RTOS Health monitoring system with blood oxygen saturation analytics.

Mr. Chiranjeevi M.R*	Assistant Professor, Department of computer science Engineering, Adichunchanagiri University, B G Nagara, Karnataka, India. *Corresponding Author
Chandrashekar H C	Principal & Head, Department of Community Health Nursing, Adichunchanagiri College of Nursing, Adichunchanagiri University, B G Nagara, Karnataka, India.
Keshavamurthy C D	Professor & Head, Department of Mental Health Nursing, Adichunchanagiri University, B G Nagara, Karnataka, India.
Dr. Balaji M S*	Assistant Professor, Department of Medical Surgical Nursing, Adichunchanagiri University, B G Nagara, Karnataka, India.

Abstract

This project presents an implementation of low power consumption, real-time remote bio-signals monitoring system based on the internet of thing technology wearable, portable wearable, portable,This implementation provides an improved step-in remote health monitoring field. Numbers of people, who require health care increase year by year and the conventional bio-signals monitoring systems require patients' attendance in person inside hospitals. This might cause an inefficient situation to take care of the patients during this pandemic, especially those who have critical and unstable health conditions. Therefore, internet technology along with modern electronic devices could offer promising solutions in this field. Based on that, this project utilizes a mobile application and web dashboard as IoT platforms to monitor remotely the live ECG signal, heart rate, SPO2, Blood pressure and the body temperature of patients. The signals are measured and processed by using a high-speed microcontroller. The main contribution of this paper is sending an electrocardiogram (ECG signal) to a smart mobile phone to be watched by a doctor. This assists in heart diseases diagnosing before the worst case can happen. Finally, the obtained results of this project are illustrated on both smartphone and web dashboard as well.

INTRODUCTION

In this day and age, it is now difficult for one to be conscious about their health. As health care goes unnoticed and untreated, people become more susceptible to health issues. Healthcare is the maintenance and monitoring of health through prevention, diagnosis and treatment. This is delivered by health and medical professionals such as doctors and nurses. However, in many sectors of the world, such healthcare is still unavailable despite improvement in both technology and healthcare. The other problem is the added expenditure of post-operative and post-hospitalization care. After the patient is discharged, follow-up at home is equally important and necessary to ensure the well-being of the patient. At home, continuous monitoring of health conditions provides caretakers visibility into the patients' path to recovery. Therefore, careful consideration must be taken for complete recovery. The process of noting down the health conditions at regular

intervals is prone to user error. For example, it is possible that one forgets to take the reading at the required time, or it is also possible that a wrong entry is made. It is also important to administer medicine to the patient at the scheduled time. However, the possibility of providing the wrong pill or forgetting to administer medicine is high. These tasks can be simplified by developing a system that notifies them regarding their medication. Adoption of Internet of Things (IoT) in healthcare can significantly improve patient-care and reduce user errors. IoT is a system of interconnected devices and sensors that is capable of exchanging data. This allows them to make smart decisions. With the growth and advancements made in the area of Internet of Things, better and improved healthcare is now possible and easily accessible.

The integration of IoT in healthcare can drastically reduce fatalities, and ensure a focused attention towards patients. With the integration of IoT in healthcare, it is possible to make quicker and accurate diagnosis regarding diseases and finding the best cure for it. The idea of the proposed work is to construct a real-time health monitoring system using Internet of Things (IoT) along with a smart phone application and web dashboard. The system consists of sensors that monitors different health factors such as blood pressure, electrocardiogram (ECG), pulse rate, body temperature and oxygen saturation (SpO2). The application presents the information from the sensors at regular intervals in a simplified manner that is understandable by all.

OBJECTIVES

The main aim of the proposed system is to provide efficient, Low cost and accurate remote human body monitoring using IoT. we have focused on the data readability of the sensors where anybody can easily can identify the status of the health without any prior technical knowledge. Giving care and health assistance to the bedridden patients at critical stages with advanced medical facilities have become one of the major problems in the modern hectic world. In hospitals where many patients whose physical conditions must be monitored frequently as a part of a diagnostic procedure, the need for a cost-effective and fast responding alert mechanism is inevitable. Proper implementation of such systems can provide timely warnings to the medical staffs and doctors and their service can be activated in case of medical emergencies.

MOTIVATION

In rural hospitals, the facilities for health caring are limited. The poor quality of health management enables issues in health care system Everyone should get the knowledge of own health as easy and early as possible. Also, it should be worth for each. Latest report of The India Spend analysis of data says that the 500,000 doctor's shortage in India. WHO defines the doctor patient ratio will be 1:1000 which has been failed in India In developing countries there is lack of resources and management to reach out the problems of individuals.

In this COVID-19 pandemic daily routine checkup of the patient in hospitals who is not affected by the corona may be expose to virus and affects his health. For this purpose, various systems which give easy and assured caring unit has been developed. This system reduces time with safely handled equipment

LITERATURE SURVEY

Internet of Things (IoT) in healthcare has a multitude of benefits such as better patient-care, reduced user errors and smart decision making. A study [1] proposed the development of a healthcare system that allows guardians and doctors to oversee the health conditions of patients remotely through Internet.

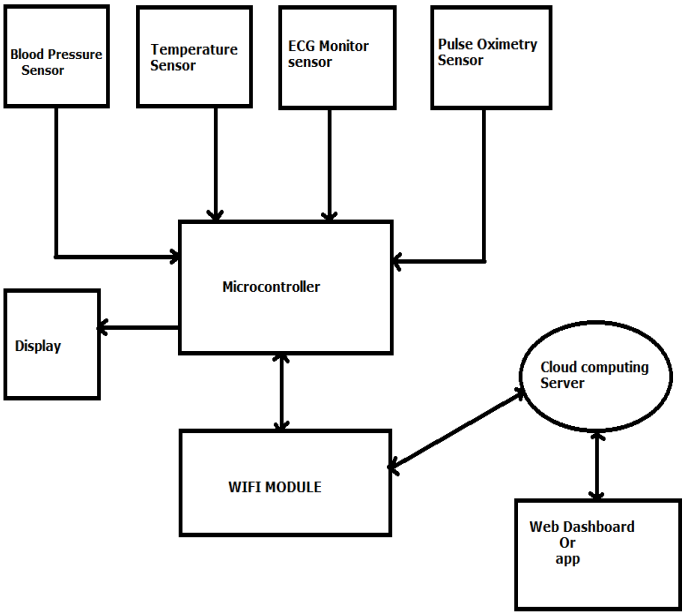
The system was developed using the E-Health Sensor Shield Kit, Phi gets Interface Kit and Arduino. The system also included a web interface using JavaScript, HTML5 and PHP. Study [3] suggested the development of system that monitors temperature and heartbeat using Arduino.

Acute health conditions might lead to sudden death. Many people die suddenly around the world because of dysfunction in one or more body organs. Before that happen, these organs produce abnormal signs. These signs, which called bio-signals, can be detected and collected via sensors. Based on the search scope, the remote healthcare systems based on IoT technology depends on microcontroller and gateway to upload data. Arduino microcontroller family is used frequently in this field. Some projects utilize NODEMCU which is ESP8266 based board [4].While others utilize Arduino UNO with ESP9266 module [5]. Other projects make matching between one of Arduino boards and Raspberry Pi board. The processing is performed by the Arduino board and the Raspberry Pi is the gateway [6].

Moreover, projects depend on Raspberry Pi for processing and uploading data to the IoT server [7]. However, some projects depend on the Arduino board for processing purposes and utilize the smartphones as gateway [8]. Sensors connected to the microcontroller via wires like most of the projects [4-7] or via a wireless protocol such as the HC-06 Bluetooth module [8].

PROPOSED METHODOLOGY

The objective of this system is to record the various sensor information and display it to the users in a simple user-friendly manner. The recorded information which can be accessed through the app and web dashboard will indicate whether the reading is within the normal limits. It will also notify the user and the contacts regarding the medication requirements such as dosage, intake time etc. In this section, the components in the architecture will be elaborated.



The proposed system comprises of sensors that monitor different health parameters, namely pulse rate, blood pressure, electrocardiogram (ECG), body temperature and oxygen saturation (SpO2). The components used are described as below.

a) Blood Pressure Sensor: BPS-BTA is a non-invasive sensor developed to measure human blood pressure. It is capable of measuring systolic, diastolic and mean arterial pressure using the oscillometer technique. Monitoring blood pressure is important because as it goes higher, there is more strain on the arteries thereby making it weaker. Due to these reasons, the chances of a stroke, heart attack, dementia is possible.

b) Pulse oximetry Sensor and body Temperature sensor: MAX30102 Pulse Oximeter is used in the proposed design to measure the temperature and oxygen saturation. Pulse oximeter is a non-invasive test which employs a probe that can be secured to a finger or earlobe. It measures the oxygen saturation level in blood. Normal oxygen saturation levels are between 95 and 100 percent. Low oxygen saturation levels below 90 percent can cause cells to be strained and damaged. Pulse oximeter is used to monitor the health conditions of a patient with problems that affect blood oxygen levels such as anemia, heart attack, heart failure etc.

c) ECG Sensor: AD8232 ECG is adopted to measure the heart's electrical activity at rest. ECG (Electrocardiogram) provides information such as the heart rate and rhythm. It can also provide information regarding the enlargement of the heart due to high blood pressure (hypertension), signs of decreased oxygen delivery to the heart, increased thickness of heart muscle and also reveal indications of a previous heart attack

d) WIFI Module: Wi-Fi Module is an economical Wi-Fi microchip. Its integration with TCP/IP protocol stack allows microcontroller to access Wi-Fi. This is integrated onto the microcontroller board.

Working of the System

Microcontroller is connected with the components of the sensing unit, WIFI Module, and is powered by an external battery. The sensors are attached onto the patient's body. The system proposed will work as a real-time monitoring system. According to the adjustments such as time interval between each reading made in the application, the readings of the sensors are recorded by the application and displayed on the display. The processed data are sent to the web dashboard and android, iOS application using cloud computing where the each and every data is stored and can be monitor.

In case an emergency event is triggered, the application will send a notification and alarm of the situation. The mobile application will also provide an interface which notifies the user and the contacts of the medication that needs to be taken, according to the time specified. The application records these details and sends it to the web dashboard and to the applications accordingly.

Advantage of this project

1. IOT Monitoring proves really helpful when we need to monitor & record and keep track of changes in the health parameters of the patient over the period of time. So, with the IOT health monitoring, we can have the database of these changes in the health parameters. Doctors can take the reference of these changes or the history of the patient while suggesting the treatment or the medicines to the patient.
2. Hospital stays are minimized due to Remote Patient Monitoring.
3. Hospital visits for normal routine checkups are minimized.
4. Patient health parameter data is stored over the cloud. So it is more beneficial than maintaining the records on printed papers kept in the files. Or even the digital records which are kept in a particular computer or laptop or memory device like a pen- drive. Because there are chances that these devices can get corrupt and data might be lost. Whereas, in the case of IOT, the cloud storage is more reliable and does have minimal chances of data loss.

Applications

- Remote human health analysis.
- All health details of patient will be stored in cloud computing system.
- Patients are monitored from distinct places by knowing the patient health records.
- It is also used to check the health of a person with any condition that affects blood oxygen levels, such as:
    - Heart attack.
    - Heart failure.
    - Chronic obstructive pulmonary disease (COPD)
    - Anemia.
    - Lung cancer.
    - Asthma.

- Pneumonia.

EXPECTED OUTCOME

The sensors details are displayed on the LCD display locally, and On the android Or iOS through internet of things. The sensors details can be stored in CSV format

Hardware and software Requirements

Hardware Requirements

1. **Blood Pressure sensor**

Features

- Intelligent automatic compression and decompression
- Easy to operate, switching button to start measuring
- 60 store groups memory measurements
- Can read single or all measures
- 3 minutes automatic power saving device
- Intelligent device debugging, automatic power to detect
- Local tests for: wrist circumference as 135-195mm
- Large-scale digital liquid crystal display screen, Easy to Read Display
- Fully Automatic, Clinical Accuracy, High-accuracy
- Power by External +5V DC
- Serial output data for external circuit processing or display.

Specification

- Working Voltage: +5V, 200mA regulated

- Output Format: Serial Data at 9600 baud rates (8 bits data, No parity, 1 stop bits). Outputs three parameters in ASCII.

Sensing unit wire length is 2 meters

2.Pulse Oximeter and Temperature Sensor (MAX30102)

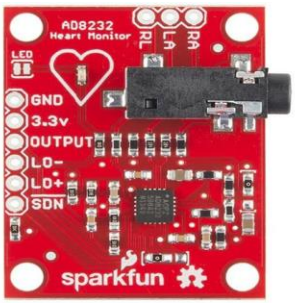
MAX30102 is an integrated pulse oximetry and heart-rate monitor sensor solution. It integrates two LEDs (IR and Red), a photodetector (visible + IR), optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. It is fully configurable through software registers, and the digital output data is stored is stored in a 32-deep FIFO within the device.

Features

- Integrated Cover Glass for Optimal, Robust Performance
- Ultra-Low Power Operation for Mobile Devices
- Programmable Sample Rate and LED Current for Power Savings
- Low-Power Heart-Rate Monitor (< 1mW)
- Ultra-Low Shutdown Current (0.7µA, typ)
- Fast Data Output Capability
- High Sample Rates
- Robust Motion Artifact Resilience
- High SNR
- -40°C to +85°C Operating Temperature Range

3.ECG Monitoring Sensor (AD8232)

AD8232 ECG Module integrated with AD8232 IC from Analog Devices, which is a single-chip designed to extract, amplify, and filter biopotential signals for biopotential measurement applications (like ECG and others). ECGs can be extremely noisy so that the AD8232 Single Lead Heart Rate Monitor acts as an op-amp to help obtain a clear signal from the PR and QT Intervals easily.



Features of the AD8232 ECG Module

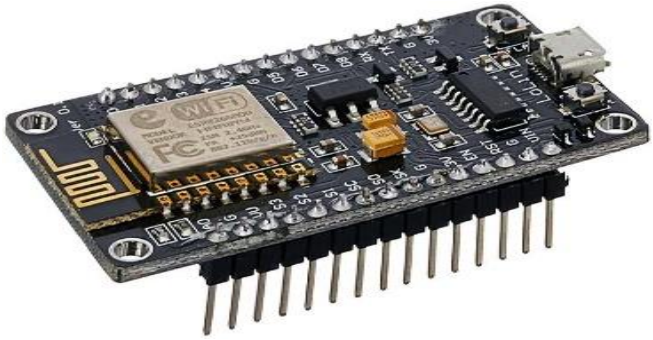
- Fully integrated single-lead ECG front end.
- Common-mode rejection ratio: 80 dB (dc to 60 Hz).
- Two or three-electrode configurations.
- Qualified for automotive application.
- Single-supply operation: 2.0 V to 3.5.
- Fast restore feature improves filter settling.

4. ARDUINO DUE

ARDUINO DUE board is one of most powerful development boards in ARDUINO series. DUE board not only has tons of features it also has terrific processing speed making it suitable for advanced applications. DUE could be considered as professional board considered UNO as beginner board. DUE board also developed on ARM controller series where as others boards are developed on ATMEGA controller series.

5. WIFI MODULE(ESP12E)

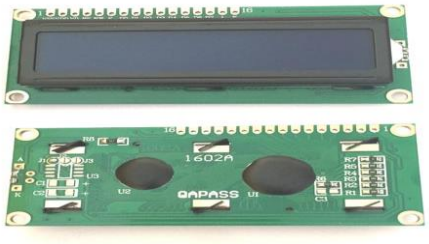
NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.



Specifications & Features

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

6.Display



Features of 16×2 LCD module

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.

- Each character is built by a 5×8-pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters
- Available in Green and Blue Backlight

Software Requirements

1. Arduino IDE

A program for Arduino may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

A program written with the IDE for Arduino is called a sketch. Sketches are saved on the development computer as text files with the file extension. ino. Arduino Software (IDE) pre-1.0 saved sketches with the extension. pde. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

2. BLYNK SERVER

There is need to control the processor board like Arduino Raspberry Pi using apps. Blynk is an app with IOS and Android platforms which will make this possible. Here by simply dropping widgets on mobile screen we can establish graphic interface for another project using Blynk digital dash board and it is very simple to use. This app will not true to some specific board instead it is a supporting hardware of our choice.

Whenever the processor board are used linked to internet through Wi-Fi or Ethernet, Blynk will get is online and ready for "internet of your things".

REFERENCES

1.Ghosh, A.M., Halder, D. and Hossain, S.A., 2016, May. Remote health monitoring system through IoT. In 2016 5th International Conference on Informatics, Electronics and Vision (ICIEV) (pp. 921-926). IEEE.

2. Wu, T., Redouté, J.M. and Yuce, M., 2019. A Wearable, Low-Power, Real-Time ECG Monitor for Smart T-shirt and IoT Healthcare Applications. In Advances in Body Area Networks I (pp. 165-173).

3. Krishnan, D.S.R., Gupta, S.C. and Choudhury, T., 2018, June. An IoT based Patient Health Monitoring System. In 2018 International Conference on Advances in Computing and Communication Engineering (ICACCE) (pp. 01-07). IEEE

4. A. Škraba, A. Koložvari, D. Kofjač, R. Stojanović, V. Stanovov, and E. Semenkin, 2017 Prototype of group heart rate monitoring with NODEMCU ESP8266, in 2017 6th Mediterranean Conference on Embedded Computing (MECO), pp. 1-4.

5 .D. S. R. Krishnan, S. C. Gupta, and T. Choudhury, 2018 An IoT based patient health monitoring system.