

PORTABLE VITAL PARAMETER MONITORING SYSTEM

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Technology degree in Biomedical engineering

by

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**DEPARTMENT OF BIOMEDICAL ENGINEERING
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **NANDHAKUMAR P (38240019), SUNDAR T (38240039)** who carried out the project entitled "**Portable Vital Parameter Monitoring System**" under our supervision from **September 2021 to March 2022**.

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DECLARATION

We **NANDHAKUMAR P (38240019)**, **SUNDAR T (38240039)** hereby declare that the Project Report entitled “**Portable Vital Parameter Monitoring System**” done by us under the guidance of Dr. **S. KRISHNAKUMAR**, M.Sc., Ph.D., Department of Biomedical Engineering is submitted in partial fulfillment of the requirements for the award of Bachelor of Technology degree in Biomedical Engineering.

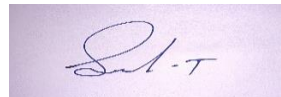
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ABSTRACT

This enforced project deals with finding the technical and advanced resolution to common people who can check their health regularly without any help of the lab technician or doctor, they can monitor them on their own using this device. Sensors used for higher health monitoring systems like blood pressure sensor, LM35 temperature sensor etc. This enforced project upgraded for a wireless emergency telemedicine system and also helps for the blinded people in this prototype it converts text to speech in which they can hear the output. Remote health watching improves quality of care, reduces attention and empowers patients. This project upgraded for wireless house maker by adding module in order to detect the placement of the patient and IOT technology also has been used. The medicine mensuration system consists of Pulse oximeter sensor, Heartbeat sensor, Digital sphygmomanometer, noninvasive glucometer, A/D device, signal learning circuit, Arduino, data cable, mobile. It is a detachable device and also low cost of efficiency. The outcome of this device will show the blood pressure, oxygen level, temperature, pulse rate, glucose level at a single display. And also helps the blind people by reading out the output loudly. The medical world today faces basic two problems when it comes to patient monitoring, firstly the need of healthcare providers present bedside the patient and secondly the patient is restricted to bed and wired to large machines. In order to achieve better quality patient care, the above cited problems have to be solved. This project presents an IoT based E-Health Monitoring System using Arduino Uno which monitors certain health parameters of the patient and broadcasts the monitored data on a particular IP address (Wi-Fi). A prototype of the proposed system has been built to demonstrate its performance. Thus, this project helps in taking care of patients at the right time and to avoid difficulties and also helps the people to regularly check their health parameters.

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LIST OF ABBREVIATION

ABBREVIATION	EXPANSION
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NIR	NEAR INFRARED
-----	---------------

IR	INFRARED
----	----------

AVR	ADVANCED VIRTUAL RISC
-----	-----------------------

AC	ALTERNATE CURRENT
----	-------------------

SPO2	OXYGEN SATURATION
------	-------------------

LCD	LIQUID CRYSTAL DISPLAY
-----	------------------------

LED	LIGHT EMITTING DIODE
-----	----------------------

SRAM	STATIC RANDOM ACCESS MEMORY
------	-----------------------------

IOT	INTERNET OF THINGS
-----	--------------------

DC	DIRECT CURRENT
----	----------------

DSP	DIGITAL SIGNAL PROCESSOR
-----	--------------------------

BP	BLOOD PRESSURE
----	----------------

VS	VISUAL STUDIO
----	---------------

GSM	GLOBAL SYSTEM FOR MOBILE COMMUNICATION
-----	--

PPG	PHOTOPLETHYSMOGRAPHY
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ECG	ELECTROCARDIOGRAM
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EEPROM	ELECTRONICALLY ERASABLE PROGRAMMABLE READ-ONLY MEMORY
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CHAPTER-1

INTRODUCTION

As a consequence of rapid medical innovation, contemporary civilization's health-care systems have become significantly more mature and efficient. Individual wearable monitoring systems and portable technology are replacing traditional in-hospital systems. Many ideas for generating a faster and more accurate pre-diagnosis including examples for laypeople. A healthcare system is one that assists society in protecting and enhancing the health of its citizens. As we demonstrate a portable vital parameter monitor with an IP address, Bluetooth, and voice communication.

Types of interventions/comparators

The monitors under consideration had to be able to measure any or all of the vital signs: heart rate, glucose level, oxygen saturation, blood pressure, and temperature in an outpatient setting with minimum restrictions on the patient's typical lifestyle. Only monitors with real-time monitoring capabilities were considered.

How this system is useful to people?

Medical professionals and engineers are working to make healthcare and biomedical technologies more advanced, computerized, and portable in order to meet the demands and requirements of patients. Innovation has become a fundamental and vital component of cutting-edge life, and it has an impact on the way we live and work as a society. Teja et al., (2018) previously built a comparable gadget that is semi-portable and constantly monitors the patient's health indicators. This smart ECG may be worn, and it offers simple features that patients can monitor and conduct in real time. Healthcare personnel can access patient data electronically and in real time using their smartphones. Similarly, Checkme, a vital-signs-detecting gadget, was designed to improve routine patient monitoring by minimizing testing time, variances, and improper inputs throughout the Electronic Health Record (EHR) (Weenk et al., 2018). They used the Checkme to evaluate the reliability of patient self-measurements to world standard and nurse tests. The data

analysis of the fifty patients on whom the time-related evaluation sessions were done at random was shown in the study. The Checkme device allows patients to simply and reliably measure their vital signs on their own. By manually inputting data into the EHR, nurses might save time and avoid mistakes.

Wrist blood pressure monitors: Are they accurate?

Body posture is particularly sensitive to wrist blood pressure monitors. When using a wrist monitor to check your blood pressure, be sure your arm and wrist are at heart level. Even so, blood pressure readings taken at the wrist are typically higher and less reliable than those taken in the upper arm. Because the wrist arteries are narrower and less deep beneath the skin than those in the upper arm, this is the case. Because they have a large arm or find blood pressure readings painful, some people cannot have their blood pressure taken in the upper arm. In these circumstances, taking your blood pressure at your wrist is sufficient.

Blood glucose level monitoring by noninvasive method using near infra-red spectroscopy
It is critical to keep track of blood glucose levels in order to avoid diabetic complications and organ damage. Non-invasive glucose level testing is used as an alternative to invasive glucose level monitoring, which is uncomfortable and causes nerve damage. Shined and Prasad devised a noninvasive glucose monitoring system in which the NIR is transmitted through the fingertip and the results are displayed on a screen. For 30 seconds, over-systolic pressure is administered to the finger to stop the flow of blood. The optical system's response. The resulting signal is investigated using a spectrum analyzer and FFT analysis. Chi Fuk et al(2012), examined current improvements in noninvasive glucose monitoring and concluded that the optical approach is one of the most painless and promising noninvasive blood glucose testing technologies available. Jyoti Yadav conducted an experiment on the human forearm using a 940nm NIR LED to assess glucose levels. Proposes a noninvasive blood glucose glucometer using two LEDs of the same wavelength, one operating as a photo emitter and the other as a photodetector. In a total of 8 LED pairs were evaluated for sensitivity to various glucose concentrations, and the most effective pair was NIR LED with a wavelength of 1450 nm, according to the

results. The 940 nm NIR LED was used to measure blood glucose in three separate probes (arm, finger, and ear lobe). To correctly detect reflected signals, Parag et al., put the emitter and detector on the same side of the finger, resulting in a 180-degree phase shift between transmitted and reflected signals. This work describes the design and development of a noninvasive blood glucose measuring sensor system that uses a 940 nm NIR light source. Blood glucose levels can be estimated by measuring the intensity of light perceived after passing through the finger. An Android application (app) is developed to show and save the measured glucose levels, as well as the date and time, in a text file that can be accessed at any time. The major goal of this project is to create a glucose monitoring instrument that is easy, reliable, painless, cost effective, and portable.

Exploring the use of speech input by blind people on mobile devices

The difficulty of nonvisual text entering on mobile devices has been the subject of a lot of recent research. While scholars have tried to overcome this problem using gestures, we look into a different mode of communication: voice. We polled 169 blind and sighted people to find out how often, for what reasons, and why blind people use speech for input on their mobile devices. Blind persons utilized speech more frequently and input lengthier texts than sighted people, according to our findings. We then ran a trial with eight blind people to see how they used the on-screen keyboard with Voice-over versus speech input on an iPod. We discovered that talking was roughly 5 times faster than typing. While the majority of participants were satisfied with the speech input, correcting recognition problems was a source of frustration. The typical participant spent 80.3 percent of their time editing. Finally, we make recommendations for future research, such as more efficient eyes-free editing and better error detection systems for text review.

CHAPTER-2

LITERATURE SURVEY

Lei Ru, et. al., (2021) A Detailed Research on Human Health Monitoring System Based on Internet of Things, BP300 sensors, which is sensitive, accurate, and precise. Besides, air pumps, resistors, and capacitors. The pressure sensor converts the pressure signal by converting the blood flow pressure signal in the inflatable bandage into a voltage signal close to the microcontroller's voltage amplitude. Smart sensing devices and the Internet have brought practical solutions to many networking sectors, public and private sector enterprises, and government organizations around the world. This research aims to link Internet of Things (IoT) technology with health monitoring to make it more personalized and timelier by allowing devices to communicate with one another. This research will look into a variety of wearable health monitoring modules that people can use to track their heart rate, blood pressure, pulse, body temperature, and other physiological data. The wireless sensor is used to collect data in order to develop a health monitoring system. To enable real-time monitoring, the data is integrated utilizing the Internet of Things for processing, linking, and computing. The temperature of three people measured by the temperature thermometer is 36.4, 36.7, and 36.5 (°C), respectively, and the average acquired by the monitoring system of the three people is 36.5, 36.4, and 36.5 (°C), respectively, indicating that the system demonstrated relatively accurate and stable testability. The user's ECG is displayed clearly and conveniently using the ECG acquisition system. The pulse rate of the three people tested by the system is 78, 78, and 79 (times/min), respectively, similar to the medical pulse meter results. The physiological information acquired using the semantic recognition, matching system, and character matching system is relatively accurate. It concludes that the human health monitoring system based on the Internet of Things can provide people with daily health management, instrumental in heightening health service quality and level.

Zhiyuan Lu, et.al., (2015) the prototype of a pulse oximeter for mobile healthcare is shown in this research. A reflective pulse oximeter is incorporated into the rear cover of a smart

portable device in this prototype, allowing for easy monitoring of heart rate (HR) and SpO₂ (estimation of arterial oxygen saturation) for home or mobile applications. To avoid the influence of ambient light and interferences generated by integrating the sensor within a flat cover, novel and miniaturized circuit modules including a chopper network and a filtering amplifier were built. A method based on adaptive trough detection is given for improved HR and SpO₂ estimate, with appropriate simplification for mobile device implementation. A photoplethysmogram validation approach that is both quick and effective is also proposed. A fast and effective photoplethysmogram validation scheme is also proposed. To calibrate and evaluate our oximeter, we conducted clinical studies. With no significant difference shown by paired t-tests ($p = 0.182$ for SpO₂ measurement and $p = 0.496$ for HR measurement), our prototype oximeter can achieve equivalent performance to a clinical oximeter. This pulse oximeter's design allows for quick and easy measurement of SpO₂ for mobile healthcare.

Daarani & Kavitha Mani (2017), blood glucose level monitoring by noninvasive method using near infra-red sensor, International Journal of Latest Trends in Engineering and Technology, Diabetes is a common chronic condition that affects almost every country on the planet. The most popular method for measuring blood glucose levels is an intrusive procedure that is uncomfortable, expensive, and poses a risk of spreading infectious infections. The intrusive approach causes long-term harm to the finger tissues. A noninvasive approach can be employed instead, which allows for more frequent testing and eliminates the pain and discomfort caused by frequent finger pricks. This research proposes a noninvasive approach for measuring glucose levels. The glucose level of blood is determined by the variation in the intensity of NIR light received from the photo detector after passing through the finger.

Shahanim Mohamad Hadis, et.al., (2020) IoT Based Patient Monitoring System using Sensors to Detect, Analyze and Monitor Two Primary Vital Signs Nor, the construction of a patient monitoring system for two basic vital indicators, body temperature and respiration rate, is presented in this work. The monitoring system was created with Arduino Mega 2560 and ESP8266 Wi-Fi Module on an IoT platform. Two Sensor modules

are utilized to determine the level of each vital sign, and each module uses temperature to do so. The goals of this project are to create a patient monitoring system that can recognize when a patient is in danger. Level of vital signs, analyze the level of vital signs based on the patient's age, and provide an alarm for aberrant condition, as well as wirelessly displaying the results via Android apps. This idea would reduce the amount of work that nurses have to do in the hospital and give an easier way to check the status of each patient's vital signs. The traditional system, which requires a nurse to visit each patient and take vital signs, is time intensive. Nurses can use android apps loaded on any android smartphone to monitor the patient's condition with this system. Nurses and doctors can also check prior vital sign status by downloading data in excel format from the cloud. This system's two vital sign levels were compared to those obtained from standard measurement equipment or manual observation.

Madhan Mohan, et.al., (2016) the heart rate and arterial oxygen saturation are measured using pulse oximeters (SpO₂). The noise generated by movement has a significant impact on the photoplethysmography (PPG) data from pulse oximeters. The ambient light signal has an impact on the signal. For the measurement of arterial oxygen saturation, obtaining a clean signal is critical (SpO₂). To reduce noise from the signal, an Adaptive Noise Cancelling (ANC) technique is applied in this paper. During the data collecting process, data from a tri-axial accelerometer is also collected. The adaptive filter algorithm is based on the Normalized Least Mean Square (NLMS). The data from a tri-axis accelerometer provides directional information along all three axes. They are added together and used as a reference noise signal by the adaptive filter. The coefficients in the filter are updated based on the error signal, and they are changed until the error is as small as possible. The oxygen saturation is determined from the clean signal by determining the normalized ratio of ratios. Adaptive noise cancellation using an accelerometer has been proven to reduce arterial oxygen saturation inaccuracies. The average result for the algorithm in question is roughly 0.2409. The result is also found to be in agreement with the pulse oximeter used as a reference.

Mohammad Salah Uddin, et al., (2017) in the field of remote monitoring, the popularity of

the internet of Things is growing by the day. Vehicle or asset monitoring, kids/pets monitoring, fleet management, parking management, water and oil leaks, energy grid monitoring, and so on are all examples of remote monitoring systems. In this research, we propose an intelligent patient monitoring system that uses sensor-based connected networks to automatically monitor patients' health. The biological behaviors of a patient are collected using a variety of sensors. The relevant biological data is subsequently sent to the Internet of Things cloud. The system is more sophisticated in that it can detect a patient's serious state by analyzing sensor data and sending push notifications to doctors, nurses, and hospital in-charge personnel. Doctors and nurses gain from this method since they may monitor their patients without having to visit them in person. With limited access, patients' family can also profit from this method.

Sachi Marathe, et al., (2019) the design and implementation of a mobile patient-monitoring system integrating four sensors in one system is demonstrated in this work. In the past, healthcare personnel in disaster zones measured vital signs manually, documented them on paper, and communicated over the radio, but when the number of patients surged dramatically, it caused pandemonium among the healthcare providers. Because technical improvements have resulted in rising healthcare costs, the suggested mobile sensor-based system will not only be technologically advanced but also cost effective. Electrocardiogram (ECG) module, blood pressure sensor, temperature sensor, and pulse oximeter module are the four main sensors in the system. Using Arduino, the sensors will be combined into a single system. The data collected from the sensors will be transferred to a WIFI module called NodeMCU ESP8266, which will upload the data to the cloud, where it may be viewed by the healthcare professional. We measured and presented the four vital indicators for ten distinct patients in this research.

Kranjec, et.al., (2014) non-contact heart rate and heart rate variability measurements: A review. Biomedical Signal Processing and Control. 13. The following research examines four unique noncontact approaches for measuring heart rate (HR) and, as a result, HR variability, an important marker of autonomic activity that has been shown to predict the likelihood of future health-related occurrences. The fundamental concepts feasibility

research focuses on signal-to-noise ratio measurements with relation to the distance between the subject and the HR sensor/apparatus. Methods detecting electromagnetic energy created by bioelectrical activity within the cardiac muscle (referred to as direct methods) and methods measuring displacement of a component of the subject's body caused by periodic muscular contractions of the heart are classified into two categories (referred to as indirect methods). A measuring instrument that detects changes in the surrounding electric field belongs to the first group, whereas measuring devices that use the Doppler Effect phenomena (microwave radar, ultrasonic radar) and audio signals recorded by a condenser microphone belong to the second group. All of the measurement instruments were put together and tested. The findings show that noncontact HR measurement is possible, especially at distances of less than 50 cm, and that it meets the criteria for HR diagnostic purposes.

Paul B Benni, et.al., (2018) A validation method for near-infrared spectroscopy-based tissue oximeters for cerebral and somatic tissue oxygen saturation measurements, we describe the validation methodology for the NIRS based FORE-SIGHT ELITE (CAS Medical Systems, Branford, CT, USA) tissue oximeter for cerebral and somatic tissue oxygen saturation (StO₂) measurements for adult subjects submitted to the United States Food and Drug Administration (FDA) to obtain clearance for clinical use. This validation methodology evolved from a history of NIRS validations in the literature and FDA recommended use of Deming regression and bootstrapping statistical validation methods. For cerebral validation, forehead cerebral StO₂ measurements were compared to a weighted 70:30 reference (REF CX_B) of co-oximeter internal jugular venous and arterial blood saturation of healthy adult subjects during a controlled hypoxia sequence, with a sensor placed on the forehead. For somatic validation, somatic StO₂ measurements were compared to a weighted 70:30 reference (REF CX_S) of co-oximetry central venous and arterial saturation values following a similar protocol, with sensors place on the flank, quadriceps muscle, and calf muscle. With informed consent, 25 subjects successfully completed the cerebral validation study. The bias and precision (1 SD) of cerebral StO₂ compared to REF CX_B was $-0.14 \pm 3.07\%$. With informed consent, 24 subjects successfully completed the somatic validation study. The bias and precision of somatic

StO₂ compared to REF CX_S was $0.04 \pm 4.22\%$ from the average of flank, quadriceps, and calf StO₂ measurements to best represent the global whole-body REF CX_S. The NIRS validation methods presented potentially provide a reliable means to test NIRS monitors and qualify them for clinical use.

Lidija Poposka, et.al., (2020). Noninvasive Glucose Measurement and Correlation with Heart Rate Variability, Diabetes is one of the world's most serious illnesses today, and it's only getting worse. Blood glucose levels must be measured on a regular basis in order to monitor glucose levels and establish diabetes treatment strategies. The most common method of monitoring glucose levels is by an intrusive procedure that involves pricking your finger with a lancet, which can be uncomfortable and annoying, especially if done on a daily basis. We examine noninvasive glucose measuring methods in this study and propose many classification dimensions based on several criteria, including size, invasiveness, studied material, sensing qualities, applied method, activation type, response latency, measurement time, and access to data. As part of a new study, we focused on employing machine learning and neural network methodologies, as well as correlations with heart rate variability and ECG.

Sanjay Kumar, & Piyush Agrawal (2014), lot-based diagnosing of Heart rate and SpO₂ saturation level, any patient can be detecting our body disease by an Electronics device. Now days Electronics devices are improving any field by their work. Everybody want to a good health in our life, but this is not easy for everyone. People are very lazy for their health of point of view. They do not go to for daily exercise and eat unhealthy foods. So, by this reason human heart does not work properly and occurred many problems like diabetes, high blood pressure, low blood pressure and low Oxygen level. If people will have those type any devices which can measure the heart types problem, then that person can take the treatment before occurs the disease. We know that cardiovascular types disease is not a small disease, this is very dangerous for any people. In this project an electronics device which has an Oxygen Level measuring sensor and pulse measuring sensor (Max30100) gives the correct reading and with the help of data base like BLYNK mobile application or Think Speak all reading can be send to the particular sensor. Any

patient can be detecting our body disease by an Electronics device. Now days Electronics devices are improving any field by their work. Everybody want to a good health in our life, but this is not easy for everyone. People are very lazy for their health of point of view. They do not go to for daily exercise and eat unhealthy foods. So, by this reason human heart does not work properly and occurred many problems like diabetes, high blood pressure, low blood pressure and low Oxygen level. If people will have those type any devices which can measure the heart types problem, then that person can take the treatment before occurs the disease. We know that cardiovascular types disease is not a small disease, this is very dangerous for any people. In this project an electronics device which has an Oxygen Level measuring sensor and pulse measuring sensor (Max30100) gives the correct reading and with the help of data base like BLYNK mobile application or Think Speak all reading can be send to the particular. When the measured health parameters are compared to a commercially available Choice Med pulse oximeter, a maximum variance of 2% is found, indicating that the suggested sensor device is quite accurate.

Mian Mujtaba Ali, et.al., (2019) Design of Internet of Things (IoT) and Android Based Low-Cost Health Monitoring Embedded System Wearable Sensor for Measuring SpO₂, Heart Rate and Body Temperature Simultaneously. Wireless Personal Communications. An implementation of affordable medical technology health monitoring sensor system is developed and demonstrated to measure blood saturation levels (SpO₂), heart rate and body temperature simultaneously. The embedded system is based on Arduino platform due to reliability and plug and play capability. The proposed pulse oximetry sensor uses spectrophotometry to calculate the ratio of oxygenated hemoglobin to deoxygenated hemoglobin which then is used to calculate the percentage of oxygenated blood levels. The accuracy of pulse oximeter is enhanced using light emitting diodes driver circuits, sample and hold circuits thus that a variable baseline can be established for different skin tones including the finger width where the measurements are undertaken. The embedded sensor system is designed to monitor SpO₂, heart rate and body temperature and display the obtained results on an LCD. The measured vitals are also transmitted via Bluetooth

module to Android mobile, and using Wi-Fi module to the internet, forming internet of things platform for the designed embedded system of sensors. The low-cost embedded sensor system reported in this study can be used to monitor key health parameters of patients in hospitals or at home. The proposed affordable medical technology sensor system can be used as wearable wireless sensor which can be used as a plug and play sensor with Arduino to monitor human key health parameters. The measured health parameters are compared with commercially available Choice Med pulse oximeter and a maximum deviation of 2% is observed which demonstrates that the proposed sensor device is highly accurate.

David Kaputa et.al., (2010) Biomed instrument Technology, A portable, inexpensive, wireless vital signs monitoring system. This device facilitates modes of data collection that would be expensive, inconvenient, or impossible to obtain by traditional means within the medical facility. Data can be collected on specific days, at specific times, during specific activities, or while traveling. The device uses biosensors to obtain information such as pulse oximetry (SpO₂), heart rate, electrocardiogram (ECG), non-invasive blood pressure (NIBP), and weight which are sent via Bluetooth to an interactive monitoring device. The data can then be downloaded to an electronic storage device or transmitted to a company server, physician's office, or hospital. The data collection software is usable on any computer device with Bluetooth capability, thereby removing the need for special hardware for the monitoring device and reducing the total cost of the system. The modular biosensors can be added or removed as needed without changing the monitoring device software. The user is prompted by easy-to-follow instructions written in non-technical language. Additional features, such as screens with large buttons and large text, allow for use by those with limited vision or limited motor skills.

Honggu Chun et.al., (2005) Stud Health Technol Inform. IT-based diagnostic instrumentation systems for personalized healthcare services. This paper describes recent research and development activities on the diagnostic instruments for personalized

healthcare services in Seoul National University. Utilizing the state-of-the-art information technologies (IT), various diagnostic medical instruments have been integrated into a personal wearable device and a home telehealth care system. We developed a wrist-worn integrated health monitoring device (WIHMD) which performs the measurements of non-invasive blood pressure (NIBP), pulse oximetry (SpO₂), electrocardiogram (ECG), respiration rate, heart rate, and body surface temperature and the detection of falls to determine the onset of emergency situation. The WIHMD also analyzes the acquired bio-signals and transmits the resultant data to a healthcare service center through a commercial cellular phone. Two different kinds of IT-based blood glucometer have been developed using a cellular phone and PDA (personal digital assistant) as a main unit. A blood glucometer was also integrated within a wrist pressure measurement module which is interfaced with a cellular phone via Telecommunications Technology Association (TTA) standard in order to provide users with easiness in measuring and handling two important health parameters. Non-intrusive bio-signal measurement systems were developed for the ease of home use. One can measure his ECG on a bed while he is sleeping; measure his ECG, body temperature, body fat ratio and weight on a toilet seat; measure his ECG on a chair; and estimate the degree of activity by motion analysis using a camera. Another integrated diagnostic system for home telehealth care services has been developed to include a 12 channels ECG, a pressure meter for NIBP, a blood glucometer, a body fat meter and a spirometer. It is an expert system to analyze the measured health data and based on the diagnostic result, the system provides an appropriate medical consultation. The measured data can be either stored on the system or transmitted to the central server through the internet. We have installed the developed systems on a model house for the performance evaluation and confirmed the possibility of the system as an effective tool for the personalized healthcare services.

Rachel Austin, et.al., (2021) GSM and Arduino Based Vital Aims the analysis of a patient's vital signs can help in early illness detection and treatment. Many ailments can be diagnosed and controlled by reviewing this medical information on a regular basis. Background Monitoring Human vital signs, which reveal the typical body's key processes

and indicate the status of an individual's health condition, is a simple way to detect numerous early-stage medical disorders. Objective In many circumstances, patients do not obtain timely medical care, and as a result, unanticipated occurrences occur as a result of one's lack of knowledge about one's health state. Because pulse rate and vital sign area unit are the most important characteristics, an inexpensive gadget that can detect them is beneficial to human health. Because pulse rate and vital sign area unit the most important parameters, a cheap gadget to detect such parameters is beneficial to human health. Methods Photoplethysmography (PPG) is a photosensitive technique that measures differences in blood volume of the pulse (typically in the body's soft tissues) by specifically interfering with differences in the photo emitter's absorption, reflection, volume, and dispersion of light, which is then registered by the photoreceptor. The PPG waveform then reflects changes in arterial blood flow. A pulse oximeter's waveform lights the skin and analyses differences in light absorption. Results The embedded systems- Arduino, GSM module, and other sensors employed in this study give a simple monitoring technique that does not necessitate the usage of a smartphone or the internet connectivity conclusion, the purpose of this study is to demonstrate the need of regularly monitoring vital indicators. The suggested gadget was created as an Arduino software that is simple and affordable, a transportable system that captures vital signs data and delivers text messages as warning signals during a health emergency. Sign Monitoring System.

Garima Gupta, et.al., (2017) An ANN based SpO₂ measurement for clinical management systems. Pulse oximeters are ubiquitous in modern medicine to noninvasively measure the percentage of oxygenated hemoglobin in a patient's blood. Pulse oximeters are well adapted, simpler and quite easy to measure. In this paper, An ANN based model using LabVIEW is proposed to measure and estimate the SpO₂ present in the blood. Infra-red (IR) and red LED lights are passed through the fingers and the ratio of transmission characteristics (R value) is calculated through LabVIEW system. Based on the R value the oxygen saturation SPO₂ is calculated. This study is done through a ANETka, which is an ANN work system designed in LabVIEW. Finally, the result is compared with both fuzzy logic and linear regression-based methods. The proposed method shows that ANN can be efficiently used in clinical management systems and also proved its consistency

and accuracy.

Christian Petersen, et.al., (2013) A Dumont Design and evaluation of a low-cost smartphone pulse oximeter. Every year, infectious illnesses like pneumonia kill millions of children in low- and middle-income nations. The availability of reliable and low-cost diagnostic tools based on integrated sensor technologies could save many of these deaths. Pulse oximetry, in particular, provides a non-invasive and specific diagnostic for the severity of several infectious infections, including pneumonia. Pulse oximetry could become an attractive answer to global health concerns if it could be given via widely available mobile phones. Many lives could be saved if this technology could be efficiently spread in the impacted regions of the world to prevent people from the deadly effects of infectious diseases. We discuss how to build an oximeter like this that connects to a standard blood pressure monitor.

Vishwanath tigadl. (2013) Non-invasive blood glucose monitoring using near-infrared spectroscopy. Blood glucose monitors are used to measure glucose levels in the blood, particularly in individuals who have symptoms or a history of unusually high or low blood glucose levels. They are most typically used to help diabetic people inject proper insulin doses. The availability of home-use glucometers, as opposed to clinical-use devices, has significantly enhanced these people's quality of life. However, such monitors necessitate a blood collection via finger pricks for each test, which is inconvenient and painful. Each test necessitates the purchase of a new test strip, adding to the device's ongoing costs. Optimum insulin dosage, however, requires frequent/continuous monitoring of blood glucose, and currently available glucometers do not address this requirement. Continuous monitors do exist, but they need to be implanted under the skin, causing trauma while being implanted, and they need to be replaced every week. An alternative exists in non-invasive blood glucose monitors. This article introduces an architecture that uses Near

Infrared (NIR) spectroscopy to determine blood glucose levels based on transmittance spectroscopy on the ear lobe. Using various body parameters, such as tissue thickness, blood oxygen saturation, and a linear regression-analysis based calibration system, an accurate and real-time architecture is proposed. An example implementation using full analog, digital, and mixed signal capabilities of a programmable system-on-chip, the PSoC-5LP controller from Cypress, is given as well.

Yu Fu, & Jian Liu, System Design for Wearable Blood Oxygen Saturation and Pulse Measurement Device, the demand for sport monitoring research is rapidly expanding due to the rapid growth of information technology. Sport Internet of Things (IoTs) based on sensor technology and modern communication technologies are becoming increasingly significant in today's sport training and everyday activities. People who use sensor-based sport monitoring systems use wearable sport gadgets to track their own physiological data, with a focus on blood oxygen saturation and pulse measurement. We'll use a near-infrared portable tissue oximeter with a detecting module powered by the STM32 CPU to measure these two parameters. The non-invasive measurement of tissue oxygen (O₂) status using near infrared spectroscopy (NIRS) is becoming increasingly popular. The most frequent equipment for measuring oxygenated and deoxygenated hemoglobin in tiny blood arteries are continuous-wave spectrometers (arterioles, capillaries and venules). We were able to collect the blood oxygen saturation and pulse parameters by measuring them with near-infrared technology. The data will be sent to the remote coaches or doctors over GPRS/WIFI/Zigbee networks after the portable gadget has obtained the following two parameters. The expert decision-making system processes the data of the blood oxygen saturation and pulse identified by the detection module to provide coaches and doctors with information about the athlete's condition. Furthermore, through GPRS/Wi-Fi networks, the data can be transferred to the players', coaches', and physicians' smart phones.

CHAPTER-3

AIM AND SCOPE

3.1 AIM

This project is for the common people to check their health parameters regularly. Here for the blind people, we are providing a loud speech output for them and also to give them a compact portable device which is easy to carry. While comparing to other devices in the market we are giving the best quality and a cost-effective device. Because of this device in this covid situation people don't need to go to any clinics or hospitals for their regular health checkup they can check the vital health parameters in their home itself. Therefore, we gathered the main four health parameters which is spo2, BP, temperature and glucose is are measured and displayed at the same time.

3.2 SCOPE

It is essential to check their blood pressure regularly to avoid severe damages. Maintaining and monitoring the blood glucose level saturation level is necessary for the patient recovered from the hospital and diabetes patients. To avoid serious consequences, they must get their blood pressure checked on a regular basis. Maintaining and tracking the blood glucose level saturation level is essential for patients who have recently been discharged from the hospital as well as diabetics. When we travel and there is an emergency, this portable para monitor will come in and handy. It is affordable. A smartphone application based on Android that communicates with Arduino software and a Bluetooth Module will assist visually challenged people by transforming text to audio. To avoid serious consequences, they must get their blood pressure checked on a regular basis. Maintaining and tracking the blood glucose level saturation level is essential for patients who have recently been discharged from the hospital as well as diabetics. When we travel and there is an emergency, this portable para monitor will come in and handy. It is affordable. A smartphone application based on Android that communicates with Arduino software and a Bluetooth Module will assist visually challenged people by transforming text to audio. The new technology allows patients in self-isolation or self-quarantine to report daily health symptoms and difficulties to doctors via their mobile phones, which is a key contribution of this study.

CHAPTER-4

MATERIALS AND METHODS

4.1 METHODOLOGY

To construct this, I used methodology techniques to link various sensors (sensing body parameters) to an Arduino UNO and interface the Arduino UNO with an LCD 2*16 to examine the results. These readings will also be shown on the Android App, which will include a text to speech converter, allowing blind persons to hear the results. All of this gadget's data is saved on a smart smartphone where an app is installed, allowing anyone to access their medical records at any time. There will be no need for visiting physicians to examine such parameters or for different equipment to be carried about for this reason. We've included some coding in our programming to calculate parameters that are related to one another. The body temperature, SPO2, blood pressure, and glucose level were all measured by this gadget. These readings are shown on both the smartphone app and the LCD, giving you access to a basic medical record. There will be no need for visiting physicians to examine such parameters or for additional equipment to be carried for this purpose. The following is a full description of the materials used:

4.1.1 Block diagram of prototype

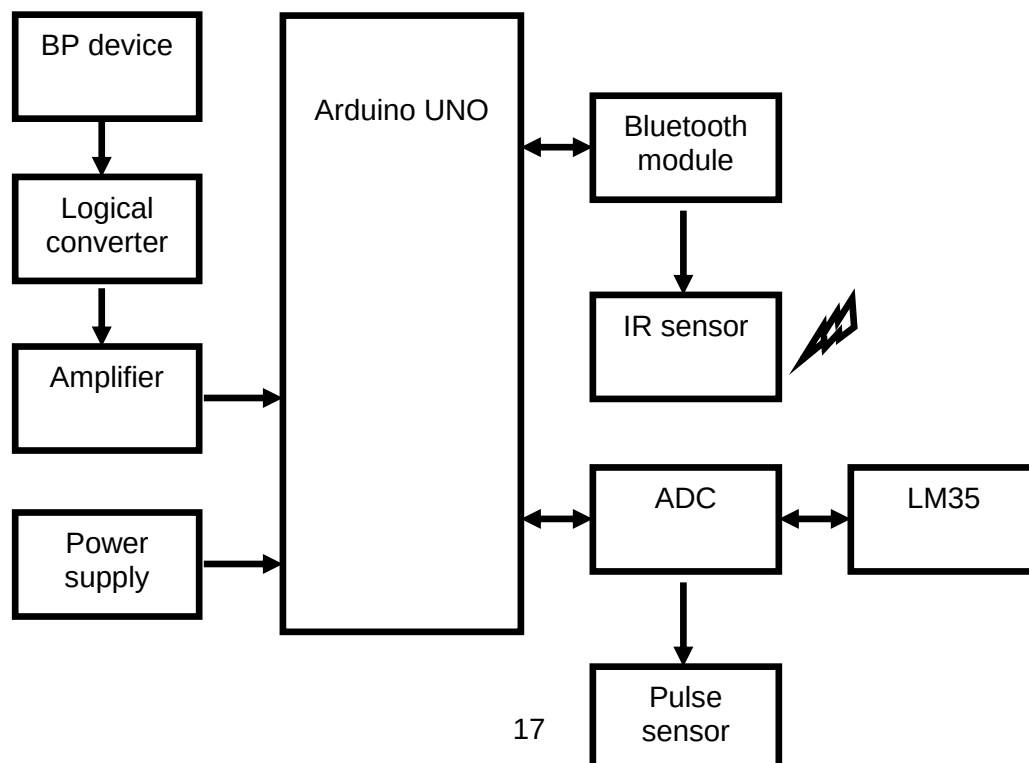


Fig: 4.1: Block Diagram of Prototype

This project is to provide proper monitoring of the patient, we have developed a project in which the heart rate and the blood oxygen saturation levels are constantly measured using the MAX30100 sensor. These two parameters are displayed on an LCD display. When the blood oxygen saturation level of a patient becomes critical then the oxygen supply is opened to the patient and then when it becomes normal the oxygen supply is closed to the patient. Thus, this project helps in taking care of patients at the right time and to avoid difficulties.

4.2 HARDWARE USED

4.2.1 Power supply module

The power supply circuit includes a step-down transformer that converts 230 volts to 12 volts. 4 diodes are used to produce a bridge rectifier in this circuit, which delivers pulsing dc voltage and is then sent to a capacitor filter, which eliminates any A.C components present even after rectification. The filtered DC voltage is fed into the regulator, which produces a constant DC voltage of 12 volts. 230V AC power is transformed to 12V AC (12V RMS value with a peak value of roughly 17V), but the necessary power is 5V DC; hence, 17V AC power must first be converted to DC power before being stepped down to 5V DC. One of the power electronic converters known as a Rectifier may convert AC power to DC. Rectifiers come in a variety of shapes and sizes, including half-wave, full-wave, and bridge rectifiers. The bridge rectifier is commonly used for converting AC to DC because of its benefits over the half and full wave rectifiers.

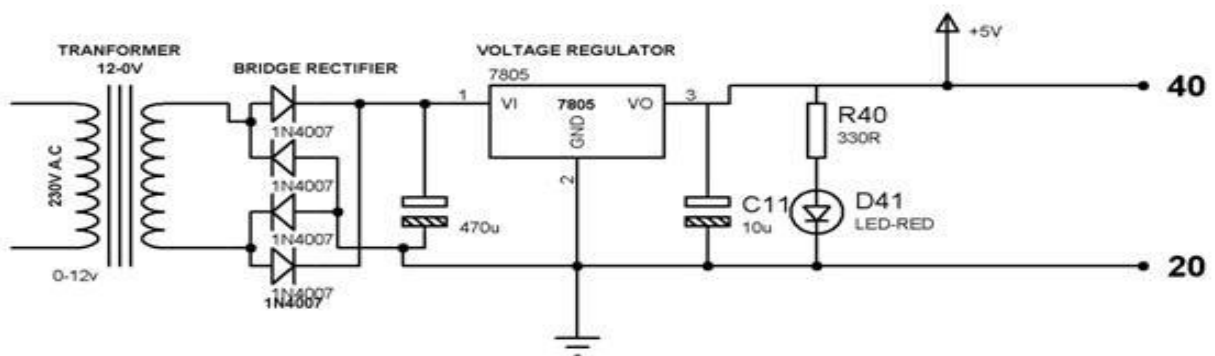


Fig: 4.2: Power Supply Module

4.2.2 Arduino uno kit

The Arduino Uno is an open-source microcontroller board created by Arduino.cc that is based on the Microchip ATmega328P microprocessor. The board includes digital and analogue input/output (I/O) pins that can be used to connect to expansion boards (shields) and other circuits. The board contains 14 digital I/O pins (six of which can be used to generate PWM output) and 6 analogue I/O pins, and it can be programmed using the Arduino IDE (Integrated Development Environment) and a type B USB connector. It can be powered by a USB cable or an external 9-volt battery, and it can handle voltages of 7 to 20 volts.

Memory

The Arduino sketch is saved in flash memory (programmable memory). When the sketch executes, variables are created and modified in SRAM (static random-access memory). EEPROM is a type of long-term memory that programmers can employ. Non-volatile memory types include flash memory and EEPROM (the information persists after the power is turned off). When the power is cycled, SRAM becomes volatile and is lost. On the Uno, the ATmega328P processor has the Arduino sketch is saved in flash memory (programmable memory). When the sketch executes, variables are created and modified in SRAM (static random-access memory). EEPROM is a type of long-term memory that programmers can employ. Non-volatile memory types include flash memory and EEPROM (the information persists after the power is turned off).

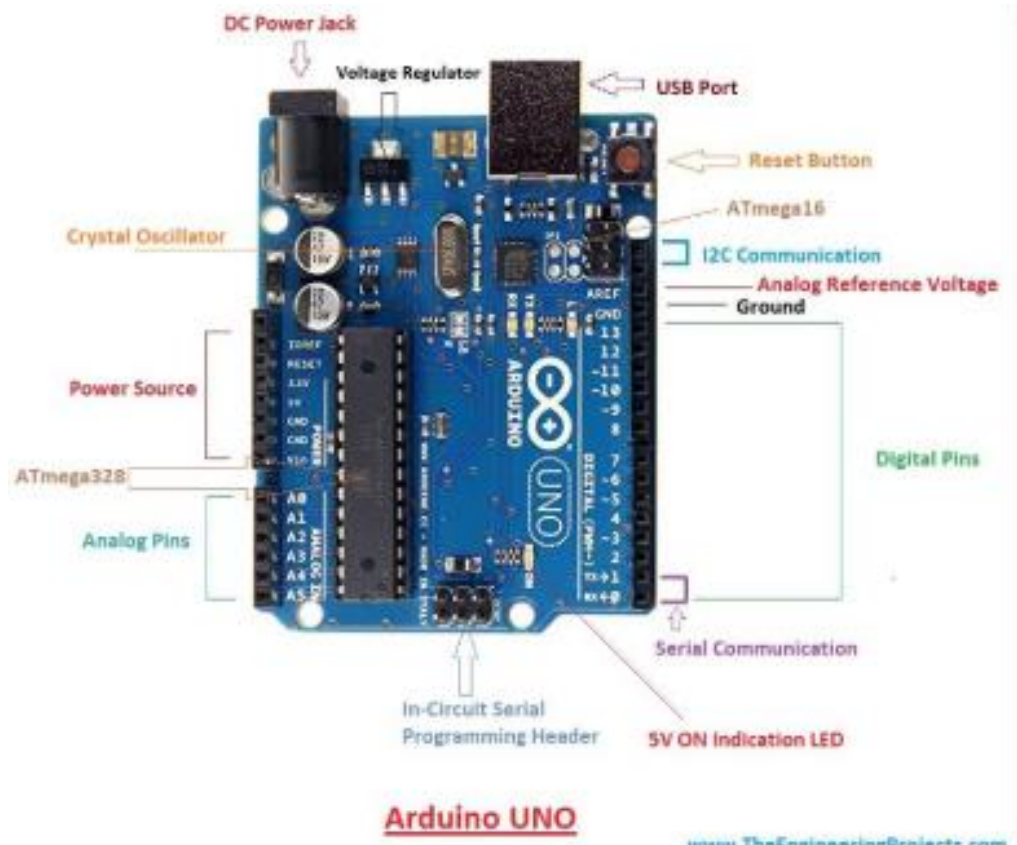


Fig: 4.3: Arduino Uno

4.2.3 Temperature sensor

Several steps must be taken to ensure optimal sensing accuracy. Self-heating, like any other temperature-sensing system, can degrade accuracy. The LM135 should be used at the lowest current that is appropriate for the application.

At the maximum operational temperature, sufficient current must be supplied to drive both the sensor and the calibration pot, as well as any external loads.

Self-heating mistakes can be eliminated if the sensor is utilized in an environment with continuous thermal resistance. If the device is powered by a temperature-stable current, this is conceivable. The temperature and so the heating will be proportional to the Zener voltage. As a result, self-heating and scale factor errors are proportional to absolute

temperature.

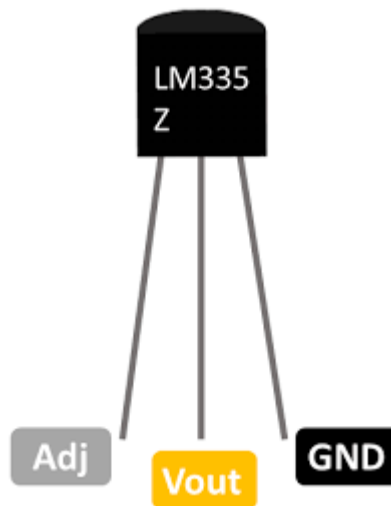


Fig: 4.4: Temperature Sensor

4.2.4 MAX30100 sensor

MAX30100 is a sensor that combines a pulse oximeter and a heart rate monitor. It's an optical sensor that measures the absorbance of pulsating blood through a photodetector after emitting two wavelengths of light from two LEDs - a red and an infrared one. This specific LED color combination is ideal for reading data with the tip of one's finger. The digital output data is stored in a 16-deep FIFO within the device, and it is fully customizable via software registers. It communicates with a host microcontroller via an I2C digital interface. Ambient light cancellation (ALC), 16-bit sigma delta ADC, and unique discrete temporal filter make up the pulse oximetry subsystem in the MAX30100. It operates at ultra-low power, making it perfect for battery-powered devices. The MAX30100 requires a power supply that is between 1.8 and 3.3 volts. Wearable gadgets, fitness assistance devices, medical monitoring devices, and other applications can all benefit from it. The MAX30100 uses 1.8V and 3.3V power supplies, and it may be powered down by software with very little standby current, allowing the power supply to be connected at all times.



Fig: 4.5: MAX30100 Sensor

4.2.5 2x16 LCD Display

Use a 16x2 standard alphanumeric LCD display; they're very common and provide a quick approach for your project to display status messages. An LCD (Liquid Crystal Display) screen is an electronic display module that can be used for a variety of purposes. A 16x2 LCD display is a relatively basic module that is utilized in a variety of devices and circuits. A 16x2 LCD can display 16 characters per line on two lines. Each character is represented by a 5x7 pixel matrix on this LCD. The 224 characters and symbols can be displayed on the 16 x 2 intelligent alphanumeric dot matrix display. There are two registers on this LCD: Command and Data. Multiple commands are stored in the display's command register. data registries This produces a change in the angle of light travelling through the polarized glass molecule, as well as a change in the angle of the top polarizing filter. As a result, a little amount of light can flow through the polarized glass and into a specific area of the LCD. As a result, that particular spot will become darker than the others. The LCD operates on the idea of light blocking. A mirrored mirror is put at the back of the LCDs while they are being built. A polarized glass with a polarizing film is put to the bottom of the device, and an electrode plane formed of indium-tin oxide is kept on top.

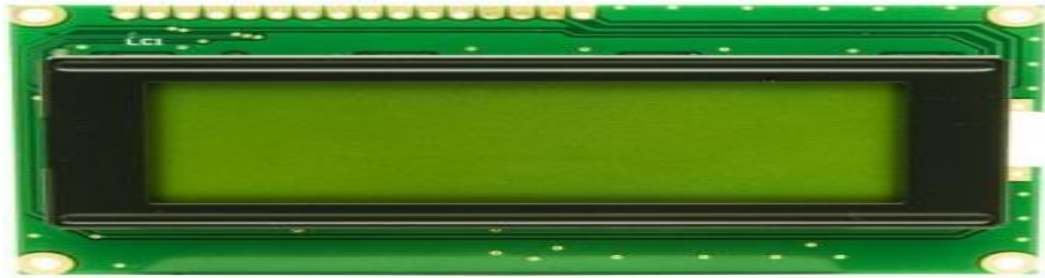


Fig: 4.6: 2x16 LCD Display

4.2.6 IR Sensor

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations. The fig shows the image of a relay.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

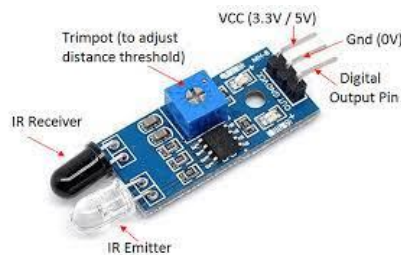


Fig: 4.7: IR Sensor

4.2.7 BP SENSOR WITH PUMP

Many people have a blood pressure monitor at home. They frequently do so in order to manage or treat a specific health problem. Keep a record, or log, of your blood pressure readings if you monitor your blood pressure at home. Your doctor will be able to see how your blood pressure changes throughout the day thanks to the record. It will assist you in documenting whether or not your blood pressure medications are working. Measuring your blood pressure at home is an easy approach to get involved in your health management. It's crucial to have the appropriate size cuff. Your arm size determines the cuff size you require. You may seek assistance from a physician, nurse, or pharmacist. If your cuff is the improper size, blood pressure measurements can be inaccurate. Your blood pressure is checked manually with an aneroid monitor. For blood pressure monitoring, digital devices are more common. They are usually more user-friendly than aneroid units. A gauge and stethoscope are both included in the digital monitor. An error indicator is also included. A tiny display shows the blood pressure reading. It's possible that this is more readable than a dial. Some systems also provide a paper printout of the reading. It's critical to have the right cuff size. The cuff size you need is determined by your arm size. A physician, nurse, or pharmacist may be able to help you. Blood pressure readings can be erroneous if your cuff is the wrong size. An aneroid monitor is used to manually check your blood pressure. Digital blood pressure monitors are becoming more common. They're usually easier to operate than aneroid units. The digital monitor comes with a gauge and a stethoscope. There's also an error indicator. The blood pressure reading is displayed on a little display. This could possibly be more readable than a dial. A paper printout of the reading is also available in some systems.

Working:

Blood pressure is usually measured with a pressure cuff attached to a mercury column. To increase the pressure on the artery, the doctor manually pumps the cuff. Then listen to the sound of blood moving through the artery with a stethoscope.

Instead of mercury, a pressure sensor is utilized to monitor the pressure in the artery and provide an output in an autonomous Blood Pressure measurement system. On the monitor, this digital output is presented. The onboard CPU in this monitor processes the

output from the pressure sensor, records the data, and displays them on the digital read-out screen.

Application of BP- sensor:

This sensor is very essential for individuals with high blood pressure because it may also be used as a 'at-home' solid-state Blood Pressure Monitor. This system is lightweight and portable. It's simple to transport and use, and it's especially valuable in distant locations where medical services are few. The pressure sensor in the cuff is the system's primary sensing component. This pressure sensor should be carefully chosen for an accurate and dependable measurement.

One of the pressure sensors utilized in this system is Honeywell's 26 PC SMT pressure sensor. This sensor is compact, inexpensive, and capable of measuring higher pressure levels. This sensor connects directly to the printed circuit board, allowing it to measure pressure more quickly and accurately. Because the sensor delivers accurate surface data,



Fig: 4.8: Bp Sensor with Pump

4.2.8 Bluetooth module

The HC-05 is a Bluetooth module that can transmit in both directions. It is therefore full-duplex. It is compatible with the majority of microcontrollers. It does so because it uses the Serial Port Protocol (SSP). The module uses a USART (Universal Synchronous/Asynchronous Receiver/Transmitter) to communicate at a baud rate of 9600, although it also supports different baud rates. As a result, we may connect this module to any microcontroller that supports USART. The HC-05 has two modes of operation. The first is Data mode, while the second is AT command mode. The HC-05 is in Data Mode when the enable pin is "LOW." The module is in AT command mode if that pin is set to "HIGH." In this case, we're using Data Mode to control this module.



Fig:4.9: Bluetooth Module

4.3 SOFTWARE USED

4.3.1 *Visual Studio*

Microsoft Visual Studio is utilized as an IDE in this project.

Visual Studio Code blends the ease of use of a source code editor with advanced developer features such as IntelliSense code completion and debugging. It is, first and foremost, an editor who stays out of your way. Less time fussing with your environment and more time executing on your ideas thanks to the delightfully frictionless edit-build-debug cycle. Visual Studio Code is available for macOS, Linux, and Windows, so you can get started right now. Visual Studio Code's core feature is a lightning-fast source code editor that's ideal for day-to-day use. Syntax highlighting, bracket-matching, auto-indentation, box-selection, snippets, and more are all available in VS Code, which supports hundreds of languages. You can traverse your code with ease thanks to intuitive keyboard shortcuts, easy modification, and community-contributed keyboard shortcut mappings. When it comes to serious coding, you'll typically benefit from tools that understand more code than just blocks of text. IntelliSense code completion, sophisticated semantic code understanding and navigation, and code refactoring are all included into Visual Studio Code. When the coding becomes difficult, the tough turn to debugging. We made it happen since debugging is generally the one feature that developers miss the most in a lighter development experience. You may step through source code, analyses variables, view call stacks, and run commands in the console with Visual Studio Code's interactive debuggers Code also connects with build and scripting tools to help you complete typical tasks faster. With Git support in VS Code, you can work with source control without having to leave the editor, including examining pending changes diffs. Customize every feature to your preference and add as many third-party extensions as you want. While most scenarios work right out of the box, VS Code grows with you, and we encourage you to customize your experience to meet your specific needs'. Code comes with enhanced built-in support for Node's. Js programming, including JavaScript and Typescript, and is driven by the same underlying technologies as Visual Studio. Web technologies such as JSX/React, HTML, CSS, SCSS, Less, and JSON are all well-represented in VS Code. Visual Studio Code integrates the finest of web, native,

and language-specific technology in its architecture. VS Code uses Electron to integrate web technologies like JavaScript and Node.js with native app speed and flexibility. The same industrial-strength HTML-based editor that powers the "Monaco" cloud editor, Internet Explorer's F12 Tools, and other projects is used in VS Code. VS Code also employs a tools service architecture that allows it to interface with many of the same technologies that run Visual Studio, such as Roslyn for.NET, TypeScript, the Visual Studio debugging engine, and others. A public extensibility model in Visual Studio Code allows developers to create and use extensions, as well as personalize their edit-build-debug experience.

4.3.2 Arduino Software

In this project the Arduino software is used.

Beginners will find the Arduino software simple to use, but advanced users will find it adaptable. It's compatible with Mac, Windows, and Linux. It is used by teachers and students to create low-cost scientific equipment, to demonstrate chemistry and physics principles, and to begin learning programming and robotics. Designers and architects create interactive prototypes, while musicians and artists utilize it to create installations and try out new instruments. Makers, for example, utilize it to construct many of the items on display at the Maker Faire. Arduino is a valuable tool for learning new skills. Anyone - youngsters, amateurs, artists, programmers - may get started tinkering by following the step-by-step instructions in a kit or sharing ideas with other Arduino members online. For physical computing, there are a variety of additional microcontrollers and microcontroller platforms to choose from. Similar functionality can be found in Parallax Basic Stamp, Net media's BX-24, Phi gets, MIT's Handy board, and many other programs. All of these programs condense the complicated elements of microcontroller programming into an easy-to-use package. Although Arduino simplifies the process of working with microcontrollers, it has some advantages over other systems for teachers, students, and curious enthusiasts.

Inexpensive - In comparison to other microcontroller systems, Arduino boards are comparatively affordable. The Arduino module's cheapest version can be assembled by hand, and even pre-made Arduino modules cost less than \$50.

Cross-platform - The Arduino Software (IDE) is available for Windows, Macintosh OSX, and Linux. The majority of microcontroller systems are only compatible with Windows.

Simple, straightforward programming environment - The Arduino Software (IDE) is simple to use for novices while yet being flexible enough for advanced users. It's built on the Processing programming environment, which is helpful for teachers because students learning to program in that environment will be familiar with how the Arduino IDE works.

Open source and extensible software - The Arduino software is accessible as open-source tools for experienced programmers to extend. People who want to learn more about the language can use C++ libraries, and those who want to learn more about the technical specifics can switch from Arduino to the AVR C programming language. Similarly, if you want to, you can include AVR-C code directly in your Arduino applications.

Open source and extensible hardware - The Arduino board blueprints are made available under a Creative Commons license, allowing experienced circuit designers to create their own version of the module, extending and upgrading it.

CHAPTER – 5

RESULTS AND DISCUSSION

5.1 RESULTS

We are using Arduino software to measure the data from all of the sensors in this project. The measured parameters are shown on an LCD display, and the outputs are relayed to the mobile phone through Bluetooth, where they are read aloud using the text to speech converter.

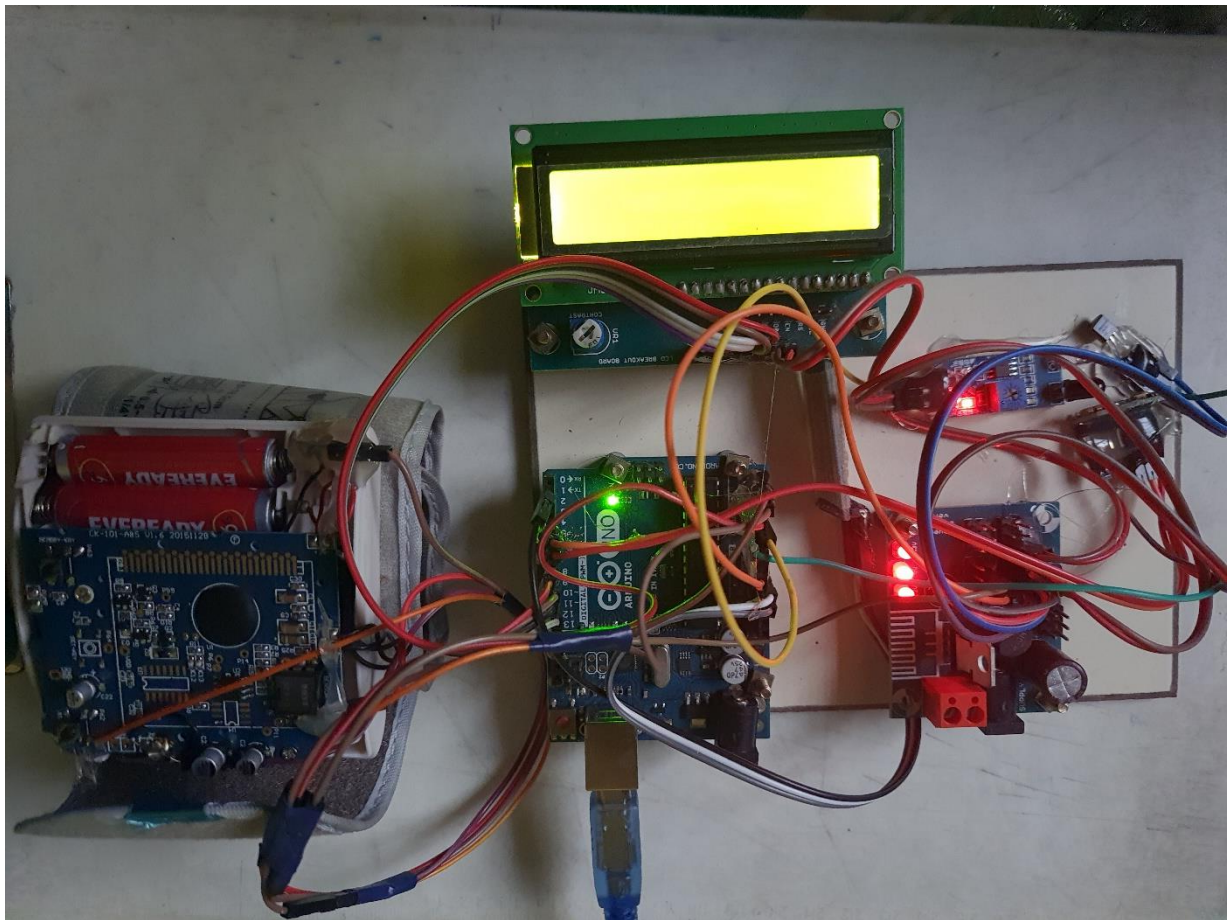


Fig: 5.1: Hardware Set Up

This above picture represents the prototype of our project. Which is contains to Arduino, power supply, IR sensor, temperature sensor, pulse oximeter sensor, blood pressure kit these all connected to an LCD display which will show the output

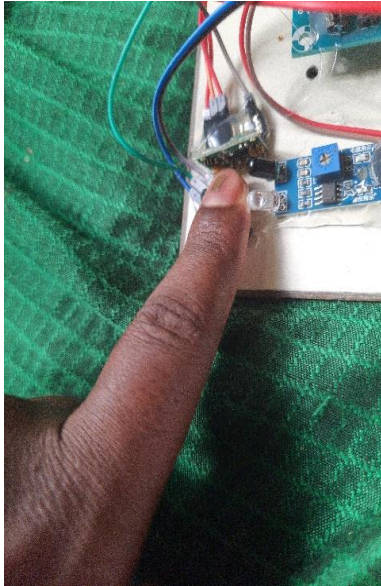


Fig:5.2: Sensor Module

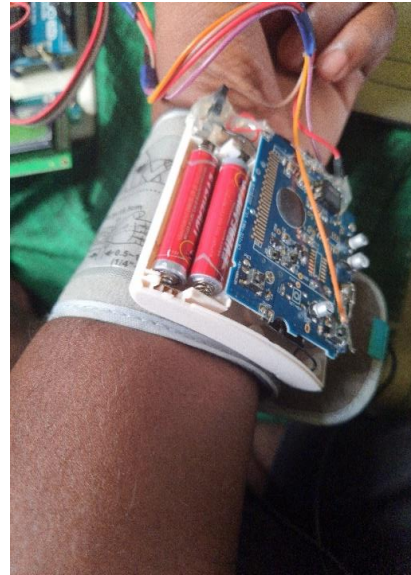


Fig:5.3: BP Parameter

In the Fig 5.2 and 5.3 , To check their temperature, users keep their finger on the sensor module, SPO2 and glucose levels are also measured , Blood pressure band is affixed to the wrist to measure the Pressure level in the Blood

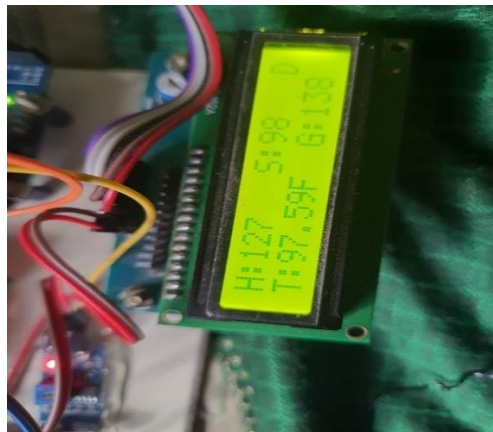


Fig: 5.4: All Parameters Output in Display

Within 10 seconds of executing the procedure, the results are displayed on the LCD screen.

H- HIGH BLOOD PRESSURE

S-SPO2 LEVEL

T-TEMPERATURE

G-GLUCOSE LEVEL

D-DETECTING



Fig: 5.5: Displayed Output Converted to Speech

This programme is used to translate text to speech using a Bluetooth module connected via Arduino software, which aids visually impaired persons.

5.2 DISCUSSION

The University of Connecticut's Department of Biomedical Engineering (David kaput et.al., at 2017) has developed a device that patients can use to collect physiological data outside of a medical facility. Data collection methods that would otherwise be excessively expensive, laborious, or impossible to gather in a medical facility are now possible thanks to this device. Data can be collected on certain days, hours, activities, or even while travelling. Biosensors capture information such as pulse oximetry (SpO2), heart rate, electrocardiogram (ECG), non-invasive blood pressure (NIBP), and weight, which is subsequently sent to an interactive monitoring device through Bluetooth. The information can then be sent to a commercial server, a doctor's office, or a hospital. For typical persons who suffer from diabetes, we employed glucose instead of ECG. Diabetes patients are more prevalent in this society than heart patients.

Cost-effective vital signs monitoring system for COVID-19 patients in smart hospital (Raghied at 2021). Due to a staffing crisis during the COVID-19 pandemic, hospitals are expanding their facilities in non-traditional settings to include centralised communication systems to monitor patients' vital signs and predictive models to

identify their health conditions. In this study, we created a wireless vital signs monitoring system based on a microcontroller that can measure the patient's body temperature, heart rate, blood oxygen level, breathing rate, and electrocardiogram. We were able to get a reliable, low-cost vital signs monitor with outstanding mobility that may be used in large facilities. Apart from ECG, we also included glucose and a text-to-speech converter, which is quite useful for blind people. They can only be used in hospitals, whereas our equipment can be used anywhere.

Intelligent Medical System with Low-Cost Wearable Monitoring Devices to Measure Basic Vital Signals of Admitted Patients (Siraporn Sakphrom at 2021). This article describes the design of a low-cost Wireless Body Sensor Network (WBSN) for monitoring vital signs, which incorporates a low-cost smart wristwatch with an ESP-32 microcontroller and three sensors: heart rate (HR), blood pressure (BP), and body temperature (BT), as well as an IoT platform. The data from the patient's vital signs is analysed and presented on an OLED screen on the wristwatch before being uploaded to a data centre via a wireless connection (Wi-Fi) and a Cloud Thing Board system. When the sensors send out aberrant signals, the data may be reviewed, and medical personnel can be contacted based on a set of sensor parameters. They employed two different sensors for heart rate and oxygen level, but we used the MAX30100 sensor for both heart rate and oxygen level. We also designed our device non-detachable, which reduces the majority of the harm.

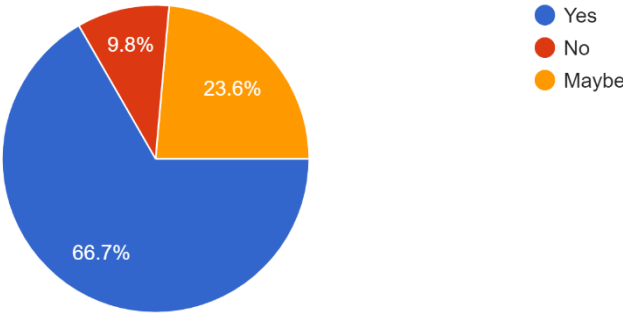
This section provides about a review of applications of ambient sensors and systems used in this project. After the successful implementation and testing of coding the following output was achieved. The screenshots of the outputs have been displayed above the figure.

- Hardware set up
- Measuring parameters (as Normal)
- pressure measurement as normal.
- All parameters output in single display
- Displayed output converted to speech

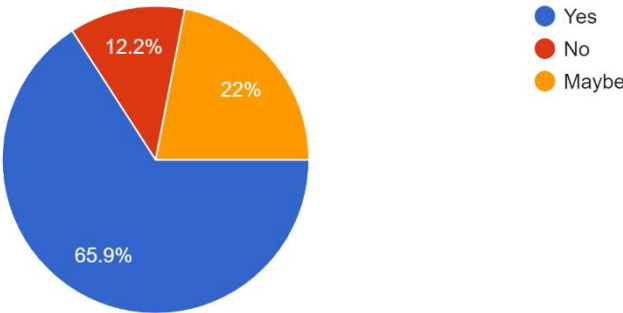
We conducted a survey of around 120 people and obtained the following stake

results for our health parameter, and we believe that the project will be beneficial on a daily basis.

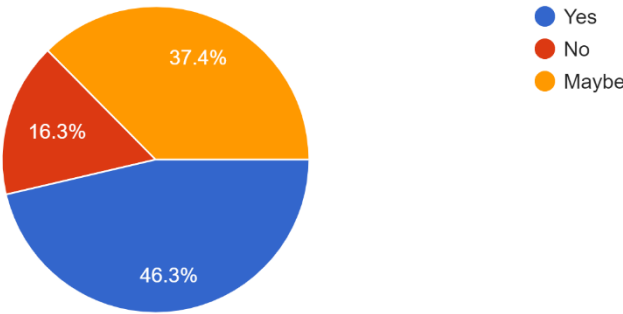
Do you like to check your health parameter daily
123 responses



Are you health conscious ?
123 responses

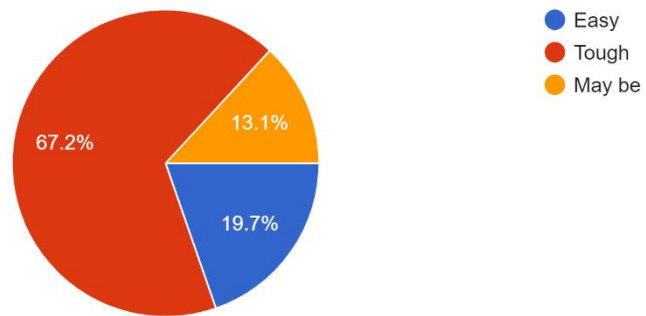


Do you know anyone who goes to hospital twice a day or a week to hospital to check their BP, Glucose, SpO₂ ,Etc...
123 responses



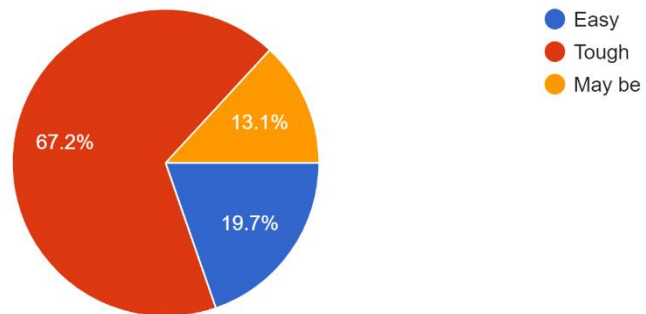
Is it easier or tough going to hospital regularly ?

122 responses



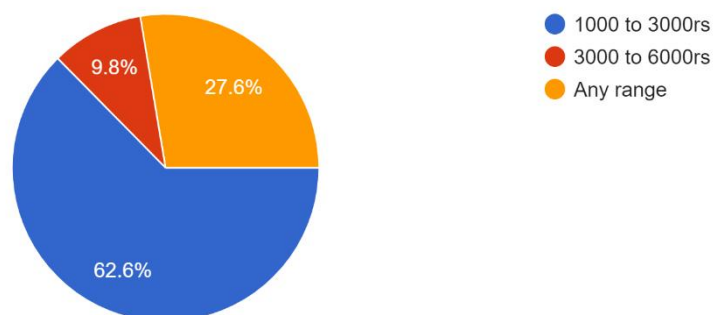
Is it easier or tough going to hospital regularly ?

122 responses



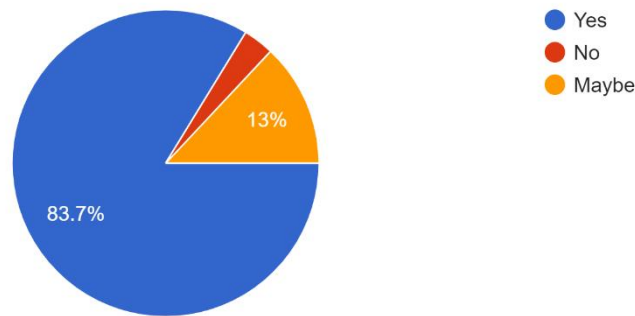
At which range of cost do you expect it should be?

123 responses



Will it be usefull?

123 responses



The survey was conducted with all stakeholders in consideration. The pool of respondents was chosen based on their age, gender, profession, and other factors. The poll featured a series of questions that were answered by persons for which the demand ratio was greater than 60%, indicating that there was a demand for these digital health parameters in the market. According to the survey, there are problems. Consumerism among the new generation has resulted in a demand for efficient, simple, and inexpensive services, which has shifted to the digital forefront with newer companies, start-ups, or enterprise hospitals seeking to expand into the digital services industry to keep up with technological changes.

CHAPTER – 6

SUMMARY AND CONCLUSION

6.1 SUMMARY

Vital Parameter Monitor are a new reality in healthcare that are currently being developed with the goal of being integrated into medical health systems. On the market, there are certain personal monitoring devices that can give instantaneous single-parameter evaluation and transmission. The sensitivity of wearable sensors is an essential attribute that should be extensively researched. We polled around 123 people and acquired the following preliminary findings for our health parameter, and we feel that the project will be useful on a daily basis. Two LEDs, a photodetector, better optics, and low-noise analogue signal processing are used to detect pulse oximetry and heart rate signals. We employed an IR sensor to measure blood glucose levels, as well as a blood pressure sensor. The information from all of the sensors in this project is being measured using Arduino software. Users maintain their finger on the sensor module to monitor their temperature, SPO2 and glucose levels are also checked, and a blood pressure band is attached to the wrist to detect the pressure level in the blood. On the 2 x 16 LCD display, the sensor output is presented. This software is used to converting text to speech by connecting a Bluetooth module to Arduino software, which benefits visually challenged people. According to the findings, including correlation characteristics to indicate the inherent link between the essential parameters enhanced sensitivity. The results of the tests show that the system is stable and that the measurement accuracy is excellent.

6.2 CONCLUSION

Based on the monitor readings, the doctors may make an informed judgement regarding the treatment plan and the course of action that needs to be taken for that specific patient. Sensitivity, specificity, and overall classification accuracy were used to compare the baseline and suggested systems. The inclusion of correlation features to represent the intrinsic relationship between the critical parameters improved sensitivity, according to the findings. The number of people who needed to be admitted to hospitals grew as a result of the COVID-19 pandemic. As a result,

hospitals in many parts of the world experienced issues as a result of increased workloads and inadequate resources. As a result, a successful design and deployment of a full-scale smart monitoring system could lead to fully fledged smart hospitals or intelligent senior living facilities. From testing studies with a 60-person sample size, an intelligent medical system with low-cost wearable monitoring devices was developed with excellent accuracy for measuring basic vital signals of admitted patients. The fundamental low-cost vital signs sensors and the IoT platform were built, completing the monitoring system and allowing it to be used for a variety of medical applications with minimal cost and installation time, such as field hospitals, bedridden patients, and palliative care patients.

REFERENCES

- 1) Chi kuf so, kup sze Choi, Thomas Wong KS, Joanne Chung WY, Recent advances in noninvasive glucose monitoring, Med Devices (Auck), (2012), 10-13.
- 2) Kang J, Kim KJ, Park KS, Kim HC. IT-based diagnostic instrumentation systems for personalized healthcare services. Stud Health Technol Inform. (2005); 117:180-90.
- 3) Daarani.P & Kavithamani.A, BLOOD GLUCOSE LEVEL MONITORING BY NONINVASIVE using near infra-red SENSOR, (2017)
- 4) Garima P Gupta P, Rajashree Nair, Jeyanthi Ramasamy, An ANN based SpO2 Measurement for Clinical Management Systems Energy Procedia (2017), 117:393-400.
- 5) Kaputa D, Price D, Enderle JD. A portable, inexpensive, wireless vital signs monitoring system, BiomeQad Instrum Technol, (2010) ,44(4),350-3.
- 6) Kranjec J, Begus S, Gersak G, Drnovsek J, Non-contact heart rate and heart rate variability measurements, Biomedical signal processing and control volume 13, (2014),102-112.
- 7) Lei Ru, Bin Zhang, Jing Duan, Guo Ru, Ashutosh Sharma, Gaurav Dhiman, Gurjot Singh Gaba, Emad Sami Jaha, and Mehedi Masud, A Detailed Research on Human Health Monitoring System Based on Internet of Things, Deepak Gupta, (2021)
- 8) Poposka, Gjoko Spasevski, Magdalena Kostoska, Bojana Koteska, Monika Simjanoska , Nevena Ackovska, Aleksandar Stojmenski, Jurij Tasic, and Janez Trontelj, (2020),3-8.
- 9) Madhan Mohan P, Annie Nisha A, Nagarajan Velmurugan, Smiley Jeya Jothi E, Measurement of arterial oxygen saturation (SpO2) using PPG optical

- sensor, International Conference on Communication and Signal Processing, (2016)
- 10) Mian Mujtaba Ali, Shyqyri Haxha, Munna Alam M, Chike Nwibor, Mohamed Sake, Design of Internet of Things (IoT) and Android Based Low-Cost Health Monitoring Embedded System Wearable Sensor for Measuring SpO₂, Heart Rate and Body Temperature Simultaneously, Wireless Personal Communications (2020) 111:2449–2463
 - 11) Mohammad Salah Uddin, Jannat Binta Alma, Suraiya Banu, Real time patient monitoring system based on Internet of Things, International Conference on Advances in Electrical Engineering, (2018)
 - 12) Paul Benni B, David MacLeod, Keita Ikeda, Hung Mo Lin, A validation method for near-infrared spectroscopy-based tissue oximeters for cerebral and somatic tissue oxygen saturation measurements, (2018), 32(2), 269-284.
 - 13) Rachel Austin, Fiona Lobo, Swarnalatha Rajaguru, GSM and Arduino Based Vital Sign Monitoring System, (2021), volume 15, 78-89.
 - 14) Sachi Marathe, Dikas Zeeshan, Tanya Thomas, Vidhya S, A Wireless Patient Monitoring System using Integrated ECG module, Pulse Oximeter, Blood Pressure and Temperature Sensor, International Conference on Vision Towards Emerging Trends in Communication and Networking, (2019)
 - 15) Sanjay Kumar, & Piyush Agrawal, IoT-based diagnosing of Heart rate and SpO₂ saturation level, IILM AHL College of Engineering & Technology, (2014), 8-12.
 - 16) Shahanim Mohamad Hadis, Nor, Nazri Amirnazarullah, Muhammad, Mahdi Jafri, Muhammad, Abdullah, Samihah, IoT Based Patient Monitoring System using Sensors to Detect, Analyse and Monitor Two Primary Vital Signs, Journal of Physics, Conference Series, Volume 1535, Issue 1, (2020)
 - 17) Weenk, Harry van Goor, Maartje van Acht, Lucien J LPG Engelen, Tom H. van de Belt, Sebastian J. H. Bredie. A smart all-in-one device to measure vital

signs in admitted patients, Yoshiaki Taniyama, Osaka University Graduate School of Medicine, (2017),1-4.

18)Yu Fu, Jian Liu System design for wearable blood oxygen saturation and pulse measurement device Procedia manufacturing (2015), volume 3, 1187-1194.

19)Zhiyuan Lu, Xiang Chen, Zhongfei Dong, Zhangyan Zhao, Xu Zhang, A Prototype of Reflection Pulse Oximeter Designed for Mobile Healthcare, IEEE Journal of Biomedical and Health Informatics,(2015),