AN IOT BASED HEALTH MONITORING SYSTEM (ECG, TEMPERATURE, HEARTBEAT, SKIN & SpO2)

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ABSTRACT

This paper describes the development and test of sensors and IOT (Internet of Things) to enable the use of Mobile phones to receive the incoming temperature, electrocardiogram (ECG), Heartbeat & SpO2 signal from a user and show it in real time on the cell phone screen via text message. It uses different sort of sensors to obtain ceaseless key signs of patients counting heart rate and body temperature.

KEYWORDS: *AD8232 ECG Sensor, LM35 Temperature Sensor, MAX30100 Heart Rate & Spo2 Sensor, GSR Sensor.*

INTRODUCTION

In a clinical environment, heart rate is measured under controlled conditions similar in cases of SpO2, blood measurement, heart beat measurement, and Electrocardiogram (ECG). However, there is a great need that patients should be able to measure the heart rate in the home environment as well. Health monitoring is effective in both, forecasting heart disease and keeping cardiac patients under tight surveillance of their heart conditions. Widespread use of Health monitoring is however a pretty distant goal, mainly in nations of the developing world and poor nations. The main reasons for that are the high cost of machines, bulky Health equipment, the need for a specialist to operate the Health device, and the competing demands from other areas (e.g. educational and infrastructure development) for limited national budgets. Indeed, significant part of population within the nations of industrialized world cannot afford private healthcare. Therefore, reducing costs of medical devices can lead to improvement of the aforementioned scenario.

BACKGROUND OF THE STUDY

In recent years mankind has witnessed a revolution in the smart phone industry and emerging growth in the usage of mobile applications that range from entertainment and educational apps to simple games, health care apps and more.

As the advancement in wireless sensor technology made remote monitoring easier, the number of smart phone applications utilizing this opportunity has become increasing. As a result it is now more common to see Mobile Electrocardiograph (ECG) applications that work with wireless health monitoring devices or remote control apps in our daily life.

IOT (Internet of Things)

The Internet of Things (IoT) describes the network of physical objects—"things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over

the internet. These devices range from ordinary household objects to sophisticated industrial tools.

Before Internet of Things, patients' interactions with doctors were limited to visits, and tele and text communications. There was no way doctors or hospitals could monitor patients' health continuously and make recommendations accordingly.

Figure 1: IOT for Healthcare.

IoT is undoubtedly transforming the healthcare industry by redefining the space of devices and people interaction in delivering healthcare solutions. IoT has applications in healthcare that benefit patients, families, physicians, hospitals and insurance companies.

OBJECTIVES OF THE STUDY

- To remotely detect body Temperature, Heartbeat, SpO2 and ECG rate of an Individual using sensor.

- To ensure data readability of the sensors where anybody can easily identify the status of the health without any prior technical knowledge.

- To provide a fast responding alert mechanism and timely medical help for critically ill patients.

- The proposed health monitoring system is compatible with the use of a variety of sensors to extract medical data that helps determine multiple parameters such as Heartbeat rate, body temperature, SpO2, Skin Conductance and ECG at the same time.

WORKING OF THE SYSTEM

The complete set of the proposed system. Details of the heart rate, body temperature, SpO2, Skin Conductance and ECG is displayed on the local LCD display, and on android via the internet. The sensors are connected to the Arduino, which is also connected to the Wi-Fi module. The shield is mounted on an arduino board and provides internet connectivity throughout the system. The Arduino is connected to the components of the hearing unit and is powered by an external battery. The nerves are attached to the patient's body. The proposed system will serve as a real-time monitoring system.

Depending on the time-varying adjustment between each reading done in the system, sensory reading is recorded by the system and displayed on the LCD display. Used data is sent to mobile phones as text message using cloud computing where individual data is stored and monitored. In the event of an emergency, the application will send a notification to patients in that emergency.

The measured parameters i.e., oxygen level, Heartbeat rate, body temperature, ECG of a person will be displayed on the screen. The sensors details are updated continuously on our mobile. We can keep a constant watch at our body parameters by using this system. The medications can be suggested by the doctor even from a distance.

This system helps the user to avail proper medication that needs to be taken without any delay. The recording details of the application send it to the LCD display as well as to the mobile phones.
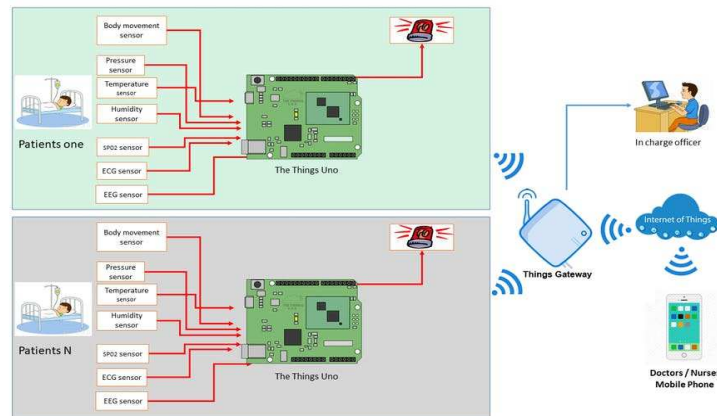

Figure 2: IOT based Health Monitoring System.

SYSTEM COMPONENTS

ECG Sensor (AD8232)

The AD8232 ECG sensor is a commercial board used to calculate the electrical movement of the human heart. This action can be chart like an Electrocardiogram and the output of this is an analog reading. Electrocardiograms can be very noisy, so to reduce the noise the AD8232 chip can be used. The working principle of the ECG sensor is like an operational amplifier to help in getting a clear signal from the intervals simply.

Figure 3: AD8232 ECG Sensor.

Temperature Sensor (LM35)

Figure 4: Temperature Sensor (LM35).

- LM35 is a temperature measuring device having an analog output voltage proportional to the temperature.

- It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry.

- The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases. E.g. 250 mV means 25°C.

- It is a 3-terminal sensor used to measure surrounding temperature ranging from -55 °C to 150 °C.

- LM35 gives temperature output which is more precise than thermistor output.

Heartbeat & SpO2 Sensors (MAX 30100)

The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.
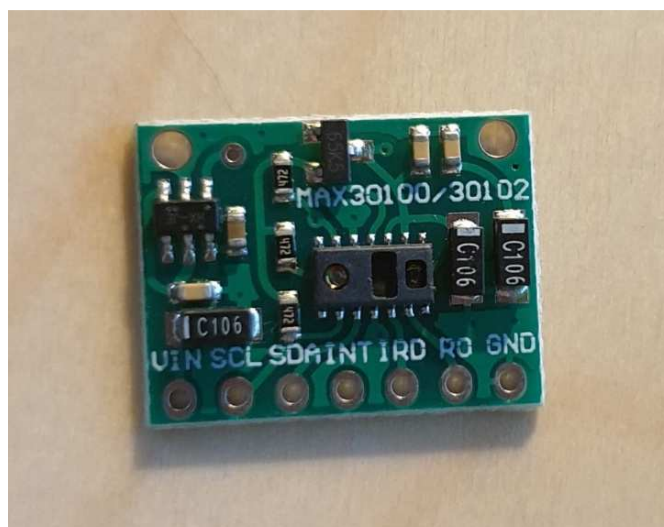

Figure 5: MAX30100 Pluse Oximeter Heart Rate-Sensor.

GSR Sensor

The skin tells everything – our skin gives away a lot of information on how we feel when we're exposed to emotionally loaded images, videos, events, or other kinds of stimuli – both positive and negative. No matter whether we are stressed, nervous, fearful, psyched up, stoked, baffled, or surprised – whenever we are emotionally aroused, the electrical conductivity of our skin subtly changes.
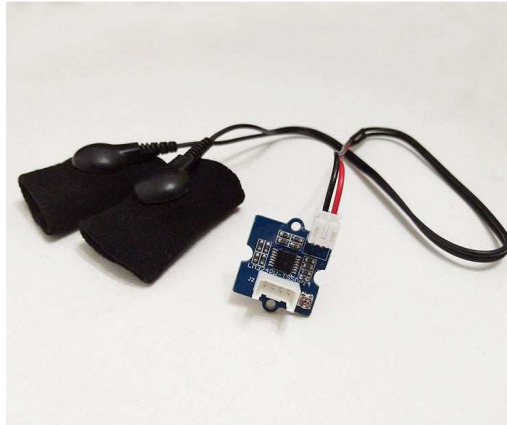
Figure 6: GSR Sensor.

Ardunio Nano

Arduino boards are widely used in robotics, embedded systems, automation and electronics projects. These boards were initially introduced for the students and non-technical users but nowadays Arduino boards are widely used in industrial projects.

Arduino Nano is a small, complete, flexible and breadboard-friendly Microcontroller board, based on ATmega328p, developed by Arduino.cc in Italy in 2008 and contains 30 male I/O headers, configured in a DIP30 style.

Figure 7: Arduino Nano.

LCD Display

LCD 1602 Parallel LCD Display that provides a simple and cost-effective solution for adding a 16×2 White on Liquid Crystal Display into your project. The display is 16 character by 2 line display has a very clear and high contrast white text upon a blue background/backlight.

Figure 8: LCD Display.

ESP8266 Node MCU
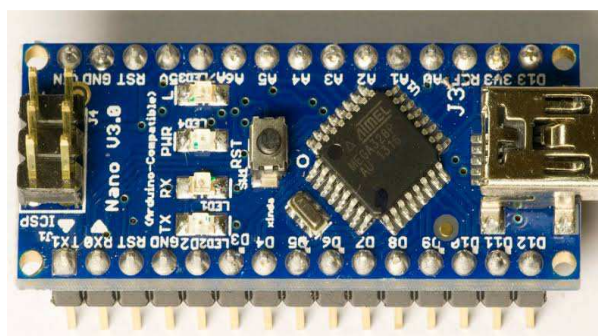
The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self-contained applications.

This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCU devkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

Figure 9: ESP8266 Node MCU.

SIM 800L GSM Module

SIM800L GSM/GPRS module is a miniature GSM modem, which can be integrated into a great number of IoT projects. You can use this module to accomplish almost anything a normal cell phone can; SMS text messages, Make or receive phone calls, connecting to internet through GPRS, TCP/IP, and more! To top it off, the module supports quad-band GSM/GPRS network, meaning it works pretty much anywhere in the world.

RESULTS & DISCUSSIONS

Block Diagram of the Proposed Project
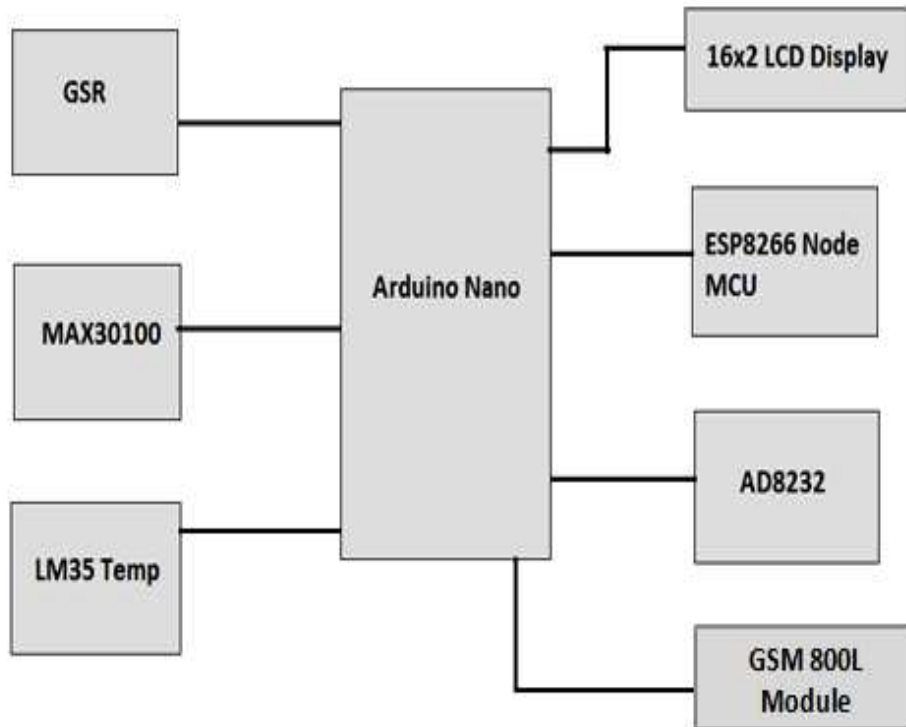
Figure 10: Block Diagram.

The GSR equipment to measure the stress around the skin is connected to the input A0 of the Arduino along with the MAX 30100 which is an integrated wearable device that measures the heartbeat and the blood oxygen level. MAX30100 is connected to Arduino through the pins A4 & A5. The temperature sensor LM35 is connected at pin 12 with the Arduino.

The output ports of the Arduino are connected with a 16x2 LCD, that displays the temperature, oximeter output and the stress in the contact skin. There is also an ECG monitor connected at pins 10 &11 that displays the electrical rate of heartbeat. The GSM 800LModule at the Rx and Tx of the Arduino assists in the data communication, enabling the system function. ES8266 is an external power supply connected to the main ports of Arduino to back up the ECG monitor.

Circuit Diagram of the Proposed Project

Figure 11: Circuit Diagram.

CONCLUSION

In the study, the wireless sensor technology is combined with the human health monitoring terminal based on the Internet of Things to test the health-related indexes. The test results are analyzed. It is observed that the human health monitoring system of the Internet of Things is relatively stable and has functions such as an accurate collection of human health data, real-time monitoring and alarming, and evaluation of subjects.

The human health monitoring system based on the Internet of Things designed in this study has completed collecting the user's blood pressure, pulse, body temperature, heart rate, physiological information, and other vital sign data, which is suggested in practice. After long-term data collection, factors related to a potential risk prediction should be further explored in the future to expand the application of human health monitoring systems based on the Internet of Things. This will provide a scientific and effective basis for preventing and controlling chronic high-risk diseases in the near future.

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