IOT BASED SMART REMOTE PATIENT MONITORING SYSTEM

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ABSTRACT
Many lives are lost every day in India because patients are not treated in a timely and proper manner. In addition, in clinics and hospitals, parameter values are not accurately calculated in real time. It can be difficult for hospital staff to keep track of patients' conditions on a regular basis. In addition, ICU patients cannot be monitored continuously. Our framework is useful in dealing with these types of circumstances. Our device is intended for use in hospitals as well as in home to measure a variety of parameters such as temperature, ECG, and heart rate and humidity. All these operations are performed with the help of a microcontroller Arduino Uno R3, also the data are stored in a host server namely 'Thingspeak', with the help of Wi-Fi module, so the doctors or the consent person keep an eye on the patient continuously.

Keywords: Arduino Uno R3, Wi-Fi module, Thingspeak, ECG, ICU.

INTRODUCTION
As our day-to-day lifestyles shift in this fast-paced world, the convenience of living increases as a result of technological advancements, and as urbanization and globalization increase, the number of people suffering from a wide range of harmful diseases rises. Three parameters of the human body, namely the current status of body temperature, blood pressure, and running pulse measurement on a regular basis, are critical and necessary in the current scenario of fundamental theory, safety from these harmful diseases. These activities can be tracked in real time with a user-friendly monitor and interface, which can prove to be of greater benefit and use when there is an emergency. This test will raise awareness about the seriousness of a person's illness. The aim of this study is to present a medical device that is portable and compact in size, and that can be used to measure and display the patient's body temperature, blood pressure, and running heartbeat, as well as humidity and real time location. This system is very useful for monitoring patient condition in remote locations, and it also generates an alarm system for belongings so that they can be rescued in time, or it will submit an automated question to the doctor if they are not rescued in time. The proposed device includes a microcontroller system based on the Arduino Uno, various sensors, a transmission system, and interfacing. The proposed device is cost-effective, has a small footprint, and is a portable instrument. This system outperforms the old hand measurement system by a significant margin.

METHODOLGY
The methodology of our proposed IoT Based Smart Remote Patient Monitoring System is shown in Fig.1.

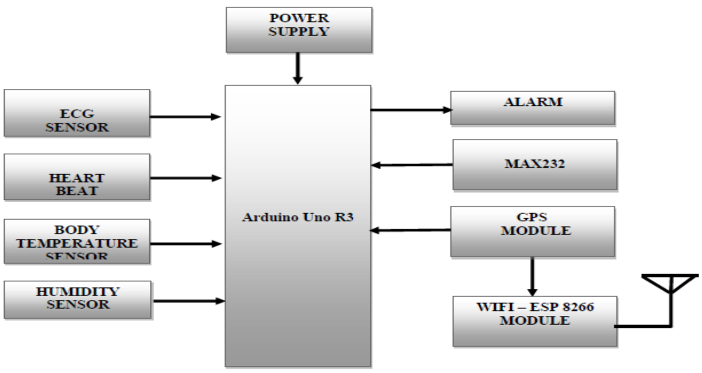

Fig.1: Methodology of the system

HARDWARE & SOFTWARE REQUIREMENT

The hardware and software used in the system is mentioned in brief as following.

3.1 Arduino Uno

Arduino is a programming language that can be used to create machines that can feel and monitor more of the real environment than a typical desktop computer. Arduino may be used to create interactive objects that accept input from various switches or sensors and power lighting, motors, and other physical outputs. The boards can be hand-assembled or bought pre-assembled, with the open-source IDE available for free download.

The ATmega328P is used in the Uno, which is a microcontroller board. There are 14 optical input/output pins (six of which can be used as PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB link, a power port, an ICSP header, and a reset button on the board. It comes with everything you'll need to help the microcontroller; simply plug it into a device with a USB cable or use an AC-to-DC converter to power it.

Fig. 2 Arduino Uno

3.2 Temperature Sensor

The LM35 series of precision integrated-circuit temperature sensors have an output voltage that is proportional to the temperature in Celsius (Centigrade). In comparison to linear temperature sensors measured in degrees Kelvin, the LM35 has the advantage of not requiring the consumer to remove a significant constant voltage from the signal to achieve convenient Centigrade scaling.

The LM35 needs no external calibration or trimming to achieve normal accuracies of 14°C at room temperature and 34°C over a temperature range of 55 to +150°C. Trimming and calibration at the water level ensure low costs. The LM35's low performance impedance, linear output, and accurate inherent calibration make it particularly simple to interface with readout or control circuitry. It works for single power supplies as well as plus and minus power supplies. It has very poor self-heating, less than 0.1°C in still air, so it only draws 60 A from its supply.

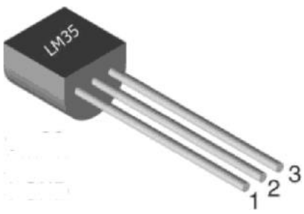

Fig. 3: Temperature Sensor

3.3 Heart Beat Sensor

A high-intensity form LED and an LDR are used to detect heartbeat. Between the LED and the LDR is a finger. A camera diode or a photo transistor may be used as a sensor. For identification, the skin may be illuminated with detectable (red) light that is projected or mirrored. The changing blood content in human tissue causes very slight variations in reflectivity or transmittance, which are almost imperceptible.

A red LED is used for emitted light illumination, and an LDR is used as a detector in this configuration. The same hardware and software could be used for other lighting and identification principles with only minor modifications to the preamplifier circuit. An operating amplifier converts the picture current (AC Part) of the detector to voltage and amplifies it (LM358), the second amplifier is carried out here. The value is preset in the inverting input, and when the amplified value is compared to the preset value, an interrupt is generated to the controller ATmega32.

Fig. 4: Heart Beat Sensor

3.4 ECG Sensor

The ECG must be able to detect not only powerful AC signals between 0 and 5.0 volts, but also a DC component between 0 and 1023 millivolts (resulting from the electrode-skin contact) Instead of this, we included three points: RA (Right Arm), LA (Left Arm), and RL (Right Leg). In the body, electrical activity in the heart can be measured and kept in the Einthoven triangle.

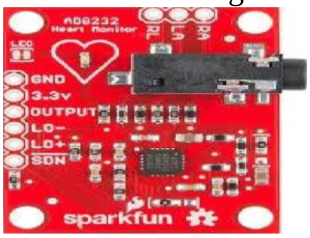

Fig. 5: ECG Sensor

3.5 GPS Module

The GPS module for Arduino is a small electronic circuit that allows you to attach to your Arduino board for location and altitude, as well as UTC (Universal Time Coordinated), speed, date and time. Uses the standard NMEA protocol to transfer location data through a serial port. The VK-16E is around 14 grams, the smallest, fastest, most refined GPS module currently available. Built-in ability to rapidly locate and monitor 20 SIRF III satellites on behalf of the chip, built-in backup battery, built-in high-gain LNA Dual LDO PCB gold immersion operation, wide area of GPS radiology signal, not a comparable general locator. Better and more reliable signals.

Fig. 6: GPS Module

3.6 Humidity Sensor

The humidity sensor is an electronic instrument that tests the humidity in its atmosphere and translates its findings to the corresponding electrical signal. Humidity sensors vary considerably in size and functionality; some of the humidity sensors can be used in mobile devices (such as smartphones), while others are built into larger embedded systems (such as air quality monitoring systems).

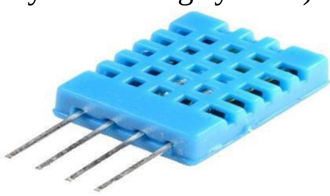

Fig. 7: Humidity Sensor

3.7 Accelerometer

The ADXL335 is a small, low power, complete 3-axis accelerometer with signal conditioned voltage outputs. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

The ADXL335 Accelerometer assembly consists of IC, voltage regulator IC, resistors and capacitors in an integrated circuit. It's very simple to use the Accelerometer module with a microcontroller. Connect VCC and GND pins to Microcontroller 5V and GND pins. Link the X, Y, and Z pins to the Arduino Analog pins. The basic configuration of the accelerometer is made up of fixed plates and rotating plates. The acceleration is then applied to the axis of the capacitance between the fixed plates and the moving plates. This results in a sensor output voltage amplitude that is equal to the acceleration.

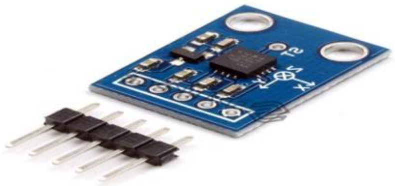

Fig. 8: Accelerometer

3.9 Wi-Fi Module

The ESP8266 is a Wi-Fi based microcontroller with 9 GPIO pins that can be operated via the ICP/IP protocol. The ESP8266 can either host an application or offload all Wi-Fi networking functions to a separate application processor.

Fig. 9: Wi-Fi Module

INTERFACING WITH ARDUINO UNO

The Uno is an ATmega328P based microcontroller module. It has 14 optical input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB link, a power jack, an ICSP header and a reset button. Both sensors and modules are attached as per the appropriate connection, as seen in the figure, our microcontroller receives the feedback from the sensor received from the patient's body. This Microcontroller collects input from specific sensors into signals and transforms it into a digital form from which this information is retrieved through the ESP module and transmitted to our host website, from which it is further transmitted to the user's cell phone that can be accessed through the android application as well as to the user's by login to the host website.

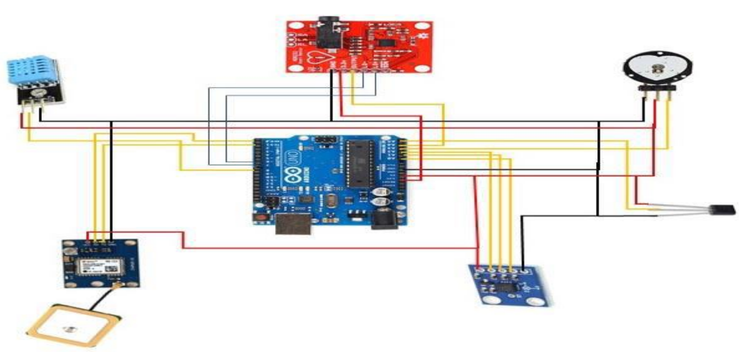

Fig. 10: Circuit Diagram of the System

WORKING OF PROPOSED MODULE

The system uses Node MCU which are programmed using the Arduino IDE. It is a modified version of C++ programming language. This software is responsible for operating the sensors and GPS. The system was configured as a sensor network in Internet of Things by using a source API called ‘Thingspeak’. This enables the creation of nodes, gateway and communication between them. The system uses a Node MCU which is running in a local to enable remote monitoring of the system.

Thingspaeak has a web interface that allows the user to visualize the data that is received as shown in figure 12. The value presented are changed when an update in the values is reported by the system.

The main source of monitoring comes through the web interface; however, ‘Thingspeak’ also offers a web server that allows for more accessibility. Through the web server user can monitor the same parameters and can maintain the data if needed. This piece of coded runs on the local server which is independent of all the electronics that are responsible for the operation of the system.

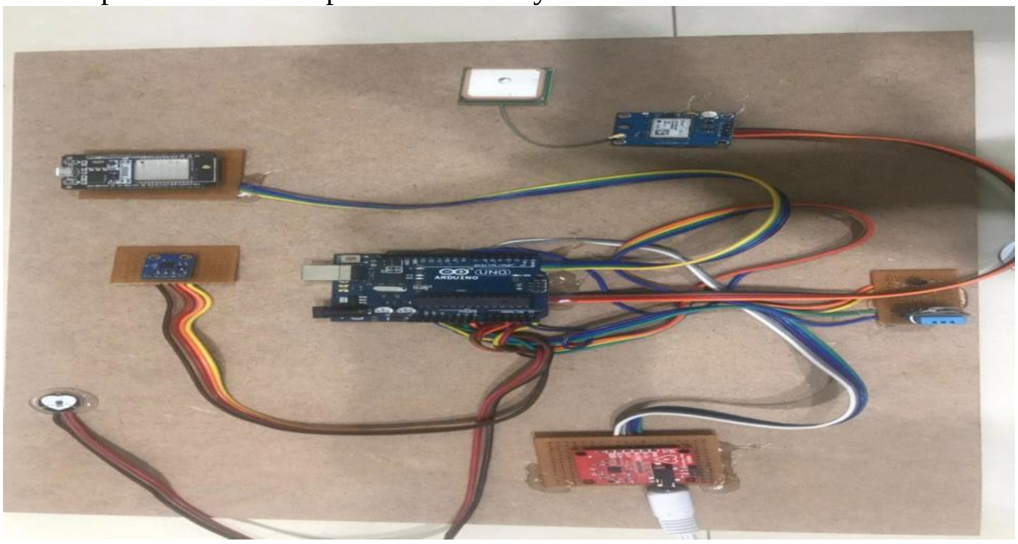

Fig. 11: Hardware Interfacing

RESULT

On the ‘Thingspeaks’ channel, the result, i.e. the sensed values, is displayed. The data is presented in a numerical format. These values can be accessed at any time and from any location using a user id and password, making it simple for the concerned person to keep a constant eye on the patient.

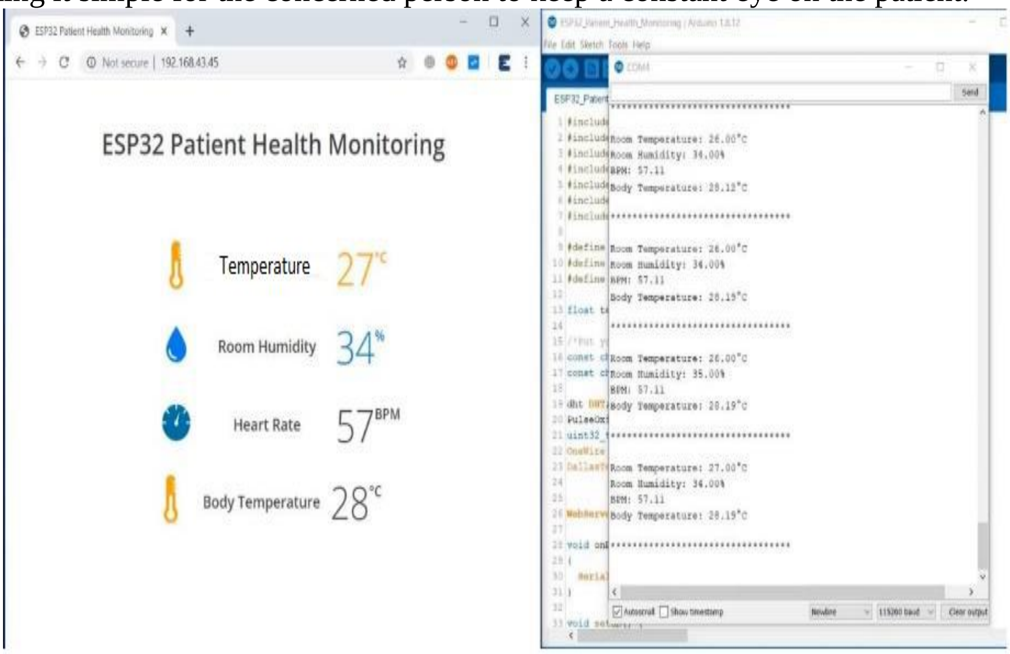

Fig. 12: Output Received on Cloud Website

CONCLUSION

The prototype in this paper provides a reliable real-time approach for monitoring patient body parameters. To better understand its efficiency and use, this device can be implemented in hospital general wards as well as in homes. The data storage processes can be used in a variety of ways, including disease prediction, analysis, and so on. It could be possible to reduce the risk of death in an emergency situation by using this system.

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