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RESEARCH ARTICLE
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Wearable Smart Device That Can Monitor Multiple Vital Parameters

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ABSTRACT

The health care sector is one of several remote monitoring applications that the Internet of Things (IOT) is revolutionising. The demand for portable multi-vital sign monitoring devices has grown dramatically in recent years as a result of increasing awareness of individual physical health conditions. A portable method for monitoring several vital signs was created in this work. This article introduces the second iteration of VITAL-ECG, a smart device designed to monitor the most important vital parameters as a "one touch" device, anywhere and at fair price. It is a wearable device that can access bio-parameters like the patients or individual oxygen levels and ECG when used in combination with an IOT cloud. Even if it isn't yet considered medical equipment, a close examination of electrocardiograph used as the industry standard is required.

Keywords: *IOT, SPO2, ECG, Arduino, Wearable device*

INTRODUCTION

Healthcare services are one of the many sectors where internet of things (IOT) technologies are spreading swiftly. These technologies have enormous potential for the future of technology, industry, and society. Real-time medical issue diagnosis, remote patient monitoring and other IOT capabilities may be leveraged to enhance healthcare services, boosting their efficacy and user experience. The internet of medical things is expanding due to the widespread usage of wearable technology and its numerous health monitoring applications (IOMT).The IOMT greatly lowers the death rate by decreasing diseases early. Analysing clinical datasets is a crucial problem in the prediction of cardiac disease.

The proposed research aims to forecast heart lines using machine learning (ML) classification techniques. IOMTbased cloud-for diagnostics for heart diseases have been proposed. In order to swiftly classify patient data using ML, fog layer is deployed. A number of simulations are used to evaluate the performance of the health care model, and the result demonstrates a significant improvement over prior models with 97.32%accuracy, 97.16% precision, 97.22%Gmean. IoMT in IoT classifies health data and reveals hidden patterns using AI, ML, and data mining techniques. IoMT provides real-time patient data, enabling clinicians to manage patients in a methodical manner. The IoT technologies work by integrating many devices. Considerable amount of data is provided by these linked gadgets. Doctors frequently use information to assess health danger trends.

It also helps in assessing how different drugs affect individuals. IOMT is a network of software and hardware used in healthcare. IoMT offers the service for gathering patient data and transferring it to healthcare professionals.

IoMT has changed how patients and doctors interact, making it simpler to give patients individualized treatment while also encouraging preventative health. The healthcare sector has adopted the IoMT in order to increase the effectiveness of the sector by deploying IoT-connected equipment. Technology is being used by businesses and hospitals to track down patients and remotely monitor them. IoMT is frequently employed in patient monitoring applications through linked devices. The use of IoT devices in healthcare procedures increases the effectiveness of staff members and processes. Growing need for real-time healthcare solutions and growing wearable device usage are projected to fuel the IoMT market. A linked gadget makes it simple for medical professionals to evaluate patients, which lowers the cost of consultation. The equipment used for ambulatory health monitoring, remote monitoring, motion detection, and activity monitoring are the primary topics of this article. The devices covered in this article are those that track one or more external signals and activate their detection, monitoring, recording, and reporting functions in response to changes in those signals. More specifically, it pertains to wearable technology that may be used to track physiological health, track activity, track human condition, classify activities, and detect falls.

Many wearable medical devices are currently available on the market, but they suffer from a number of drawbacks, including: An imbalance in hardware volume and cost, High power consumption ,Unsatisfactory accuracy and The ability to measure only one important parameter; it is not possible to measure two or more parameters at onceThe ECG and oxygen cannot currently be detected by a wearable device. The detection of these characteristics is difficult and time-consuming. The second version of VITAL-ECG, a smart gadget created to monitor the most crucial vital parameters as a "one touch" device, anywhere, at a reasonable price, is presented in this article. It is a wearable gadget that, when used in conjunction with an IOT cloud, may measure bio parameters like the patient's or individual's oxygen levels and EKG. The most crucial vital indicators, such as heart rate, Spo2, ECG may be collected with the VITAL-ECG. It also records the volume of physical activity. It is a wearable and reasonably priced.

LITERATURE SURVEY

Royce Thomas Iype(2019) The ambulance management system with real-time patient monitoring using IOT that the author presented shows that a lower death rate is a good indicator of a country’s effective healthcare system. A critical patient should be sent as soon as possible to a hospital with the necessary equipment in order to lower the fatality rate. The significant of the golden hour in situations of the traffic accidents doesn’t need to be explained. The movement of the ambulances on our roadways must be hassle-free in order to carry out this objective successfully. The autonomous ambulance management system with real time patient monitoring utilizing IOT provides the solution to the vexing problem of how to shorten the handover period. The suggested system will locate the closest hospital, the shortest route, communicate critical information to the hospital in advance, and furthermore manage the traffic signal to guarantee that the ambulance may travel without incident. A successful and efficient method of aiding in lifesaving.

Anam Bhatti (2020) the author offered a useful tele monitoring method for patients at far-off locations. Throughout the last few decades, scholars have paid a lot of attention to the healthcare monitoring system. A consequences of the growing trends in information and communication technology (ICT) applications is the emergence of potential technology that have replaced the conventional healthcare system with a more advanced digital healthcare system. Even though these technologies have significantly altered healthcare situations, none of them has been totally successful in offering a comprehensive, current, and dependable tele monitoring framework in terms of cost, time, and improved real-time diagnosis. As a result, the majority of currently deployed technologies are employed in processes that are both costly and time-consuming.. This prototype framework will be used for the real time tele monitoring, which will eventually improve diagnosis and care for the community of remote patients. The construction of a unique, quick and affordable tele monitoring architecture based on the

Arduino hardware system is the primary subject of this article. The main objective was to create a prototype that might function as a dependable patient monitoring system, allowing medical practitioners to keep an eye on patients who are either critically ill in the hospital or unable to go about their everyday lives normally. In this paper, we offer a low-cost, Arduino based tele monitoring system that can deliver real-time information on a patient's physiological state. In order to correctly assess the state of patients' health and fitness, our suggested system is created to measure, monitor, and communicate significant physiological characteristics of patients in the form of vital signs.

Md Ashraf Uddin, Andrew Stranieri, Iqbal Gondal, Venki Balasubramanian (2019 For a variety of applications, such as ongoing Remote Patient Monitoring, the Internet of Things has allowed services without human interaction (RPM). Nevertheless, RPM is difficult due to the complexity of RPM structures, the amount of produced datasets, and the restricted power capacity of devices. In this study, we present a tier-based End to End architecture with a Patient Centric Agent as its core for continuous patient monitoring. When body area sensor data is flooding in and has to be securely stored, the PCA handles a Block chain component to maintain anonymity. A simple communication protocol is included in the PCA-based architecture to ensure data security as it travels through various components of the continuous, real-time patient monitoring architecture. Simulation findings show that the PCA-based End to End architecture can improve security and privacy in remote patient monitoring.

Tingting Zhu1 , Glen W. Colopy1 , Clare MacEwen1 , Kate Niehaus1 ,Yang Yang1 , Chris W. Pugh2 and David A. Clifton1(2019) By using affordable wearable technology to monitor continuous time-series vital sign data, patient wellbeing may be managed. The generated data may then be combined with automated algorithms to offer early notice of a person's health decline. Without taking into account the time-variability and inter-subject variability of the data being gathered, such algorithms are often trained for a large population. It might be challenging to build a generalised population model from a small sample size when there are few participants available. The physiological patterns of certain "normal" individuals may differ from those of other "normal" patients, generating various "normal" clusters/subgroups. This makes it challenging to deduce a population model. To circumvent these difficulties, it is desirable to create time-series models that are particular to a patient or subgroup. For each patient or group of patients who exhibit comparable patterns, we suggest utilising Bayesian Hierarchical Gaussian processes to estimate the hidden latent structure of the vital sign trajectory. Using the symmetric KullbackLeibler divergence, we further establish the viability of such a model in novelty detection.

T. M. Aarthi1, B. Chitra Raghavi, A. **Shanmugapriya (2020)** Wearable technology is utilised in many applications to gather data, such as step counts, sleep patterns, workout data, and health-related data. It is crucial to protect the security of the obtained data due to the type and richness of the data that these devices collect. This study introduces a brand-new, lightweight authentication method appropriate for use with wearable technology. For secure communication between the wearable device and the mobile terminal, the system enables a user to mutually verify his or her wearable device(s) and the mobile terminal (such as an Android or iOS smartphone) and create a session key among these devices. Next, the suggested scheme's security is proven using the widely used Real-Or-Random model and the well-known Automatic Validation of Internet Security Protocols and Apps formal security verification tool (AVISPA). In our last section, we provide a comparative assessment of the proposed scheme's overheads, including computing and communication costs, security and functionality characteristics, and evaluation results from the NS2 simulation.

Proposed Statement

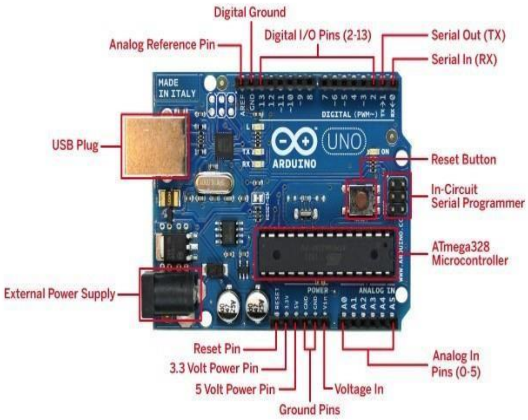
The wearable gadget has a number of sensors, including heart rate, ECG, and oxygen saturation (SP02) sensors, to help collect data and analyses all of these symptoms. The device then sends the data to the cloud for additional analysis after determining the indicators. The wearable gadget detects these elements and delivers accuracy values. In this part, an Arduino microcontroller is used to manage the entire system. In this part, an Arduino microcontroller is used to manage the entire system. A heart rate sensor is used to read the heartbeat. An ECG sensor is used to determine the HEART BEAT. A SPO2 sensor is used to assess blood oxygen levels. A LCD show the status at the moment. Between 95 to 100% of the time, adults and kids are considered to have normal spo2 readings, an electrocardiogram is a medical test that can diagnose the electrical activities that heart generates when it is contracting. Any number of illness might be indicated by an irregular ECG.A heart rhythm abnormality that shows up on an ECG sometimes is merely a common variation that has no bearing on your health. The goal of connecting the internet of things is to enable data exchange with other systems and devices through the cloud. A buzzer is used to inform people when there is any unusual behaviour.

System Design

The embedded hardware modules that seem to be essential of the system design each contribute in different ways to the creation of a smart pilgrim system. Here, the choice of hardwires is covered.

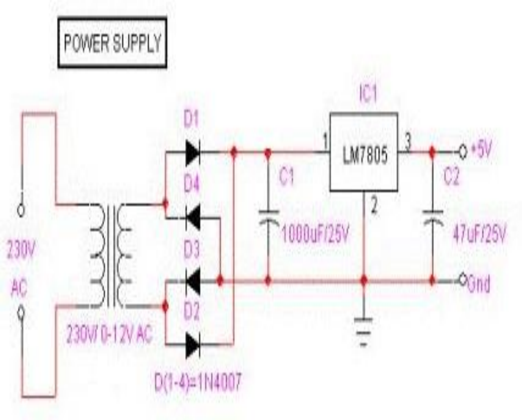
A.Arduino Uno

Arduino-based hardware is open source. On the Arduino website, the hardware reference design are available and distributed under a creative commons retribution share alike 2.5 licence.For various hardware variations, additional designs and production files are available. The Arduino Uno may be programmed using the Arduino software IDE. Several Arduino functionalities can be used to connect with a computer, an additional Arduino or other microcontrollers. The Atmega328 supports serial communication on digital pins 0(RX) and 1.The ATmega16u2 on the board routes this serial connection over USB and presents as a virtual com port to computer applications.



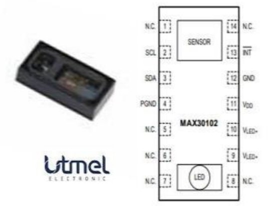
B. Power Supply

The crucial section is the power supply one. The project must deliver a regular power source with a consistent output in order to be successful. A 0-12V/1 MA transformer is used in this. An on/off switch and fuse connect the primary of this transformer to the main supply to guard against overload and short circuits. The secondary is connected to the diodes to convert 12V AC electricity to 12V DC voltage. After being filtered by the capacitors, the IC 7805 further regulates the signal to +5v.



C.Spo2 And Ecg Sensor

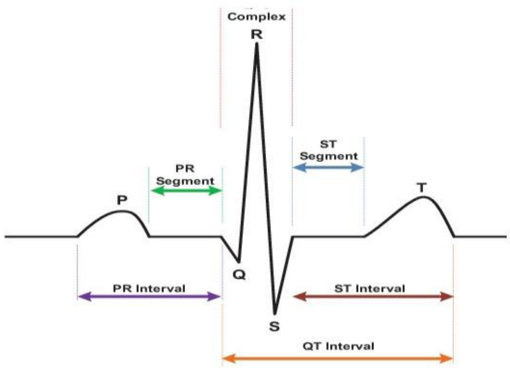
A biosensor module called the MAX30102 has integrated pulse oximetry and heart-rate monitoring. It includes built-in photodetectors, LEDs, optical parts, low-noise electronics, and ambient light rejection electronics. With the VITAL-ECG, pulse oximetry is implemented using a MAX30102. Adopting an integrated circuit provides the main advantage of containing all required functional lenses, LEDs, and photodiodes on a single chip. This makes it possible to significantly reduce the PCB area and, more importantly, the manufacturing complexity of the finished board. By doing all data acquisition, post processing, and SpO2 calculations prior to the data being communicated to the microcontroller, the integrated solution also avoids the need for further data processing on the microcontroller.



ECG SENSOR AD8232   MAX30102 Pinout

D. Introduction Of Piezo Buzzer

Square waves power a piezo buzzer at its rated voltage (V p-p). While functioning typically, the operating voltage Nonetheless, it cannot be confirmed that it will deliver the least SPL at the rated voltage. Current Consumption: The current is continually utilised during regular operation. Yet once work starts, it frequently needs three times as much current. Larger capacitance piezo buzzers can generate louder SPL, but they also consume more energy. Sound Output: A decibel metre is used to measure sound output. Across a 10 cm area, square waves and the specified voltage are delivered. A buzzer may make sound at any frequency, but the recommended frequency is best since it generates the highest and most consistent SPL.



Pr Interval

The right atrium to the left electrical impulse produces the first wave, Known as the PR interval. The first chamber to get an electrical impulse is the right one. The depolarization of the chamber is caused by the electrical impulse. The left atrium begins to contract as soon as the electric impulse passes over the top of the heart. The left atrium is in charge of moving newly oxygenated blood from the lungs into the left ventricle through the left and right pulmonary veins. The pulmonary veins are shown since they carry oxygenated blood.

Qr Interval

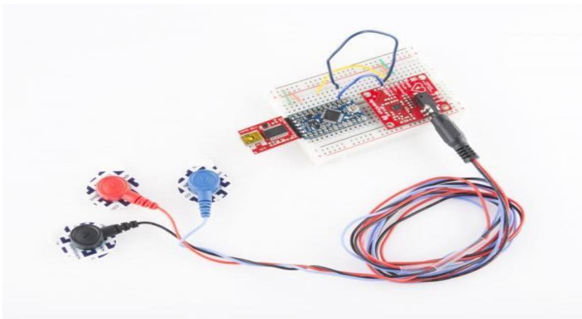
The QT interval is when things truly starts to get interesting. What causes the recognisable “BEEP” heard on cardiac monitors is a sophisticated QRS process. Both ventricle start to pump during QRS.Blood with low oxygen content begins to be pumped from the right ventricle through the left and right pulmonary arteries into the lungs.

Since they are transporting deoxygenated blood, the pulmonary arteries are shown in the image as blue. Even yet, because they transport blood out from the heart, arteries are still referred to such. Science once more moreover, the left ventricle is starting to deliver newly oxygenated blood to the rest of the body through the aorta.

E. Sensor Pad Placement

Now that the electronics are complete, let's examine the ideal location for the sensor pad. It is advisable to snap the sensor pads onto the leads before putting to the body.

The measurement becomes more precise the nearer the heart the pads are. The cables are colour coded in the table, which is based on Einthoven's triangle, to make it simpler to identify their proper placement. The sensors may be mounted to the leg and forearm, as seen in the image on the left. They can also be positioned on the chest above the right lower belly and close to the arms, as seen in the image on the right (i.e., just above the right hip).

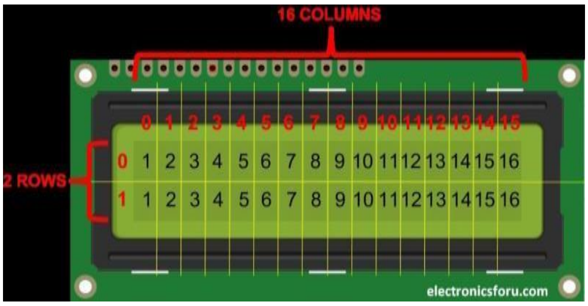


Sensors connected to heart monitor

Cable colour	Signal
Black	RA (Right Arm)
Blue	LA (Left Arm)
Red	RL (Right Leg)

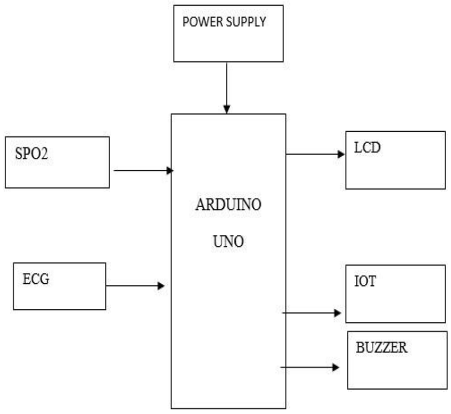
F. Liquid Crystal Display

An LCD panel is a flexible type of electronic display. A 16*2 lcs display is a widely used, reasonably basic component that is utilised in several devices and circuits. These modules are preferred over multi-segment LEDs with seven segments or more. The justifications cite LCD's inexpensive price, simplicity of programming, and absence of restrictions when it comes to showing distinctive and even customised characters, animations, and other data.



V. Working Principle

This method suggests using the Arduino Uno microcontroller to interact with the sensors and communication equipment. For the internet of things, Oxygen saturation, an electrocardiogram sensor, a liquid crystal display, a buzzer, and a nodemcu.By incorporating the oxygen saturation (Spo2) test measures how much oxygen is in your blood compared to the maximum amount that it can carry. Between 95 and 100% of the time, adults and kids are considered to have normal spo2 readings (below 95% is considered abnormal).An ECG is a medical test that can diagnose cardiac abnormalities by monitoring the electrical activity the heart generates when it is contracting. Any number of illness might be indicated by an irregular ECG.

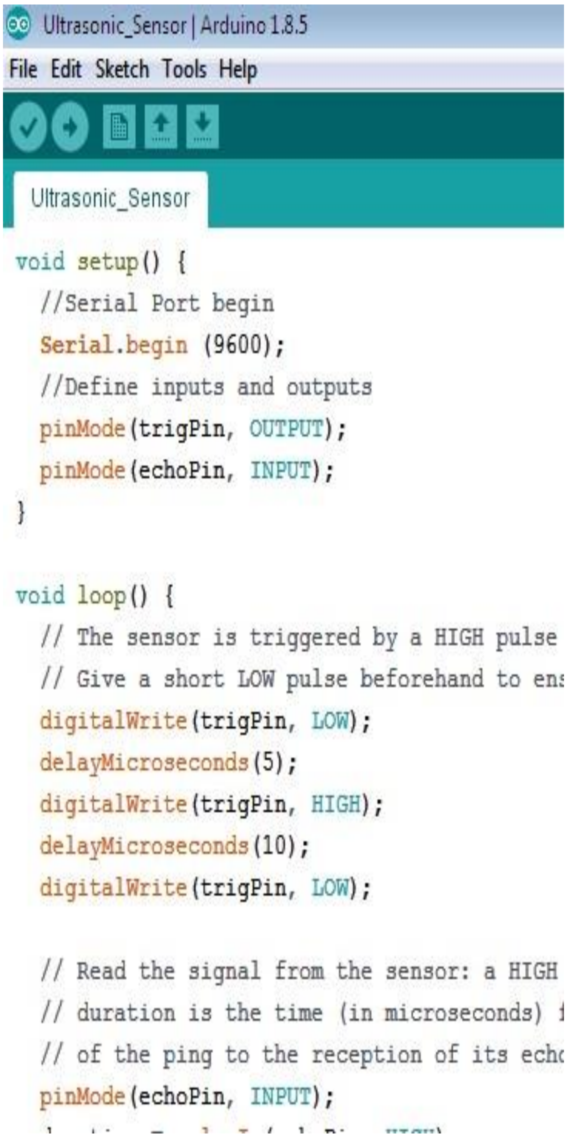


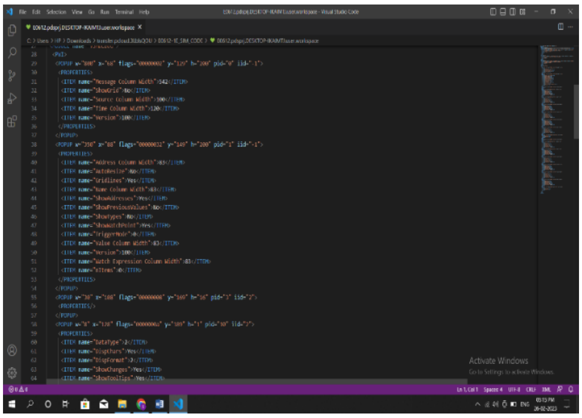
On an ECG,a heart rhythm irregularity might occasionally just be a normal fluctuation that doesn't harm your health. An abnormal ECG can also be a sign of a medical emergency, such as a myocardial infraction/heart attack or a dangerous arrhythmia. The goal of connecting the internet of things is to enable data exchange with other systems and devices through the cloud. PLX-DAQ offers simple

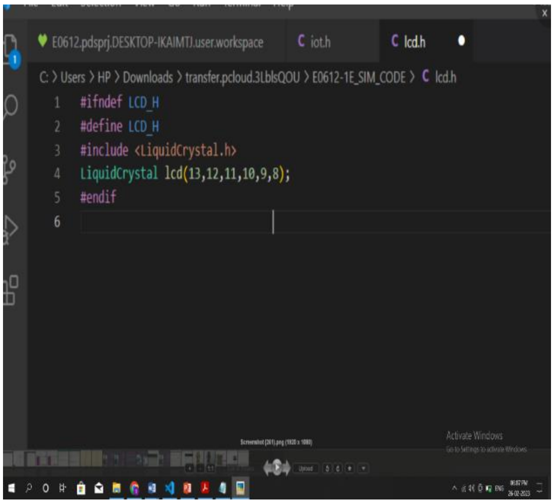
Spreadsheet analysis of field data, sensor analysis, and real-time equipment monitoring. A buzzer is used to inform people when there is any unusual behaviour. All of the most recent sensor data is shown on the liquid crystal display.

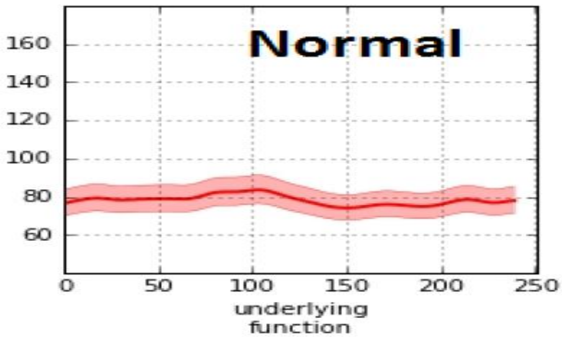
RESULT AND DISCUSSION

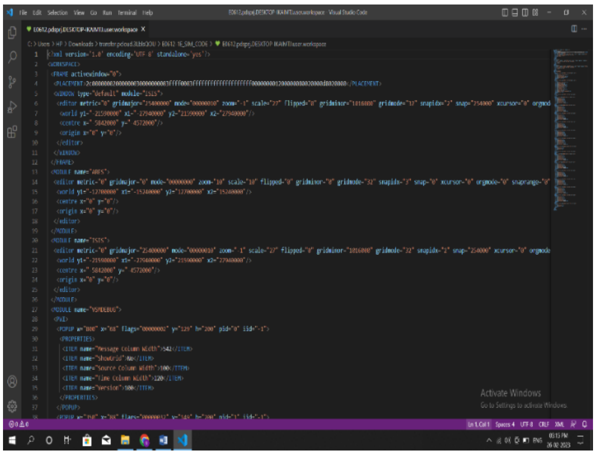
This improvement will be smoothly integrated into the person's life because the full framework will be contained in a little wearing band. The IoT's applicability in health care systems is expanding quickly due to the sensors used. This enables a range of physical duties, elderly care, and remote health monitoring. The ability of tiny, fantastic, modern sensors in health bands connected by IoT technologies allows the checking system to push near to the person for health monitoring rather than the person travelling to the expert. The sensors on the health band collect data about health. The Arduino Uno may be programmed using the Arduino Software (IDE). Choose "Arduino/Genuine Uno" from the Tools> Board menu (according to the microcontroller on your board). For further details, consult the tutorials and the reference. You may add new code to the Arduino Uno's ATmega328 without using an external hardware programmer thanks to the boor loader that is pre-programmed on the chip. It communicates via the original STK500 protocol (reference, C header files).

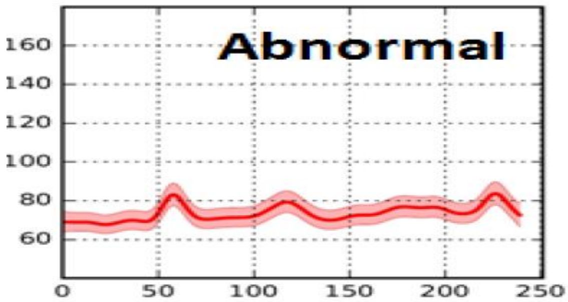












Making distinctive characters on an LCD is nor extremely challenging. It demands knowledge of the LCD's custom generated random access memory (CG-RAM) and LCD chip controller. Most LCDc use the Hitachi HD4478 controller.CG-RAM is the main technology utilised to produce customised characters. The custom characters are saved after being specified in the code. The CG-64-byte RAM's size enables the simultaneous generation of eight characters. A character is eight bytes in size.

CONCLUSION

We have provided an up-to-date analysis of physiological data and activity tracking systems created on a wearable platform in this work. The primary goal of a wearable health monitoring system is to allow people to lead independent, active lives in the comfort of their own homes while ensuring continuous, nonintrusive, nonintrusive and seamless surveillance of their physical and mental well-being. The production and use of small, affordable, low-power sensors, actuators, electronic components, and potent computers have been made possible by the rapid advancement of technology over the past few years, paving the way for non-intrusive e, continuous, and extremely affordable monitoring of a person's health.

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