Arduino and Raspberry Pi based Efficient Patient Monitoring System

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Abstract--**This developed model presents the implementation of an e-health smart network system. The system aimed at prevents delays in the arrival of patient's medical information to the health providers, so which measure patient's physical parameter by using wireless sensor networks. It is cost effective and reliable. From the sensor readings, with pre-programmed logic microcontroller identifies monitored human position, movement, humidity, vibration and heart beat rate etc. A technique measured heart beat rate through a fingertip and arduino. It is based on the principle of photoplethysmography(PPG)which is the non-invasive method of measuring the variation in blood volume in tissue using a light source(IR LED) and detector(PHOTODIODE).The IR LED transmit an infrared light into the fingertip, Which reflected back from inside finger arteries. So every time the heart beats the amount of reflected infrared light changes, which can be detected by the photodiode, with a high gain amplifier, this little alteration in the amplifier of the reflected light can be converted into the pulse. Technological advancement in the field of medical electronics and communication can help decreasing the cost of healthcare. The system enables doctors to remotely follow-up the status of their patient using this computer (MATLAB) and smartphone. The system was tested and checked by medical team for validation.**

Keywords:- Body humidity, movement, position, sensor, arduino ECG waveform, amplifier, raspberry pi, computer or smart phone

I. INTRODUCTION

Constant monitoring of the human's body parameters such as temperature pulse rate, voltage etc. Is a difficult task, also intensive care units it is necessary to monitor continuously the patient's health parameters and keep their record. These are the possibility of human's errors. There is some shortcoming present in existing system. Currently, there are a number of health monitoring systems available for the ICU patients which can be used only when the patient is on the bed. This system has wiring complexities. Regular monitoring of patients is not possible once he\she is discharged from hospitals. These systems cannot be used at an individual level. Hence to remove human errors and to lessen the excessive burden of continuously monitoring patient's health from doctor's head, we are proposing health monitoring system using's.

The proposed prototype in this paper detects the human motion such as walking, running or position within a closed room. It can classify activities like standing, sleeping, sitting, position. This system also tracks heart rate with the body temperature and humidity to determine the physical condition and abnormality. The main target to monitoring temperature, humidity and heart rate of the human body and provide an intensive care support. Thus facilitates the monitoring committee to look after patients and ensure the security especially for the challenging mental patient or the autistic people. To monitor the human movement or gesture some sensors are used in this system to detect the position, motion, speed, vibrating rate, temperature, humidity, heartbeat rate etc. The sensor is attached to the sensor interfacing hardware prototyping board which is name as Arduino.

A heart rate monitor is a personal monitoring device that allows a subject to measure their heart rate in real time or record their heart rate for later study. Early models consisted of a monitoring box with an asset of electrode leads that attached to the chest. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm) and babiesataround90bpm Electrocardiogram (ECG) is one of a frequently used method for measuring the heart rate. But it is an expensive device. Low cost device in the form of wrist watches are also available for the instantaneous measurements but their cost usually in excess of-of several hundred dollars making them uneconomical. So this heart rate monitor with a temperature sensor is definitely a useful instrument in knowing the pulse and the temperature of the subject or the patient. In this work, we present a PC and mobile device based wireless healthcare monitoring system that can provide real-time online information about physiological conditions of patients.

II.WORKING PROCESS

Working process approach to recognizing the human with very simple and inexpensive few sensor based system is completely unique and not available in this research area. Human action is determined based on some activities such as:
i) Gesture
ii) Position
 iii) Moving distance
 iv) Moving direction
v) Body temperature
vi) Heart beat rate
vii) Body humidity and so on

Our research work has been done with the movement direction, moving distance, position, vibration;

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Heart beat rate and temperature as well as humidity of the body. By using the ultrasonic sensor, magnetometer, peizo vibration, humidity sensor all these parameter value are estimated. The whole process for detecting of human movement and behavior is given bellow

1) Tracking of human behaviour, gesture movement, and heartbeat, humidity or position

Moving distance based segment detection: Human movement is arbitrated by using the ultrasonic sensor in our system. Usually, ultrasonic sensors are used for the robotic abnormal situation or deceptive physical condition. The proposed prototype in this paper detects the human motion such as walking, running, etc or position within a closed room. It can classify activities like standing, sleeping, sitting position. This system also tracks heart rate with the body temperature and humidity to determine the physical condition and abnormality. The main target to develop this prototype is to track every single gesture, movement along with body temperature, humidity and heart rate of the human body and provide an intensive-care support. Thus, it facilitates the monitoring committee to look after patients and ensure the security especially for the challenging mental patient or the autistic people. To monitor the human movement or gesture some sensors are used in this system to detect the position, motion speed, vibrating rate, temperature, humidity, heartbeat rate etc. The sensors are attached to the sensor interfacing hardware prototyping board which is named as Arduino. After collecting sensor data of different activities of the human is aggregated by using Arduino is analyzed.

2) Position based segment detection

Magnetometer GY-273 module has been used for detecting the moving direction. By using magnetometer sensor module, human movement can be observed in which direction it moves like X, Y or Z axis direction.

3) Vibration based segment

The piezo vibration sensor is being used to measure vibrating rate of the human body. The vibration sensor is generally used to detect vibration and shock of an object. By using this sensor the exact vibration rate of the body can be determined.

4) Heart beat rate and pressure measuring based segment

A device is used for measuring heart beat and pressure in different situation. Using this device the accurate data for heart rate and pressure. By using this data we are able to determine the accurate situation which is determined from the sensor value which actually found in this experiment.

5) Temperature and humidity based segment

Temperature and respective humidity of human body can be determined by the temperature and humidity sensor. One sensor is being used for this experiment. By using this sensor the exact temperature and its respective humidity can be measured.

III.BLOCK DIOGRAM
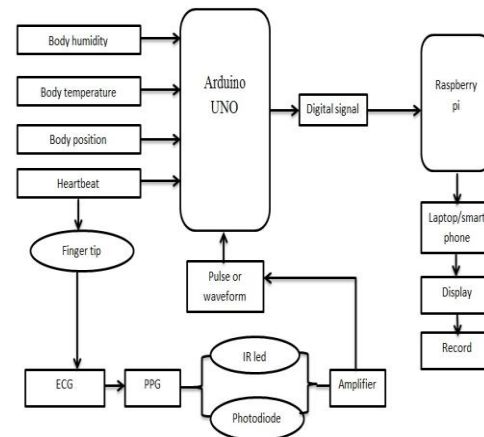
IV.HARDWARE DEVELOPMENT TOOLS

- Raspberry Pi
- arduino Uno
- body temperature sensor
- heart beat sensor
- ECG sensor
- amplifier circuit
- laptop/smart phone
- Wi-Fi/ 3G/ GPRS/ Bluetooth 802.15.4/ ZigBee
- Power supply

The system for health care monitoring can be subdivided into three main units as shown in the block diagram Figure 1 that interact with each Other to provide real-time monitoring, processing and reporting.

They are Data acquisition unit, Data processing unit and Data communication unit. Data acquisition unit mainly consists of biomedical sensors for measuring heart rate and body temperature with interfacing to Arduino and raspberry pi. This unit acquires the data and makes it available for the data processing unit. Medical sensors allow for easy and pervasive electronic measurement of several health parameters. Such medical sensors will be mounted on the person's body, which continuously monitor the body parameters of the person like pulse rate, body temperature, etc. and provides output in the form of electric signals. These signals are then compared to a standard range of acceptable values set as the threshold in the data processing unit.

The data processing unit consists of an Arduino with sufficient memory to convert the digital signal coming from the data acquisition unit through sensors into a format appropriate for transmission via raspberry pi communication to a PC for analyzing and displaying the data. The main functions of this unit are, the incoming medical parameters measured on a patient can be viewed on the local P C, the collected accurate patient medical information's will be carefully monitoring and transmitted by using ZigBee /Wi-Fi/3G protocols using MATLAB GUI.

V. SOFTWARE DEVELOPMENT TOOLS

- ➢ Arduino 1.0.1 Compiler
- ➢ MATLAB GUI
- ➢ Proteus circuit Design
- ➢ Programming Language: embedded C, python

Arduino is an open-source prototyping platform based on easy-to- use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board.

To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing MATLAB apps are self-contained MATLAB programs with GUI frontends that automate a task or calculation.

The GUI typically contains controls such as menus, toolbars, buttons, and sliders. Many MATLAB products, such as Curve Fitting Toolbox, Signal Processing Toolbox, and Control System Toolbox, include apps with custom user interfaces. You can also create your own custom apps, including their corresponding UIs, for others to use Arduino programs may be written in any programming languages with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVRStudio, and the newer Atmel Studio.

VI.WAVEFORM

Heart rate, body temperature, and blood pressure monitoring are very important parameters of the human body. Doctors use various kinds of medical apparatus like thermometer for checking fever or body temperature, BP monitor for blood pressure measurement and heart rate monitor for heart rate measurement. In this project, we have built an Arduino based temperature and heartbeat monitor which counts the number of heartbeats in a minute. Here we have used a temperature sensor and heartbeat sensor module which senses the heartbeat and temperature upon putting a finger on the sensor and all waveform given bellow that
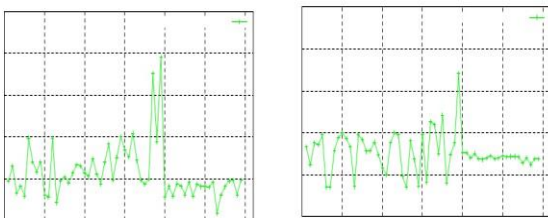
Samples of heartbeat and ECG

VII. RESULTS AND VALIDATIONS

The system operating procedure is as follows:
1. We are fixed the fingertip in PPG
2. We connect the Arduino Shield with a temperature sensor, a blood pressure sensor, and a blood glucose level sensor.

3. From the Arduino shield, we connect a wireless node (as a transmitter) and the USB port of the tablet (as a receiver) or the smartphone that has Matlab software running on it to take the reading of the physiological data from the patients' body. The data are then Processed and displayed on the Matlab front panel by using Data Dashboard application.
4. The data are also saved according to the time and presented in a report format. In addition, some personal details of the patient are also recorded.
5. The data is then published on the internet so that the patient's data can be accessed by the authorize healthcare personnel from anywhere at any time.

PPG waveform and heart rate displayed in computer screen

The results support the view that human gesture and movement describe as a sequence of movement, vibrating rate, changing direction of axis, temperature and humidity of the agent body and heart beat and pressure rate. By analyzing the graph we can determine the situation of the agent body.

From the simulation result, it is revealed that the proposed system allows measuring heart rate, detecting position as well as distancing from a particular place, temperature and relative humidity of human body precisely. By using this system we can automatically detect the action, mood, physical condition of a human. These sensors which are used in our system are available in local market and also very cheap rather than other sensors. General people can easily use this sensor a very low cost.

Wireless BSN technology is emerging as a significant element of next generation healthcare services. In this paper, we proposed a mobile physiological monitoring system, which is able to continuously monitor the patient's heartbeat, blood pressure and other critical parameters in the hospital. The entire system consists of a coordinator node to acquire the patient's physiological data, a WMHRN to forward the data and a BS to collect the data. The system is able to carry out a long-term monitoring on patient's condition and is equipped with an emergency rescue mechanism using mobile apps.

VIII. REPORTS

This system was tested and checked by medical team for validation

CONCLUSION

The development of this project was to make an intelligent health monitoring system is designed where temperature and pulse rate of a critical patient is measured and the data will be uploaded. The total system is designed by using the microcontroller. It is a system that automatically collects the temperature and the pulse rate of a critical patient, the temperature will convert and by using microcontroller and RF module it will update in online. Since it is an online process the doctor or their close relatives can check anytime. All Several health care projects are in full swing in different universities and institutions, with the objective of providing more and more assistance to the elderly.

[1] CAST(Centre for Aging Services Technologies) is organizing multiple projects from the simulation result it is revealed that the proposed system allows to measure heart rate, detect position as well as distance from a particular place, temperature and relative humidity of human body precisely. Finally, the reliability and validity of our system have been ensured via field tests. The field tests show that our system can produce medical data that are similar to those produced by the existing medical equipment.

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