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IOT Base Monitoring Systems for ICU of Buraimi Hospital

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Abstract

There have been attempts to use modern technology in numerous sectors to improve the quality of human life as technology has improved and sensors have been miniaturized. The healthcare sector is one of the key areas of research where the technology has been adopted. People who require healthcare services find it prohibitively expensive, especially in developing nations. As a result, this initiative is an attempt to address a contemporary healthcare issue in society. The research major goal was to create a remote healthcare system. It is divided into three sections. The first component involved employing sensors to detect the patient's vital signs, the second involved transmitting the data to cloud storage, and the third involved delivering the detected data for remote viewing. A doctor or guardian can monitor a patient's health status while they are not in the hospital by accessing the data remotely. The Internet of Things (IoT) concepts have been widely employed to connect accessible medical resources and provide patients with smart, dependable, and effective healthcare. One of the paradigms that can use the IoT advantages to improve the patient's lifestyle is health monitoring for active and supported living. I demonstrated an IoT architecture tailored for healthcare applications in this paper. The goal was to come up with a Remote Health Monitoring System that could be created with locally accessible sensors and would be economical if mass produced. As a result, the suggested architecture gathers sensor data via the Raspberry Pi microcontroller and relays it via the WIFI model to a location where it is processed and analyzed for remote viewing. When having notifications in case of any crises, the Feedback actions appear in the IOTGECKO program.

Keywords: Internet of things; smart; intensive care unit

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1. Introduction

The Internet of Things technology is not a specific product or system that will be produced by a company and will be sold to millions of users. The Internet of Things is a new concept that relies on the use of the Internet to facilitate our daily life and work. The IOT is a group of objects or devices that have the ability to connect to the Internet or can interact with each other or interact with humans to perform a set of tasks [1]. There are many applications of the Internet of Things, including: Monitoring the health status of humans by monitoring health symptoms that may arise and predicting diseases that may occur in the future. In addition to its various applications in the field of industry, such as monitoring devices and equipment in factories and forecasting faults. The medical sector benefited from IOT, so IOT has become an important use to facilitate health care in health centers [2]. Recently, the body sensornetwork has demonstrated great connectivity and vitality to monitor and manage healthcare services using IOT. In this research, we will define the uses of IOT in health care, how it works, and its benefits in the daily lives of patients and staff in health centers. As the sensor system communicates the sensor information to the primary control unit using the Internet of Things where it will be analyzed, and an alert is generated to inform the stakeholders in that department. The expert takes the appropriate decision for that patient and then the rescue team will be directed to save that patient, the information will be very important because this system is able to discover the patient's condition before his health collapses and he loses [3]. In the end, the medical sector benefited from digital transformation and modern communication techniques and is likely to depend more and more on the technologies of the smart stuffs of future years of processes through the continuous development of telecommunications systems and artificial intelligence tools that have contributed to the innovative features of the health care service [4]. The contributions of this research depicted in:

1. IOT patients' health is to aid in quick communication and the identification of emergencies, as well as to initiate communication with healthcare personnel.
2. It also aids in the initiation of prompt and proactive treatment.
3. Patients' health can be easily tracked over the internet with IOT. The doctor is not required to be present with the patients at all times and in all places [5].
4. IoT allows for easy monitoring of their health condition over the internet. When we need to monitor, record, and keep track of changes in the health parameters of a patient over time, IOT Monitoring comes in handy.

We organized this paper by beginning with the related wok in section II. We described the methodology in section

III. By apply System Module in section IV we have described systems elements. Finally, we presented the conclusion and point to the future work in section V.

2. Related Work

There are more studies about IOT, these studies different in techniques used to measure and use the purpose of the IOT. Here will present number of studies and their techniques and purpose of study which initiated in the following:

2.1 Embedded based smart ICU

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The intensive care unit is the most important unit in the hospital. It is an organized system to provide care to critically ill patients. The most important activity in the care unit is to monitor the patient constantly, because any error or delay may lead to death. In several surveys show the high workload of health professionals in the intensive care unit as the cause of burnout [6]. Where in 2015, 49 deaths out of 265 cases were in intensive care, and one of the reasons was medical error due to the large workload. The application of the Internet of Things in the intensive care unit monitoring process reduces the workload of the health workforce and the time of the patient monitoring process. The proportional assessment method (COPRAS) is used to prioritize the risks of the current monitoring process to select the appropriate IoT. This paper proposes three business process models that use IoT based patient monitoring and intelligent monitoring analytics and combine them. The combination of IoT based patient monitoring and intelligent monitoring analytics results in the largest reduction in operation time by 37.10% and intelligent monitoring analytics results in the least reduction in operation time by 37.10%. 11.56%. In they used 'Thing Speak' system as the dedicated web server [7]. These system measures body temperatures, heart rate, blood pressure; Oxygen saturation level and electrocardiogram signals (ECG) through sensors are processed through the Arduino Mega 2560 of patients admitted into Intensive Care Unit (ICU) or Operating Room (OR) and are stored in the Thing Speak cloud through the internet. It will automatically update all these data in every 45 seconds. At any crucial moment, the system sends SMS to the mobile phone through GSM module or a bell will alert the doctor about the patient's condition to receive the appropriate treatment immediately. In the adaptive automated technique makes an effort to provide a hospital management system, although the technique is inefficient in terms of response time. Rather than wasting time checking patients' reports online, the triggers and alarm strategy will be more effective in the ICU [8]. IoT allows for the creation of smarter ICUs that are more capable and efficient. There is a lack of an alert system, efficiency, and security in Embedded Based Smart ICU-For Intelligent Patient Monitoring. Although the remote heart monitoring system is limited to only heart patients and includes an unnecessary feature of a doctor's SMS response, it is effective and simple to use. This system requires further testing and experience with other patients.

2.2 Real-Time patient monitoring system

Monitoring the patient is very important and most important because a small delay in making the decision regarding the treatment of patients may cause permanent disability or even death. In the intensive care unit is equipped with different sensors to measure health parameters, but monitoring them all the time is still a difficult task [9]. This system proposes a system based on the Internet of Things, which can help in speeding up communication, identifying emergencies, and starting communication with health care staff, and thus starting rapid preventive treatment. This in turn reduces the possibility of human errors and will help the doctor save more time in making decisions through accurate observations. An American medical institute says that medical errors continue to be the No. 3 killer that kills about 400,000 people each year, in short, the proposed smart truth. A time-based system based on the Internet of things to monitor intensive care patients will prevent human errors and allow continuous monitoring of the patient with fewer than support staff. The real-time patient monitoring system collects data through the bedside patient monitors and the network interconnection system uploads this data to the cloud for

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further processing, the In-Telligent agent also processes this data further and sends notifications to the special monitoring cell and the doctor. Moreover, in they developed a system in which the system monitors the patient's body temperature, heart rate, body movements, and blood pressure reading data [10]. The numerous sensors are attached to the patient's body and take readings before sending a signal to the Raspberry Pi. The Raspberry Pi is a single-board computer the size of a credit card that runs Linux. Various sensors are used to assess the patient's body temperature, heart rate, and blood pressure, and the findings are transferred to a database through Raspberry Pi, where they can be monitored from anywhere in the globe using the internet and the GSM module. In the real-time parameters of a patient's health are communicated to the cloud utilizing Internet connectivity in a patient monitoring system based on the Internet of things project [11]. The distinction between an SMS-based patient health monitoring system and an IOT-based patient monitoring system is significant. Many individuals can examine details of the patient's health in an IOT-based system. The reason for this is because the data must be accurate. Another advantage of employing IOT is that this data may be viewed on a desktop computer, laptop, Android smart phone, tab, or tablet. To view this data, all that is required is a working Internet connection. To view this data over the Internet, there are a number of cloud service providers to choose from. Also, In Various biomedical sensors, such as a temperature sensor, a heart rate sensor, and a blood pressure sensor, are used to monitor the health state and are all incorporated into a single system on-chip [12]. Any time there is a significant change, it is communicated. This notification would assist in taking proper action at a specific point in time. Patients would be saved in the future as a result of this. Two sensors have been employed to allow real-time monitoring of the patient's ECG signal and temperature: an ECG sensor and a digital thermometer. Furthermore, the data is automatically updated to the cloud on a regular basis. This assists doctors, nurses, or the patient's relatives in monitoring the patient's health and taking appropriate action at the proper moment. If the ECG signals and temperature readings fall over or below the threshold value, the system sends an automated text message to the doctors or relatives. It will benefit doctors in a variety of ways and improve the efficiency of patient monitoring and treatment. To make the system even more efficient, it will be changed in the future by adding a pulse oximeter to assess oxygen saturation in blood for a patient. In there are countless people who lose their lives every year due to various diseases or health problems. With regard to chronic diseases, the number of people who die from chronic diseases accounts for 60% of the total number of deaths worldwide [13]. So patient monitoring works using multiple devices including wearable devices such as smart watches, including those that can remind patients to take their medication on time such as networking devices, EKG, blood oxygen, blood pressure will reduce these symptoms. These smart devices can reduce patient anxiety and reduce waste of resources this is very different from other sensitive health monitoring devices in traditional hospitals and support patient health information and improve continuous measurement, monitoring, and structure support for patients and caregivers, thus improving clinical outcomes using smart home sensor data and learning-based data analysis to predict clinical scores. This sensor uses a cloud computing system. In these studies were reviewed on the Internet of Things including nursing which aimed to determine bibliometric information [14]. It allows devices to become smarter, stronger, and more efficient. Including sensors, actuators, wearable devices, information technology and linguistics (ICT), and cloud computing. Regarding mortality rates, 12% of all deaths are related to neurological diseases and disorders of reasoning, including cerebrovascular disease and the highest overall

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mortality rate (about 10%). As a result, IoT applications have been developed for patients with these disorders, these include Parkinson's disease, epilepsy, and Alzheimer's disease and cardiovascular disease is also the world's leading findings of this study it showed that 22% of IoT applications were commonly used for monitoring to manage and treat cardiovascular diseases.

2.3 IOT based Covid Patient

In order to treat COVID patients, we now require special Covid 19 Quarantine facilities to be created up on the COVID platform. Because covid is very infectious, it is critical to isolate these patients, but doctors must also check the health of covid patients. It's becoming more difficult to maintain track of the health problems of many isolated patients as the number of instances grows. In, it's becoming more difficult to maintain track of the health problems of many isolated patients as the number of instances grows [15]. Some issues occur, such as the requirement for doctors to assess patient health on a frequent basis. There are an increasing number of patients for doctors to keep track of. Only for the purpose of monitoring, the doctors are at danger of infection. To address this problem, we created a remote IoT-based health monitoring system that allows many covid patients to be monitored remotely over the internet. The system uses a heartbeat sensor, a temperature sensor, and a blood pressure sensor to monitor the patient's heartbeat, temperature, and blood pressure. The system subsequently connects to a wifi internet connection and broadcasts the data over the internet utilizing wifi transmission. IOT Gecko platform transmits and receives data over IOT to display patient data remotely. A microcontroller-based circuitry controls the entire system. If a patient touches the emergency help button on an IOT device, an alarm is delivered over IOT remotely if any irregularity in the patient's health is detected. In From a healthcare perspective, IoT can be thought of as any device that can collect health- related data from individuals, including computing devices, cell phones, smart bands and wearable, digital medicines, implantable surgical devices, or other mobile devices that can measurement of health data and internet Connection [16]. And with the 2020 public health response to the new COVID-19 pandemic to shut down traditional patterns of service delivery, demonstrate how IoT devices are improving health service delivery. Smart healthcare services take advantage of advances in information technologies, such as the Internet of Things, big data analytics, cloud computing, artificial intelligence, and deep machine learning, to transform traditional healthcare delivery to be a more efficient, convenient and more personalized system. Current advances in computer informatics technologies have allowed the development of healthcare solutions with smarter prediction capabilities in and out of the hospital. We are seeing the use of virtual models to bring hospital care home through the use of sensors and devices that allow remote review and monitoring of patients in their homes or their treatment in hospitals and create a continuum between them through cloud access from the spread of COVID-19. AI has also contributed to providing health information to points of care, such as chatbots (or AI doctors), which can provide lifestyle advice and medical advice. Examples of such AI bots include Woebot, Your.Md, Babylon and HealthTap, where a patient can enter their symptoms and provide advice immediately. In nowadays monitoring individual's health day to day has become an important concern in view of Covid19 [17]. It would help us to diagnose some changes that could happen inside a human body. Two of the important parameters that could be monitored are the internal temperature level and heartbeat of a person that could be made a part of an IOT system. This is used to monitor the health of a person.

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2.4 Elderly monitoring system

The elderly needs remote monitoring, especially those who are alone at home or who live with one or two members at home. In the employed a microcontroller as a communication gateway. This system proposes a smart patient health monitoring system that employs sensors to track patient health and utilizes the internet to notify loved ones or worried doctors in the event of an emergency [18]. A buzzer is also attached to the controller to alert the caretaker to any changes in detector output. To track the patient's status, the sensors are attached to a microcontroller, which is then interfaced with an LCD display as well as a wireless local area network association to send notifications. If the system detects any changes in the patient's pulse rate or blood pressure, it sends an alarm to the doctor via IoT and also displays the patient's heartbeat, blood pressure, and temperature in real time via the cloud. This is highly handy because the doctor may detect the patient's health factors simply by visiting a website or looking up their IP address on the internet. Several IoT apps are also being developed today. As a result, the doctor and relatives will use Android apps to monitor or track the patient's health. You'll need a Wi-Fi connection to use an IoT-based health tracking system. The Wi-Fi module connects the microcontroller or Arduino board to the Wi-Fi network. When there is no Wi-Fi network, this system will not work since the Arduino UNO board continuously reads the information from three senses. The information is then sent to the cloud by delivering it to a specific URL/IP address. Then, for a set amount of time, the process of accelerating data to the cloud is repeated. In they used active network technology to connect multiple sensors to a single PMS; Patients' different key metrics are continually monitored via a single PMS and relayed to the on-site doctors or nurses for prompt response in the event of an emergency [19]. The sensors are affixed to the patients' bodies without giving them any discomfort. Using commonly available sensors, we monitor essential physical indicators such as body temperature, ECG, heart rate, and blood pressure in this PMS. As a result, the analog values sensed by the various sensors are sent to a microcontroller attached to it. These analog signal values of health parameters are processed independently by the microcontroller and converted to digital values using an ADC converter. More than one microcontroller's digitalized values are now delivered to the Central PMS. Each sensor-connected microcontroller with a transceiver will function as a separate module with its own unique ID. Each module sends data wirelessly to a gateway connected to the Central PMS's PC. The gateway, which is connected to the medical center's PC, Central PMS, is capable of selecting various patient IDs and allowing the gateway to receive various physical parameter values for the patient defined by the ID. The software, which is developed with a Graphical User Interface (GUI), may operate on various physical characteristics of each patient in a sequential manner with a predetermined time interval for each patient. Any doctor or nurse can log on to the Central PMS at each time and check the history of any patient connected to the networks observed critical metrics [20]. In they designed HIOT system by three technologies:

1- Identification Technology
2- Communication Technology.
3- Location Technology.

2.4.1 Analysis of related work

There are more researches about IOT, these studies different in techniques used to measure and use the purpose of the IOT. Here will present number of studies and their tools and descriptions of study which initiated in the following Table 1.

This project is about a Raspberry Pi-based system that uses a few sensors to collect patient information. It communicates this information to the internet via the Wi-Fi module. Here blood pressure and heart rate monitor module is electrically connected to the system and is worn by the user. The sensor detects systolic and diastolic

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blood pressure, as well as the heartbeat, and sends the information to the central controller when a button is pressed. When the Temperature sensor is in close contact to the user, it detects the ambient temperature and reports the user's body temperature. Thus, the doctor can retrieve these crucial parameters relevant to the patients' health from anywhere around the world using the IOT Gecko web interface. As a result, the IOT Based ICU Patient Monitoring System is a more advanced system that assists in the monitoring of ICU patients without the need for manual intervention.

Table 1: Analysis of Related Work

Tools	Description
COPRAS, BPMN, iGrafx, BPR	This study recommended using IoT technology to improve the ICU monitoring process [6].
Arduino Mega	The system sends SMS to the mobile phone through the GSM module at any critical moment [7].
Arduino UNO	System requires further testing and experience with other patients [8].
IRTBS, (PDA)	The proposed design can be put to the test and compared to other systems[9].
VibrationSensor, GSM	The approach more advantageous for decision making[10] .
Arduino UNO	This project demonstrates one of the most recent electronic project ideas for medical purposes [11].
Arduino Uno	Intelligent patient monitoring system that uses multiple sensors to automatically screen the patient's health status [12].
Smart watches	Building a smart health protection system, focusing on building a digital health system of upgrading [16].
Temperature Sensor	A health monitoring system that monitors symptoms such as body temperature will be designed into the Internet of Things network [17].
Arduino Micro	Allowing medical services to be dispatched in the event of an emergency for elderly patients [19].
Arduino	Healthcare monitoring systems have emerged as one of the most vital and have become technology oriented since the last decade [21].

3. Methodology

In this research, we will talk about the most important methodologies that are used in Intensive care, and we have divided these methodologies into two types: Hardware Specifications and Software Specifications. These are Some

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examples of hardware specifications (Power supply, Rectifier, Regulator, LCD display, Temperature and humidity sensor, Blood pressure sensor, Wi-Fi module, Raspberry Pi, Resistor, Capacitors and Diodes) An additional These are some examples of software specifications (Python compiler, Programming Language Python and IOTGecko) [22-30].

3.1 Blood pressure sensor

The blood pressure sensor is used to measure blood. It is also similar to a sphygmomanometer but from a column of mercury, a blood pressure sensor is used. In an automatic sphygmomanometer, a pressure sensor is used instead of mercury to detect the pressure in the artery and give the output [31]. This digital output is displayed on the screen. This monitor contains an internal processor to process the output generated by the pressure sensor and to record and display the results on the digital readout display. For an accurate and reliable measurement, this pressure sensor must be chosen carefully the Honeywell [32-35].

3.2 Raspberry Pi

The Raspberry Pi Foundation, a UK non-profit that strives to educate people in computing and make computing education more accessible, has created a series of single-board computers known as the Raspberry Pi. The Raspberry Pi was first published in 2012, and since then, various revisions and modifications have been developed. The original Pi had a single-core 700MHz CPU and just 256MB RAM, while the most recent model has a quad-core 1.5GHz CPU and 4GB RAM. The Raspberry Pi has always been around $100 (typically about $35 USD), with the Pi Zero being the cheapest at just $5. People use the Raspberry Pi all across the world to learn programming, develop hardware projects, automate their homes, implement Kubernetes clusters and Edge computing, and even employ them in industrial applications. The Raspberry Pi is a low-cost computer that runs Linux and has a set of GPIO (general purpose input/output) ports for controlling electronic components and experimenting with the Internet of Things (IoT) [36-39].

3.3 IOTGecko

IOT Gecko is a free platform for students, academics, and developers to build IoT systems. IOT Gecko opens the door to physical devices managed over the internet, giving you the tools and assistance; you need to create your IOT-based solutions quickly. Get data from sensors and devices and use it through the internet. To manage and monitor your IoT system on the web, choose from one of our system templates or create your own. Process the data from the sensor and display it online. Use simple mouse clicks to control motors and physical objects. With API support for all platforms, you can quickly debug your IoT devices and combine them with your favourite programming languages. IOT Gecko Development does not necessitate extensive coding experience and provides excellent assistance for IOT-based development. It provides an efficient GUI construction platform to assist hardware devices in processing and displaying parameters [40]. Every day, the scope of IoT development expands. The internet of things adds a new layer to the internet by allowing you to control more than just digital objects. Using IOTGecko, create your own IOT-based system to read sensor values, run motorized machines, monitor things,

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and much more. With API support for Arduino, Raspberry Pi, Microcontrollers, and other controller boards, the IOTGecko cloud platform opens the door to this realm. With the IOTGecko GUI builder and customizable application maker system, you can bring your internet of things programming talents to life [41]. Using this open-source internet of things development platform, you can create your desired IOT systems. Setup and run your devices on our IoT Cloud for free now.

4. System Module and Setup

Internet of things based ICU monitoring system, including Raspberry Pi and a few sensors for collecting patient data. It transmits this data to the Internet using a Wi-Fi module. As a result, the ICU monitoring system based on the Internet is a better solution for monitoring ICU patients without the need for manual intervention, using the IOT application that records all patient readings and through which the patient's condition is tracked in a clearer, faster and easier way. Temperature and blood pressure values are recorded as part of this study. A wired cable is used to send these sensor signals to the Raspberry Pi. Raspberry Pi is a small control panel that runs custom programs; It does not have an operating system and only runs your code. Body temperature and blood pressure are measured with its sensors including a blood pressure device and can be viewed on a computer screen using a Raspberry Pi from anywhere in the world via the IOT application [41]. Here will be a picture of the system setup.
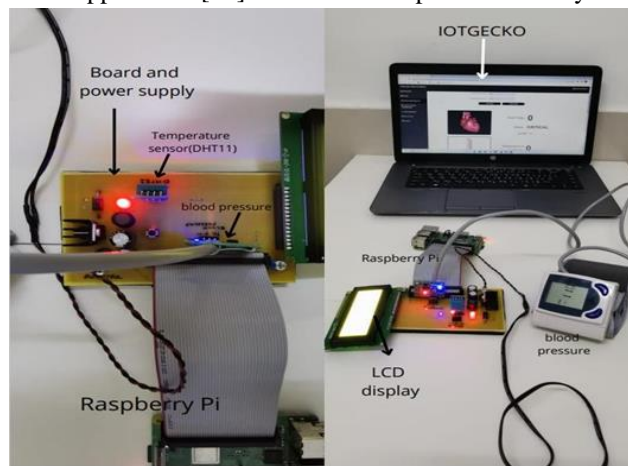

Figure 1: System Setup

The entire device setup is depicted in the image above, which includes a Raspberry Pi control board and a power supply. All sensors are connected to the Raspberry Pi controller, including the pressure and temperature sensors in the lower right. When the Raspberry Pi it is turned on, the LCD screen displays information such as location coordinates and HTTP protocols, which shows the network connection process as shown in Figure 1. If the device is unable to connect to the network, the command that it is paused can be seen and used to troubleshoot the problem.

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After the device is connected to the network, it displays all patient information as well as any abnormalities in the patient's vitals. Note that this information appears through the IOT program and shows the temperature and pressure of the patient and all his measurements during the period in which he is present. But in terms of the mechanism of operation of the system, the code written in a correct manner must be sound, in addition to connecting all the tools in the circuit correctly, whether it is the Raspberry PI or the LCD display screen and other components. Next, the system will work, and from here the program is used to record the patient's readings.

The Figure 2 shows how to monitor a patient in intensive care by monitoring various health parameters, namely temperature and blood pressure. This device is used in intensive care for patients who need to be monitored for various parameters. Check the patient health parameters body temperature and blood pressure. It displayed on the Monitor which is LCD display. The data is sent from the screen to the IOTGECKO application via WIFI model. The doctor he access to the patient's data through the application. In the event of any danger to the patient, the application notifies the doctor by alerting, so the patient receives care as soon as possible.
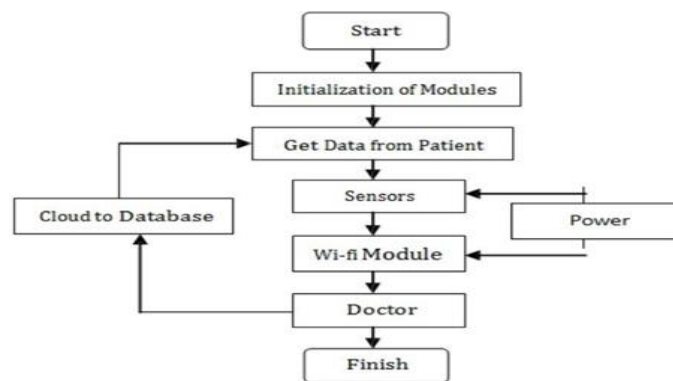

Figure 2. Flowchart of monitor a patient

We have organized a visit in cooperation with one of the volunteers at the Buraimi Hospital and specifically the intensive care unit we have reached these measurements illustrated by the following Table 2.

Scenario: While the doctor reviews the cases of his patient's routine on the computer, he received a warning through the IOT Gecko application that a vital sing of his patient in the ICU bed number 2 are dropped. BP has 90/60 mmHg and the temperature 35°C, doctor immediately go to the ICU to check of the reason and treat the case.

Table 2: Hospital Values

Number of patient	Body temperature	Body pressure	Comment
1	37.2	164/106	High Pressure result
2	37	155/98	High Pressure result

3	36.6	168/110	High Pressure result
4	36.9	170/100	High Pressure result
5	36.1	154/92	High Pressure result
6	36.8	120/81	The result are nature
7	37.5	126/87	The result are nature
8	37.1	130/88	The result are nature
9	36.4	129/92	The result are nature
10	36.1	132/90	The result are nature

In today's society, technology plays an essential role in industries, people's lives and the environment. The healthcare procedure is the most vital and decisive in these areas. We can use the information contained in this study to help strengthen our health care system and also to quickly know or find the disease that a person has, whether this disease is hereditary or not and also to promote the speed of finding appropriate solutions and monitoring the development or improvement of the person's disease. Appropriate treatment and care should be provided to the patient in the intensive care unit by the respective doctors or nurses. The patient is well cared for according to the intensive care unit monitoring system, which constantly checks his health condition. The data collected from each simulation is similarly stored in the cloud in parallel. The data cannot be permanently removed from the records as a result of this operation. Patients' health records will be sentto specific mobile applications or websites regularly to know the developments in which the patient progresses from time to time, which will be managed by the concerned doctors, thanks to this technological progress that is increasing now and developing more and more in the future to give a noticeable development in the medical field and to solve all the problems faced by medicine in addition to the progression of the patient's health to the positive side faster.

5. Conclusion

In such critical situations, doctors must keep track of the patient's health-related measures such as blood pressure, heart rate, and temperature at all times. As a result, an IOT-based ICU Patient Monitoring System can be used to monitor ICU patients without the need for physical intervention. The Raspberry Pi was connected to the output of the sensor and amplifier circuit. According to the person, the output signal was a periodic ac signal with amplitude fluctuating from peak to peak. The counted pulse rate was successfully communicated through Wi-Fi module after a sinusoidal signal and the output from the sensor were given to the Raspberry Pi. This project contributes to aid in quick communication and emergency detection, as well as initiating communication with healthcare personnel, by using the health of IOT patients. IOT supports patients in starting a speedy and proactive therapy. The doctor does not have to be with the patients at all times or in all locations because their health can be easily tracked over the internet with IOT. IOT provides for convenient internet-based monitoring of their health status. When we need to monitor, document, and keep track of changes in a patient's health indicators over time, IOT Monitoring comes in helpful. Finally, this technology is a novel addition to the medical and technical professions that has the potential to prevent unnecessary deaths and emergencies. In addition, the system can save money by reducing the number of hospital visits and doctor appointments. IoT based ICU (Intensive Care Unit) patient monitoring system could be a system that continuously monitors a patient's vital signs, pulse rate, and temperature while they are in the ICU. Following the measurement, the data is sent to a dedicated website via an IoT system. Where each doctor he is quickly accesses their patient data at any time and from any location. In comparison to previous systems, this one is

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less expensive and more exact. Data on patient health parameters is saved in the cloud. As a result, it is preferable to keeping records on printed paper in files. Future work could cover a wide range of topics. Using the Raspberry Pi and Wi-Fi module project, we may add a GPS module to IoT patient monitoring. The longitude and latitude obtained by this GPS module will be used to determine the patient's position or status. The Wi-Fi module will then broadcast this position to the cloud, which is the IoT. Doctors can track the patient's whereabouts in case they need to take preventative measures, and we can also send location or alarm signals to smart watches. So, when the situation is awful, we may simply find out what's going on.

References

[1] Pang, Z. "Technologies and Architectures of the Internet-of-Things (IoT) for Health and Well-being." *Diss*. (2013).

[2] ElSendiony, K. F. & Ghada, M. E. "The Impact of Internet of Things on Industrial Product Design for Health Care: A Comprehensive Survey.".

[3] Islam, S.M R., et al. "The internet of things for health care: a comprehensive survey." *IEEE Access* 3 (2015): 678-708.

[4] Amin, F. M. H., et al. "Implementing the System, Instructor and Student Model to Achieve Required Software Quality Assurance." *Res J Appl Sci Eng Technol* (2019): 30-42.

[5] Bui, N. & Michele Z. "Health care applications: a solution based on the internet of things." *Proc 4th Int Symp Appl Sci Biomed Commun Technol* (2011).

[6] Zen, S. G. & Dachyar, M. "Intensive care unit (ICU) patient monitoring improvement using Internet of Things (IoT) based on BPR approach." *Proc 11th Annu Int Conf Ind Eng Oper Manage.* (2021).

[7] Debnath, Prama, et al. "Design and Application of IOT-Based Real-Time Patient Telemonitoring System Using Biomedical Sensor Network." SN Computer Science 4.2 (2023): 1-23.

[8] Abd E. E. A. & Nadir K. S. "Modeling Variation in SaaS Application." *Int J Comput Sci Issues* 15.3 (2018): 22-30.

[9] Prajapati, B., et al. "An intelligent real time IoT based system (IRTBS) for monitoring ICU patient." *Springer Int Publ* 2.2 (2017).

[10] Banka, S., et al. "Smart healthcare monitoring using IoT." *Int J Appl Eng Res*. 13.15 (2018): 11984-11989.

[11] Salih, N., et al. Self Diagnosis of Diabetes by Using CBR Algorithm. *Scholars' Press*, 2018.

[12] Rahman, Alvee, et al. "IoT based patient monitoring system using ECG sensor." 2019 international conference on robotics, electrical and signal processing techniques (ICREST). IEEE, 2019.

[13] Kelly, J. T., et al. "The Internet of Things: Impact and implications for health care delivery". *J Med Internet Res*. 22.11 (2020): 20135.

(An Open Accessible, Fully Refereed and Peer Reviewed Journal)

[14] Sadoughi, F., et al. "Internet of things in medicine: a systematic mapping study." *J Biomed Inform* 103 (2020): 103383.

[15] El-hwaij, S. S. & Nadir, K. S. "Autonomic management by self-optimization for WEINMANN." 2017 *IEEE*. (2017).

[16] Yang, X., et al. "Exploring emerging IoT technologies in smart health research: A knowledge graph analysis." *BMC Med Inform Decis Mak* 20 (2020): 1-12.

[17] Teju, V. & Sowmya, K.V. "An efficeint health monitoring system with temperature and heart rate sensors using IOT." *Eur J Mol Clin Med* 8.2 (2021): 793-802.

[18] Malathi, M. & Preethi, D. "IoT based health monitoring system." *Int J Eng Res Technol*. (2019).

[19] Jasti, M. & Narasimha, R. "IoT based remote patient health monitoring system." (2017).

[20] Salih, N. K. & Tianyi, Z. "Need of Autonomic Management SaaS Application." *Int J Comput Sci Issues.* 5 (2016): 146.

[21] Zen, S. G. & Dachyar, M. "Intensive care unit (ICU) patient monitoring improvement using Internet of Things (IoT) based on BPR approach." *Proc 11th Annu Int Conf Ind Eng Oper Manage*. (2021).

[22] Senthamilarasi, C., et al. "A smart patient health monitoring system using IoT." *Int J Pure Appl Math* 119.16 (2018): 59-70.

[23] Malah, A., et al.. "Enhancement of educational services by using the internet of things applications for talent and intelligent schools." *Period Eng Nat Sci*. 8.4 (2020): 2358-2366.

[24] Kadave, A. R., et al. "IOT based patient health monitoring system using ESP8266 and Arduino."

[25] Khujamatov, K. E., et al. "Research and modelling adaptive management of hybrid power supply systems for object telecommunications based on IoT." *IEEE*. (2019).

[26] Filios, G., et al. "A smart energy management power supply unit for low-power IoT systems." *16th Int Conf Distrib Comput Sens Syst.* (2020).

[27] Viju, G. K. & Nadir K. S. "A secure multicast protocol for ownership rights." *Int Conf Comput Inf Technol.* (2012).

[28] Salih, N. K. & Tianyi, Z. "Autonomic Management for Applicability and Peformence in SaaS Model." *Int Conf Parallel Distrib Process Tech Appl.*

[29] "The importance of temperature and humidity sensors". *Comptus* (2021).

[30] Salih, N. K. "Self-Diagnosis of Cancer Using Case Base Reasoning Algorithm." *International J Res Eng*

Sci Manag. 4.6 (2021): 24-28.

[31] Singh, P. & Sanghamitra S. "Arduino-based smart irrigation using water flow sensor, soil moisture sensor, temperature sensor and ESP8266 WiFi module." *IEEE Reg 10 Humanit Technol Conf (R10-HTC).* (2016).

[32] Richardson, M. & Shawn, W. "Getting started with raspberry PI." *O'Reilly Media Inc*. (2012).

[33] Richards, P.I. "Resistor-transmission-line circuits." *Proc IRE* 36.2 (1948): 217-220.

[34] Salih, N. K. & Hanan, A. "Survey on QoS for Applications." (2022): 7421.

[35] Tang, C. W. & Steven, A. V. "Organic electroluminescent diodes." *Appl Phys Lett* 51.12 (1987): 913-915.

[36] MacLachlan, R. A. "The python compiler for cmu common lisp." *ACM Sigplan Lisp Pointers* 1 (1992): 235-246.

[37] Mao, F., et al. "A single-stage current-mode active rectifier with accurate output-current regulation for IoT." *ISCAS*. (2018).

[38] Grondahl, L. O. & Paul, H. G. "A new electronic rectifier." *J AIEE* 46.3 (1927): 215-222.

[39] Van, R. G. & Fred, L. D. J. "Python tutorial". *Neth Cent Math Comput Sci*. 620 (1995).

[40] Taware, K., et al. "Use of IOT Gecko for Asset Tracking." (2018).

[41] Sakr, Y., et al. "Sepsis in intensive care unit patients: worldwide data from the intensive care over nations audit." *Open Forum Infect Dis*. 5.12 US: *Oxf Univ Press* (2018).