AN IOT BASED PATIENT MONITORING SYSTEM USING RASPBERRY PI

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***Abstract*—In the recent development of, Internet of Things (IoT) makes all objects interconnected and it has been recognized as the next technical revolution. Some of the applications of Internet of Things are smart parking, smart home, smart city, smart environment, industrial places, agriculture fields and health monitoring process. One such application is in healthcare to monitor the patient health status Internet of Things makes medical equipments more efficient by allowing real time monitoring of patient health, in which sensor acquire data of patient's and reduces the human error. In Internet of Things patient's parameters get transmitted through medical devices via a gateway, where it is stored and analyzed. The significant challenges in the implementation of Internet of Things for healthcare applications is monitoring all patient's from various places. Thus Internet o Things in the medical field brings out the solution for effective patient monitoring at reduced cost and also reduces the trade-off between patient outcome and disease management. In this paper discuss about, monitoring patient's body temperature, respiration rate, heart beat and body movement using Raspberry Pi board.**

Keywords—Raspberry Pi board, Heartbeat sensor, Temperature sensor, Respiration sensor, Accelerometer sensor, Internet of Things.

I.INTRODUCTION

The unpredictable growth of the "Internet of Things" is changing the world and the rapid drop in price for typical IoT components is allow public to innovate new designs and products at home. IoT can be used in monitoring patient's health, for making smart home and smart city. The unexpected occurrence in patient's are monitored using IoT. In this paper specialized sensor is used to monitor patient's heart rate, body temperature, body movement and breathing rate.

One of the key learning platforms for IoT is the Raspberry Pi. The Raspberry Pi is a popular platform became it offers a complete Linux server in a tiny platform for a very low cost. The Raspberry Pi also allows interfacing services and actuators through the general purpose I/O pins.

The combination of Raspberry Pi and IoT becomes a new innovation technology in healthcare system. Raspberry Pi is act as a small clinic after connecting these (Temperature, Respiration, Accelerometer, Heartbeat) sensors. Raspberry Pi is works as small clinic in many places. Raspberry Pi is collect data from sensors and then it transfer wirelessly to IoT website. Raspberry Pi board is connected to the internet, that board MAC address is registered to the internet. After that in IoT website, add MAC address of this board. Then the sensors output is connected to the IoT website

II. LITERATURE SURVEY

Dohr et al [1] monitors blood pressure level using Keep In Touch (KIT) and closed loop healthcare services. In KIT method, KIT is connected to the JAVA based mobile phone with the help of near field communication. It works on magnetic , inductive coupling and then the distance is short. After touching the KIT, the data is send to mobile phone. In closed loop services, the data is getting from mobile phone, then the data is send to the secure website. Using this website anybody can monitor patient's blood pressure level.

Junaid mohammed et al [2] monitors patient's ECG wave anywhere in the world using IOIO- OTG Microcontroller. Android application is created for ECG Monitoring. IOIO-OTG microcontroller is connected to android phone using USB cable (or) Bluetooth dongle. After collecting data, the wave is send to android application. Monitor and store ECG waves in that android based application.

Mohammed S. Jasses et al [3] focused on body temperature monitoring using Raspberry pi board in cloud based system. In that paper, Raspberry pi is monitor body temperature and then these parameters are transfer by wireless sensor networks (WSN). Then these data's are added to the cloud based websites. Using this website monitor body temperature.

Hasmah Mansor et al [4] monitors body temperature using LM35 temperature sensor. The LM35 temperature sensor is connected to the Arduino uno board. Afterthat creating a website in SQL database format. Arduino uno board is connected to that website. Then sensor output is send to the website. Using this website anybody can monitor body temperature in login process.

Mathan Kumar et al [6] discussed about monitors ECG, Respiration rate, heart rate and body temperature. These sensors are connected to PIC16F887A microcontroller. After

collecting data from sensors, the data is upload to the website manually. For monitoring purpose created an android application and webpage for monitoring health status.

Nithin P. Jain et al [8] monitors temperature, blood pressure, heart rate of patient's. Microcontroller AT Mega 32 is used for connecting these sensors. GSM module is connected to this microcontroller. After collecting data, if the value is low SMS is send to the doctor.

Soumya Roy et al [9] monitors ECG waves of patient's. AT Mega 16L microcontroller is used for monitoring ECG waves. Zigbee module is used for transferring ECG waves. Zigbee module is sends data to nearest connected system for zigbee.

Rajeev Piyare et al [10] implement controlling and monitoring home appliances using android based smart phone. Arduino uno board is connected to home appliances (light, fan, etc). Creating an android application for this smart home. Arduino uno board and android app is connected by internet. Using this android app controlling and monitoring home appliances anywhere in the world.

Karandeep Malhi et al [7] monitors body temperature, heart rate using C8051F020 microcontroller. Wearable sensors are used to collect data and then send to microcontroller. Zigbee module is connected to this microcontroller and then that module is transfer data to the nearest receiver.

III. METHODOLOGY

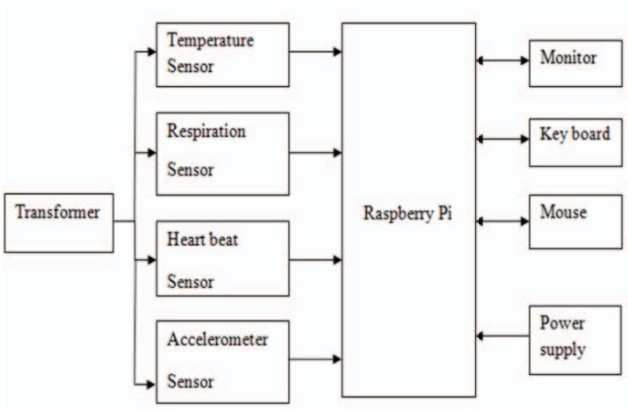

Fig 1: Block diagram of Patient Monitoring system using Raspberry Pi

In this paper we have temperature, respiration, patient's movements and heart beat reading results are monitored . These sensors signals send to the Raspberry Pi via amplifier circuit and signal conditioning unit (scu), because the signals levels are low (gain), so amplifier circuit is used to gain up the signal and transmit the signals to the Raspberry Pi. Raspberry pi is a linux based operating system works as a small pc processor system. Here patients body temperature, body movements, respiration and heart rate is measured using respective sensors and it can be monitored in the monitor screen of computer using Raspberry Pi as well as monitoring through anywhere in the world using internet source.

Raspberry Pi is programmed for the particular project need that via USB dongle (or) Ethernet for patient's health monitoring through internet. It sends all the current health data of the particular patient to the web database. Anybody can access the web and can see the health of patients.

All sensors have not same power to operate. So we have to use transformer for operate these sensors. In this paper, (0-9,15-0-15)V/1A transformer is used. This transformer is step down transformer. The supply voltage 230V is convert into 0-9V and 15-0-15V. Then the voltage is send to switched mode power supply (SMPS). This circuit is having three IC's. They are 7805,7812,7912. These IC's are operating in +5v,+12v,-12v respectively. Then these diodes are used to convert AC to DC voltage. This DC voltage is not pure DC from the IC. This DC is called as ripple DC. So 1000uf capacitor is used for getting power supply. Then power supply is connected to the specific sensors.

The heart beat is measured by IR transmitter and receiver. Normal heart rate for human being is 60 to 100 bpm. Pulse rate sensor is connected to the finger. IR receiver is connected to the vcc through the resistor which acts as potential divider. If blood flow is passes between IR transmitter and receiver the infra red rays are not passes between them. The low pass filter is removes the signal. Then the signal is amplified using LM324 OP-AMP. Then the signal is given to base of the BC 557 (PNP) and BC547(NPN) switching transistors in order to convert the TTL voltage 0 to 5 v level . Finally the TTL output is given to 7414 IC inverter to invert the pulse in digital form. Then the final square wave signal is given to Raspberry Pi.

In this paper, thermistor is used to measure the temperature. Thermistor is nothing but temperature sensitive resistor. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased.

Potential divider formula

$$Vout = Vin\ R2/(R1+R2)$$

R1 is resistor value 4.7K & R2 is thermistor, Vin is input voltage If R2 is receive temperature and then that value is added to the resistor, then using this formula calculating the temperature value. Then the value is go to the MCP 3208 IC. This IC is act as analog to digital converter (ADC) and then analog value is converted into digital form. After that the signal is go the Raspberry Pi board.

Respiration is a number of breaths per minute. In human beings respiration rate is varied. Normal respiration rate for all human beings are 12 to 18 breaths per minute. This is only for above 10 years people only. Below 10 years respiration is vary for birth to 6 weeks 30 to 60 breaths per minute, below 6 months 25 to 40 breaths per minute, less 3 years 20 t0 30 breaths per minute, below 6 years 18 to 25 breaths per minute, for 10 years 17 to 23 breaths per minute. In this respiration measurement two thermistors are used for the respiration measurement, that are connected in the resistor bridge network. The bridge terminals are connected with inverting and non inverting input terminals of the operational amplifier LM741. One thermistor is used for respiration and another one is used as measure room temperature. The differential amplifier provides the error voltage at its input. Then the error

voltage is filtered by the next stage of the op-amp. the o/p voltage is converted to +12v to -12v square wave pulse through the computer. Then the square wave pulse is converted to 5 v to 0v. Transistor-Transistor Logic (TTL) pulse goes through the transistor(BC547), then the final TTL pulse is given to Raspberry Pi in order to monitor the respiration rate.

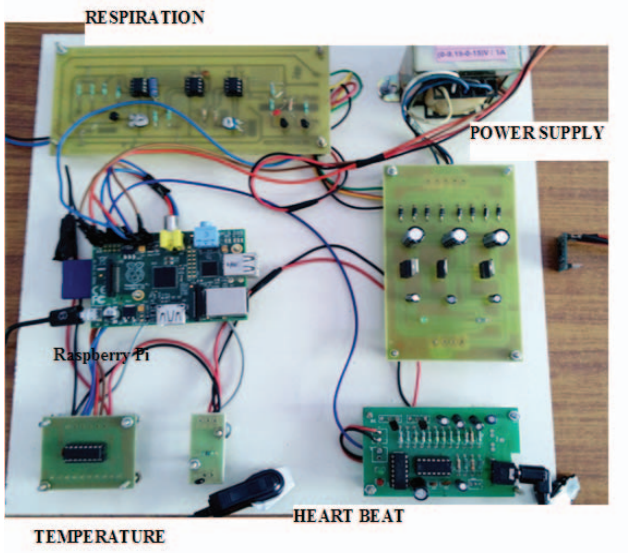

Fig 2: Hardware connection setup for Patient Monitoring system using Raspberry Pi

Accelerometer sensor MMA7260QT is used for measuring body movement. In this sensor X,Y,Z axis are used for measuring the body movement. This sensor is fit to the patient's bed. If the patient body is move, then the sensor is observe the movements and then calculate the values. This accelerometer is a surface micro machined Integrated-circuit accelerometer. This piece of equipment containing two surface micro machined capacitive sensing cells (g-cell) and a signal conditioning ASIC contained in a single board. The g-cell is a mechanical arrangement from semiconductor materials using semiconductor process.

The g-cell beams from two back to back capacitors. The ASIC uses switched capacitor techniques to measure the g-cell capacitors and extract the acceleration data from the difference between two capacitors. It also have the signal, providing high level output voltage that is ratio metric and proportional to acceleration. The 13,14,15th pins of accelerometers are connected to Raspberry Pi board for getting output.

IV.RESEARCH AND DEVELOPMENTS

Technology plays an important role in today's world like industries, personal life's, environment and agriculture fields. Among these fields health care process is the most important field and crucial also. The improvement of medical equipments and devices also plays a significant contribution for technology development in health care devices. This process is produces doctor's for new technology to monitor private use. Patient's also connect video conference to the physicians for improving their health status. It also reduces patient's money and waiting time at hospitals. Using this technology development, patient's record their health status in their own mobile phone and then store the data.

V.CONCLUSION AND FUTURE WORKS

Now got the output from hardware side only. After connecting these sensors to the Raspberry Pi board, there are two ways to access the output. One is directly connected to the monitor, keyboard, mouse to the Raspberry Pi board and got output in monitor screen. The another method is Raspberry Pi board is connected to a laptop (or) computer using data cable After that install putty software to the respective system. Change IP address, Subnet mask, gateway to that system. Then open that putty software output will display in that screen.

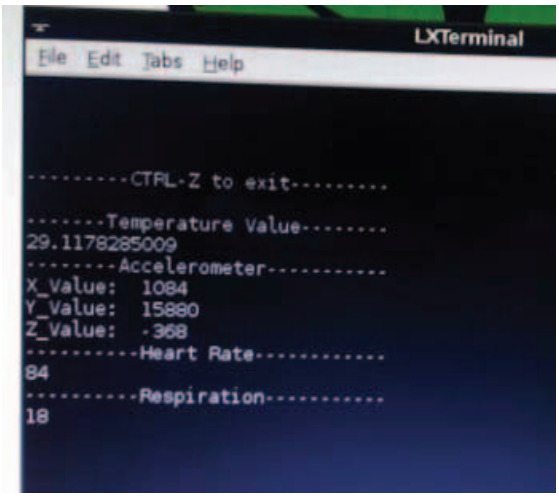

Fig 3: Sensors output from Raspberry Pi board

Raspberry Pi board is having MAC address. Using this MAC address, connecting to the internet via Ethernet, Wifi (or) USB dongle. After connecting internet, this MAC address is registered in internet protocol. There are several websites are available for internet of things For raspberry pi dweet.io, IBM cloud,developer.ibm.com is very good websites for IoT. In that websites first create an account and then add fields, MAC address for the Raspberry Pi board. In the next step, type the program for these sensors. That library files are not support from the website, the program is not run. so type only which library files are supported by the websites.

In future, adding Raspberry Pi MAC address and Programs to the website.After connecting internet to the Raspberry Pi, it act as a server. Then the server is automatically sends patient’s health status to the website. Using this website link anybody can monitor patient’s health status anywhere in the world. So it is very useful for patient's to give first aid at anytime. Add many devices like ECG, EEG to monitor patient's health status.

ACKNOWLEDGMENT

I thank the Department of Electronics and Communication Engineering of Kalasalingam University,(Kalasalingam Academy of Research and Education), Tamil Nadu, India for permitting to use the computational facilities available in Centre for Research in Signal Processing and VLSI Design which was setup with the support of the Department of Science and Technology (DST), New Delhi under FIST Program in 2013 (No.SR/FST/ETI-336/2013).

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