IoT Based Health Monitoring System for Intensive Care Unit

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***Abstract*—This work consists of the design and development ofa project used in an intensive care unit or ICU where criticallyill patients are admitted. therapy. For such critical conditions, doctors must always have up-to-date information about patient's health-related parameters such as their blood pressure, heartrate and temperature. Do manually, it is too tedious a task and also approaching for more patients impossible. For this type of situation, this IOT based system can bring automationcan constantly update the doctor over the Internet. Monitoring various patient parameters using the Internet of Things. In the patient monitoring system based on the Internet of Things project, parameters in real time the health of patients is sent to talk about the matter. There is a fundamental difference betweenthe two SMS based patient health monitoring and IOT based patient monitoring system.**

Key Words: **IOT SYSTEM, HEALTH MONITORING SYS-TEM, THINGS SPEAK.**

I. INTRODUCTION

With the development of the world, health monitoring system is used in every area such as hospital, home care unit and sports. This health monitoring system is used for patients with chronic diseases who are on daily check-ups. Heart rate abnormalities are usually difficult to monitor
manually by the patient himself. Average beats per minute for 25-year-olds varies between 140-170 beats per minute,while for a 60-year-old it is around 115-140 beats per minute and body temperature is 37 degrees Celsius or 98.6 Fahrenheit.Patients are poorly oriented in manual therapy commonly used by doctors to monitor the number of heartbeats. Various internal body monitoring tools are available in the marketChanges. However, there are many limitations in the main- tenance part due to their high cost and size tools and patient mobility. Various biomedical sensors like temperature sensor, heart rate sensor and blood pressure sensor are used for health monitoring state that is integrated into one system on a chip.If any color change takes the place where it is announced.This notification would help to take appropriate action in a particular case time.

II. LITERATURE SURVEY

Raghavendra K K presented "Using IOT based smart health-care system Raspberry Pi". They used an exclusive sensorto monitor the patient's health parameters. Therefore, the author used the Raspberry Pi platform for IoT. Raspberry Piis a platform that offers a compact, low-level Linux server platform costs. The combination of Raspberry Pi and IoT is a new game-changing technology healthcare system. Raspberry Pi collects various data from sensors and high flexibility automated, low cost, etc. Cloud capabilities allow customersto build and deploy their applications in a virtual environment servers. Cristina Elena Turcua presented "The Internet of Things as a key enabler to deliver sustainable healthcare". Here, the author considers the IOT as a global network infrastructure connecting physical and virtual objects. Thisarchitecture consists of the existing and evolving development of the Internet and networks. It offers exclusive object identifi-cation, sensors and connectivity options. Therefore the sensorswill have a high data collection rate.

R.Rubasri presented "Simulation of a health care monitoringsystem in Internet of Things by Using RFID" and proposed effective healthcare monitoring system using IoT. A health monitoring system plays a vital role IoT; The RFID tag isused to initialize the bed system as a key. Sensors are usedfor frequent monitoring of the patient's condition. Informationreport about of the patient is transferred to the website via the IOT system so that the doctor can know about the patient's
condition. The movable bed mechanism is used for this adjustthe bed according to the patient's condition. The buzzer shouldindicate close people that the patient is in a critical situation.Thirumurugan, S. presented "Literature Survey on ECG Feature Extraction". In this article, the health status of thepatient was monitored. It is well organized here a healthmonitoring system developed and designed by the author.System allows doctors to monitor the patient's health param-eters (temperature, pulse, ECG, position). Patient parametersare continuously measured (temperature, heartbeat, EKG) andtransmitted wirelessly using ZigBee. Provides solutions forimproving patient health power performance and managementmonitoring system. The presented system is used for contin-uous observation and analyze the data in the microcontroller.If the health parameter of a particular patient falls below acertain range, an SMS is sent to the doctor's mobile number
using a standard GSM module.

Hemalatha Rallapalli introduced "IOT based patient mon- itoring system". It is a mobile physiological monitoring sys- tem that is capable of continuous monitoring monitoring the patient's heart rate using an ECG. Use of exchangeable electrodes ECG sensor can be attached to the patient's chest. The signals produced during muscle contraction are the systemrecords and records. The signals collected from the body are converted to electrical signals. This article shows the use of a smart healthcare system. This

new technology is able to offer patients a wide range of benefits early detection of abnormal conditions.
Dogan Ibrahim presented “Heart rate Fingertip Measure- ment Using a Low-Cost Microcontroller”. IOT has a wide scope applications. IoT was developed for wireless sensor net-works (WSNs). Using IOT, suggestions for health monitoring are presented. There are some issues that are related to health monitoring and IOT. New technologies help minimize better quality as well as security concept. New they use technologiesand methodologies. Aurdino board, Wi-Fi modules, tempera- ture, Pulse oximeter, blood pressure and heart rate sensors are used in IoT.
Esrat Jahan presented “Overview of Heart Rate Monitoring System and Pulse Oximeter”. This post describes an inex- pensive device that measures a patient’s heart rate by placing the sensors on your fingers, later the result will be displayedon the LCD. Designed even non-professionals can use the system. A change in heart rate can be displayed using a graph using a graphic LCD. Maximum and minimum heart for a certain time rates can be displayed using the proposed system. Abnormalities are displayed on the LCD signaled by a buzzer.In order to send the heart rate to the computer, the output should be connected.
Presented by Ashley A. Patil ”Review of IOT-Based Smart Health System”. Here is the architecture of Smart Health Care Monitoring and IOT are demonstrated by the author. New tech-nologies help minimizing better quality and safety concepts. ECG signals are obtained using electrodes that are placedon the chest. Later leads are connected to the ECG sensor (AD8232). A sensor is used in the measurement electrical activity of the heart. Problems and challenges that can befaced the future represents this system. IOT applications can be enhanced with new ones methodologies and technologies. Sensors such as blood pressure, temperature, heart rate, and ECG are used in IOT along with Raspberry Pi kit and Wi-Fi module.
Sneha N. Malokar presented ”IOT based healthcare moni- toring system”. Constant observation is required in hospitals where patients are under medical care for a longer periodof time. Although the patient is not in critical condition, the doctors still they need confirmation of their health parameters.Hospitalization costs are high and expensive these days. So cheers policies in various countries have shifted their focus away from providing reactive, acute care provide care outside the hospital. So the author designs and builds the sensing data that adjusts the system to display the exact parameters of the patient’s body.

III. METHODOLOGY

A. Proposed System

In this proposed work vital parameters like temperature, heart rate and the oxygen level readings are monitored bythe Node MCU. Node MCU since sensor and outputs to thingspeak and monitors the health of patients in the ICU. DHT11 is used to detect temperature and heart rate sensor to read heart rate and an an oximeter is used to detect a patient’s oxygen level. So ICU based on IoT patient monitoring systemseffectively monitor patients’ health and save lives in time.
IOT Based Health Monitoring Used for ICU is MCU NODE

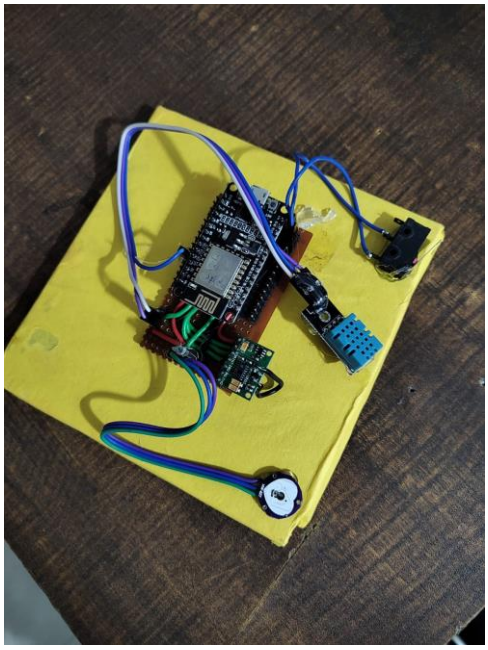

Fig. 1. Proposed system model

based system which collects information about the patientusing several sensors. The system consists of heart rate sensor for measuring heart rate value and DHT 11 sensor for measure-ment temperature and oximeter for measuring oxygen level in the patient. Blood a pressure and heart rate monitoring module connected to and physically connected to the system worn by the user. After pressing the sensor, it measures blood pressure in systolic mode and diastolic along with the heartbeat and sends it to the central controller. The The temperature sensor senses the temperature of its environment, so when this sensoris reports the user’s body temperature in close proximity. All of these the sensors are connected as output devices to the MCU node. The doctor can thus obtain access to these vital parameters related to patient health through IOT. The doctor can thus gain access to these vital parameters that relate to the patient health over IOT. a complete schematic of the system isshown in the block diagram including displayed measurementsof heart rate, SpO2 and body temperature in Arduino IDE serial monitor and IOT application. data about

measurementof all parameters in the Arduino IDE serial monitor. All sensorparameter display on Things Speak. Programming is doneusing Arduino IDE software and Circuit simulation was done using proteus software.

B. Hardware Description

NODE MCU

NodeMCU (Node MicroController Unit) is open source soft- ware and a hardware development environment that is builton very cheap System-on-a-Chip (SoC) called ESP8266. ESP8266, designed and built by Espressif Systems, contains all the key elements of a modern computer: CPU, RAM, networks (wifi), and even a modern operating system andSDK. When shopping at in bulk the ESP8266 chip costs only

$2 each. This makes it a great choice IoT projects of all kinds.Through its pins we can read inputs – light on the sensor, fingeron the button or Twitter message - and turn them into an output

- motor activation, LED lighting, publishing something online.It also has WiFi capabilities so we can control it wirelesslyand to make it work on a remote installation easily! We can tell our board what to do sending a set of instructions to the microcontroller on the board. For this we can use Arduino software (IDE).

Fig. 2. Node MCU

DHT 11 Sensor

The DHT11 is a humidity and temperature sensor that generates calibrated digital exit. DHT11 can interface with anymicrocontroller like Arduino, Raspberry Pi, etc. and get instantresults. DHT11 is cheap humidity and temperature sensor that provides high reliability and long-term stability.

It uses a capacitive humidity sensor and a thermistor to measure the surroundings of air and outputs a digital signal onthe data pin (no analog input pins needed). His very easy to useand libraries and sample codes are available for Arduino and Raspberry Pi. This module makes it easy to connect a DHT11 sensor to an Arduino or microcontroller because it containsthe pull up resistor needed to use the sensor. Only To usethe sensor, three connections need to be made - Vcc, Gnd and Output. It has high reliability and excellent long-term stability,thanks to the exclusive digital technique of signal acquisition and sensing of temperature and humidity technique.

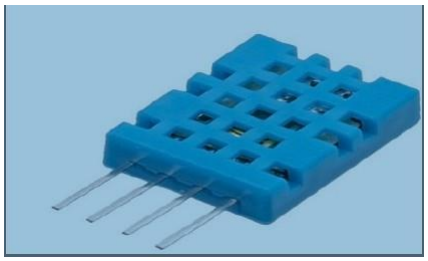

Fig. 3. DHT 11 Sensor

Pulse Sensor

The plug-and-play sensor used to detect heart rate data is called a pulse sensor. This sensor is used by athletes, students,mobile and game developers, etc. This sensor attaches to the earlobe or fingertip by connecting directly to the Arduinoboard via jumper cables. Heart rate can be monitored in real time open-source monitoring application.

The pulse signal here is the variation in blood level that occurs when it is the heart forces the blood & the detector monitors the change in blood volume. PUSH there are four ways to determine the heart rate as a photoelectric pulse wave,electrocardiogram, phonocardiography & BP measurement,but pulse sensor uses photoelectric technology.

Fig. 4. Pulse Sensor

OXIMETER

Pulse oximeters are inexpensive non-invasive medical sen- sors used around the clock measure hemoglobin oxygen saturation (SPO2) in the blood. Will appear the percent- age of blood that is loaded with oxygen. The principle ofpulse oximetry is based on differential absorption propertiesof oxygenated and deoxygenated hemoglobin. Oxygenated hemoglobin absorbs more infrared light and allows more red light to pass through over. While deoxygenated hemoglobin absorbs more red light and allowing more infrared light topass through

Fig. 5. Oximeter

C. Software Specification

Arduino IDE Software

Arduino IDE is open-source software, designed by Arduino.ccand mainly it is used to write, compile upload code to almostall Arduino modules. This is the official Arduino software,which makes compiling the code so easy that even a commonperson with no prior technical knowledge can get started.wet with the learning process. It is available for all operatingsystems i.e. MAC, Windows, Linux and runs on Java platformwhich comes with built-in functions and commands that theyplay a vital role in debugging, editing and compiling code.

PROTEUS

It is a software package containing schematic, simulation and PCB design. ISIS is software used to draw schematics and simulate circuits in real time. The simulation allows for humanaccess during the run, thus providing a real-time simulation. ARES is used for PCB design. It has the function of viewing the output in 3D view of the designed printed circuit board along with the components. The designer can also create 2D drawings of the product.

THINGS SPEAK

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize and analyze live data streams in the cloud. You can send data to ThingSpeak™ from yourdevices, create instant visualizations of live data and sendalerts using web services such as Twitter® and Twilio®. WithMATLAB® analysis inside ThingSpeak, you can write and runMATLAB code for preprocessing, visualization, and analysis.

ThingSpeak enables engineers and scientists to prototype and build IoT systems without setting up servers or web devel- opment software. ThingSpeak is a platform providing various exclusively targeted services for building IoT applications. It offers real-time data collection capabilities, visualization ofthe collected data in the form of graphs, the ability to create plugins and applications for cooperation with web services, social networks and other APIs. We will Consider each of these features in detail below. A core element of ThingSpeakis the 'ThingSpeak Channel'. Saves the channel The data we send to ThingSpeak consists of the following elements:

- 8 fields for storing data of any type - These can be used tostore the data from a sensor or from an embedded device.
- 3 location fields - Can be used to store the latitude, longitude and the elevation. These are very useful for tracking a moving device.
- 1 status field - A short message to describe the data storedin the channel. To use ThingSpeak, we need to signup andcreate a channel. Once we have a channel, we can send the data, allow ThingSpeak to process it and also retrievethe same.

To use ThingSpeak, we need to signup and create a channel. Once we have a channel, we can send the data, allow ThingS- peak to process it and also retrieve the same.

IV. RESULTS AND DISCUSSION

The trial issues are anatomized in this section agitatingcolorful obediences and assessing issues attained from their perpetration. colorful modules like palpitation accession, bodytemperature monitoring, Oxygen Level like physiological in- formation accession are observed.

A. Compliance Test of the Pulse Acquisition Module

It's apparent from the palpitation test results that the three subjects ' palpitation values are all within the normal range(the palpitation rate of an average grown-up is 70 90 beats/ min)The palpitation signal accession test is performed three times for each person, and the average palpitation value acquired is 78, 78, and 79(beats min), independently. The thermometer's corresponding values are 77, 79, and 78, indicating that the system's test results are fairly accurate.

B. Compliance Test of Body Temperature Acquisition Module

It's apparent that this system's measures are veritably close to those of a thermometer and can cover body temperature. It also indicates that the temperature test of this system is fairly stable. The temperature using a thermometer is34.4 °C,35.7 °C, and36.5 °C, independently.

C. Compliance Test of Oxygen level measurement Module

The palpitation oximeter observes a rapid-fire dimensionof oxygen achromatism position in your body without using needles or taking a blood sample. The measured quantumshown on the screen reflects the achromatism of your redblood cells with oxygen. This number gives your croakers andnursers an idea of what your treatment will be.

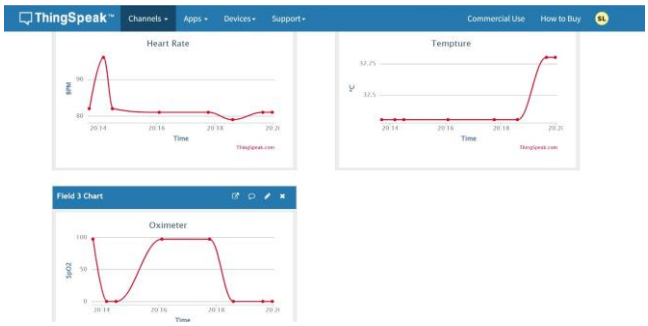

Fig. 6. Output on Thingspeak

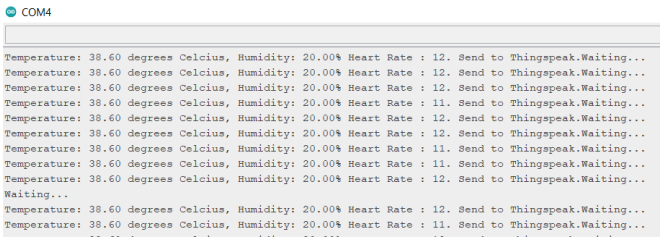

Fig. 7. Output Data at Serial Monitor

V. CONCLUSION

In the study, wireless sensor technology is combined withan IoT-based human health monitoring terminal to test health-related indices. The test results are analyzed. It is observedthat the IoT human health monitoring system is relativelystable and has functions such as accurate human health data collection, real-time monitoring and alarming, and subject evaluation. Subjects were assessed for temperature using a thermometer that provided temperature readings of 36.4, 36.7,and 36.5 (°C), respectively, demonstrating relatively accurate and stable testability. Similarly, the ECG heart rate monitoringmodule tracks test results of 78, 78, and 79 (beats/min), respectively, similar to the results of a medical pulse monitor.

The IoT-based human health monitoring system proposedin this study has completed the data collection of user's blood pressure, pulse, body temperature, heart rate, physiologicalinformation and other vital functions, which is proposed in practice. After long-term data collection, factors related topotential risk prediction should be further investigated in the future to expand the application of IoT-based human health monitoring systems. This will provide a scientific and effectivebasis for the prevention and control of chronic high-risk diseases in the near future.

For such critical conditions, doctors must always have up- to-date information about patients health-related parameters such as their blood pressure, heart rate and temperature. inin this way IOT Based ICU Patient Monitoring System helps in ICU monitoring Patients without any manual intervention. The output from the sensor was connected to the MCU node.

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