

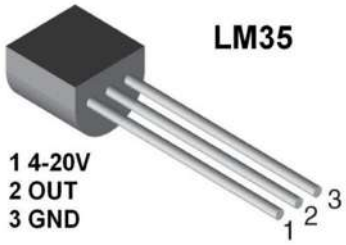



Fig LM35 sensor

Main advantage of LM35 is that it is linear i.e. 10mv/°C which means for every degree rise in temperature the output of LM35 will rise by 10mv. So if the output of LM35 is 220mv/0.22V the temperature will be 22°C. So if room temperature is 32°C then the output of LM35 will be 320mv i.e. 0.32V.

**8.LIMITATIONS**

The system has following limitations:

1. **Compatibility**: As of now, there is no standard for tagging and monitoring with sensors. A uniform concept like the USB or Bluetooth is required which should not be that difficult to do.

2. **Complexity**: There are several opportunities for failure with complex systems. For example, both you and your spouse may receive messages that the milk is over and both of you may end up buying the same. That leaves you with double the quantity required. Or there is a software bug causing the printer to order ink multiple times when it requires a single cartridge.


DOI: https://doi-ds.org/doilink/09.2024-48949385

3. **Privacy/Security**: Privacy is a big issue with IoT. All the data must be encrypted so that data about your financial status or how much milk you consume isn't common knowledge at the work place or with your friends.
4. **Safety**: There is a chance that the software can be hacked and your personal information misused. The possibilities are endless. Your prescription being changed or your account details being hacked could put you at risk. Hence, all the safety risks become the consumer's responsibility.

## 9. SOFTWARE TOOLS

**Arduino IDE (Integrated Development Environment)**

The Arduino progress condition contains a word processor for including code, a message zone, a book maintains, a toolbar with gets for crucial cutoff regular environmental factors, and an improvement of menus. It interfaces with the Arduino contraption to move activities and talk with them.

**Making Sketches**

Programming made using Arduino is called follows. These depictions are written in the substance boss. Depictions are saved with the record progress .ino. It has featured for cutting/staying and for looking/dislodging content. The message a region gives input while saving and passing on what's more shows abuses. NB: Versions of the IDE before 1.0 saved draws with the expansion pde It is possible to open these records with understanding 1.0, you will be begun to save the sketch with the .ino progression on save.

The Arduino condition uses the opportunity of a sketchbook: a standard spot to store your undertakings (or depicts). The depictions in your sketchbook can be opened from the File Sketchbook menu or the Open catch on the toolbar.

Tabs, Multiple Files, and Compilation

Connects with you to figure out draws with more than one record (all of which appear in its own astounding tab). These can be typical Arduino code records (no new unexpected new development), C reports (.c speeding up), C++ records (.cpp), or header records (.h).

## 10. FUTURE WORKS

1. The device can be connected to PC by using serial output so that measured heartbeat and temperature can be sent to PC for further online or offline analysis.
2. Sound can be added to the device so that the device makes a sound each time when the parameters changes to harmful level.
3. The output can be sent to mobile phones by using GSM module or Bluetooth module for further analysis.
4. More parameters (like GAS, Pressure) can be added to the device.

## 11. CONCLUSION

In this project, we showcased our health monitoring system that utilizes the Internet of Things (IoT) and the Wemos D1 tiny and Arduino Uno. Our system's primary function is to track and transmit various vital signs, such as temperature, heart rate, and SpO2, to a cloud-based system for analysis and the generation of alarms. By using our system, medical professionals may keep tabs on their patients' critical health metrics from a distance using an efficient and scalable approach. Improved patient care, the ability to take preventive actions, and reduced healthcare costs are all outcomes of our system, which employs Internet of Things (IoT) technology, real-time data transfer, and cloud-based analysis. By incorporating other healthcare technologies and constantly improving our system, we can revolutionize remote patient


DOI: https://doi-ds.org/doilink/09.2024-48949385

monitoring and significantly improve healthcare outcomes.

Our detailed overview laid out all of the software and hardware parts that made up our project. The parts that made up this system comprised microcontrollers, communication modules, cloud computing, web apps, and sensitive gadgets. On top of that, we evaluated the project's accuracy, reliability, efficiency, and practicality before presenting and discussing the outcomes. Better functionality, scalability, interoperability, and security were some of the topics we focused on when researching the project's limitations, challenges, and potential future updates.

Our research has yielded several important findings and contributions, one of which is an efficient, cost-effective, and user-friendly health monitoring system built on the Internet of Things. Patients dealing with chronic conditions or residing in geographically inaccessible areas may find enhanced accessibility and quality of healthcare services as a result of this system's deployment. On top of that, we demonstrated the possibilities and advantages of using IoT technology in healthcare settings. Our project's scalability allows it to grow and connect with other state-of-the-art healthcare technologies, making it a valuable asset in today's healthcare systems.

**REFERENCES**

[1] Qingping chi, Hairongyan, chungzhang, zhibo pang, Li Da Xu Senior member,(2014) , "A reconfigurable smart sensor interface for industrial WSN in IOT environment", IEEE transactions on industrial informatics, vol. 10, no. 2, 2014.

[2] MihaiT.Lazerescu,, "A design of WSN for long term environmental monitoring", "IEEE J.Emerg.Sel. Topics Circuits Syst., vol. 3, no. 1, pp. 45– 54, Mar. 2013.

[3] CharalamposDoukas and IliasMaglogiannis , "Bringing IoT and Cloud Computing towards Pervasive Healthcare", Sixth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, 2012.

[4] Lihong Jiang, Li Da Xu, HongmingCai, Zuhai Jiang, Fenglin Bu , An IoT-Oriented Data Storage Framework in Cloud Computing Platform, IEEE Transactions On Industrial Informatics, vol. 10, no. 2, 2014.

[5] George Suciu, SimonaHalunga, AlexandruVulpe, Victor Suciu , "Generic Platform for IoT and Cloud Computing Interoperability Study", IEEE Transactions On Industrial Informatics vol. 10, no. 1, 2013.

[6] Yuan Jie Fan, Yue Hong Yin , IEEE, Li Da Xu, Senior Member, IEEE, Yan Zeng, and Fan Wu "IoT-Based Smart Rehabilitation System", IEEE Transactions

[7] YingLeng and LingshuZhao, "Novel design of intelligent internet-ofvehicles management systems based on cloud- computing and internet-ofthings", International Conference on Electronic & Mechanical Engineering and Information Technology, 2011.

[8] Mohd Zeeshan, Mohd Yousuf Ali , Md. Raheem Sohail , Dr. Abdul Bari," *Semi-supervised Machine Learning Approach For DDoS Detection*",IJMTARC,Vol –VIII-Issue 29,March 2020 (ISSN :2320-1363) .**(UGC APPROVED JOURNAL) : Impact Factor :5.278**

[9] Mohammed Taha, Syed Munawwar Shareef Ahmed Sabera Aziz **Dr. Mohd Abdul Bari** *," Smart Hud Helmet", Journal of Emerging Technologies and Innovative Research* ,JETIR, ISSN: 2349-5162, Vol.8, Issue 6, page no.a947-a953, June-2021 ; **Impact Factor :7.95.**



**DOI: https://doi-ds.org/doilink/09.2024-48949385**

## AUTHOR PROFILE

**Ms. Nazima Begum,** M.Tech student in ECE (Embedded Systems) from Shadan College of Engineering And Technology, Peerancheru, Telangana.

**Dr. G. Ravi Kumar, PROFESSOR** Dept. of ECE from Shadan College of Engineering and Technology, Peerancheru, Telangana.

**Dr. Shaik Saidulu, Professor,** Dept. of ECE from Shadan College of Engineering and Technology, Peerancheru, Telangana.



**DOI: https://doi-ds.org/doilink/09.2024-48949385**