

Development of Home Health Care Self Monitoring System

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Abstract: With rapid aging and economic growth, people became more interested in their long-term health, fitness and wellness. Statistics says that every human is losing his/her life across the globe every minute. In India, everyday many lives of human are affected by heart attacks and more significantly, because the patients did not take timely and proper service. Care of critically ill patients, requires immediate & correct decisions so that life-protecting & lifesaving therapy can be properly applied. Analysis of health parameters of patients after post hospitalization is very difficult. It is necessary to monitor patient's health after he is discharged from the hospital. In this project, we implemented a real time self home healthcare analyzing system which can monitor heart rate, blood oxygen saturation and temperature. For this purpose we have used heart rate sensor, oxygen saturation sensor, body temperature sensor. The obtained bio-signal from the each sensory unit is transmitted using a Bluetooth wireless communication in real time at home to the personal computer as well as on the smart phone. We have also used accelerometer in order to alert other family members whether the patient is on his bed or fallen down from the bed. Buzzer is used to alert the other members to indicate any abnormal condition.

Keywords: Post Hospitalization, Heart Rate, Oxygen Saturation, Body Temperature, Bluetooth wireless communication.

I. INTRODUCTION

One of the emerging issues in aging society is to take care of individual living, which requires consistent health management. Healthcare monitoring has been of interest to researchers for a long time and daily monitoring is very important in chronic diseases such as asthma, diabetic, and benign prostatic hyperplasia (BPH). For example Diabetic patients should maintain appropriate blood glucose level to prevent from various side effects. Similar sites can be easily ground in other diseases, so bio-signal monitoring can play a major character for an individual health life. Daily management of health condition can be achieved by instantaneous self measurement at home. The present work aims at such purpose to develop a wireless bio-signal acquisition system [1].

The opportunity for patients to have constant monitoring of their health state is now possible by means of telemedicine applications. The continuous monitoring of health status is a fundamental practice for patients suffering from various diseases. In a hospital either the nurse or the doctor has to move physically from one person to another for health check-up of patients, due to which it is not possible to monitor their conditions continuously. Thus, any critical condition cannot be identified easily unless the nurse or doctor checked the person's health at that time. This may cause a strain for the doctors who have to take care of a lot number of people in the hospital [2].

There are very few facilities available to keep a record of the patient's health after he is discharged from

the hospital. But heart patient or any patient who has undergone surgery needs to monitor his heart rate, blood pressure, oxygen saturation, etc. for at least one month as well as to reduce length of stay in hospital, hence, we need to develop a system which can be used by patient to keep a record of their health & can wirelessly monitor patient post his hospitalization.

The rapid progress in wireless communication, sensor, and information technologies generates a new model for providing health care. The information technology subject is constantly developing, allowing many medical treatment services including up-to-date information technologies to be provided in the medical arena. In the close future, services using Smart TVs, Smart Watches, and Smart Glasses will be used. The technological progress in today's contemporary world has paved the way for miniaturization of devices and systems. This has facilitated to supply proper and efficient direction for analyzing various body conditions [3].

The aim is to produce a system that can measure various vital signs such as heart rate, body core temperature and oxygen saturation, etc. these signals are processed and transmitted to a PC as well as to smart phone so as to self monitor and keep record of one's health.

This system is aimed to be an analyzing tool for medical application. In this, we are targeting a device which can be used by the patient at his home. This system also aimed to monitor fitness level for athletes or any person.

II. BACKGROUND

Many researches have been carried out in design of health monitoring devices. Jubadi et al. [4] has proposed heart rate monitoring alert via SMS. In this an alert system is used to monitor the heart beat rate of a patient. This heart rate measurement is based on the principle of photoplethysmography (PPG) technique. Then this PPG signal was processed using PIC16F87 microcontroller to check the heart beat rate per minute. An alert was given to medical experts or family members via SMS. With the help of this system doctors could monitor & diagnose patient's condition continuously & could suggest them precautions if any. Saravanan [5] designed remote patient monitoring system using computer communication networks through Bluetooth, WiFi, Internet Android Mobile. ECG, EMG, Pulse, BP, arterial oxygen saturation, blood glucose concentration & temperature signals were monitored. They had designed android Bluetooth API & constructed a simple peer-to-peer messaging system to work between two paired Bluetooth. The monitoring unit receives data through Bluetooth communication, Wi-Fi & Internet. This system was mainly designed to send data to the doctor.

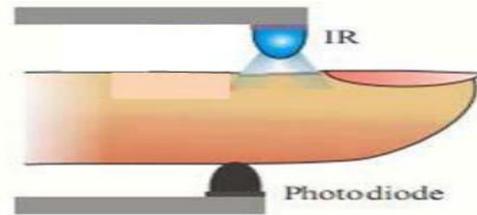
Purnima et al. [6] proposed health monitoring systems based on GSM & Zigbee technology. In this ECG, temperature & heart beat signals are continuously transmitted & monitored through Zigbee. A Zigbee node was connected to every patient monitoring system. The data are transmitted to the doctors PC via Zigbee as well as GSM technology is used to send data to doctor's mobile. Aditya Kurude et al. [7] developed advanced digital thermometer which highlighted the idea of adding a database storage facility as well as GSM communication. They have designed an embedded system that records body temperature & stores this data in memory card along with its date & time for future use. This data can be directly transmitted to doctors using GSM communication. Singh et al. [8] proposed wireless transmission system which is having a wireless sensor platform along with remote monitoring capability. They have designed sensor nodes for temperature & heart rate. This sensor data are wirelessly transmitted to the controller using RF transmitter & receiver module. This data is also wirelessly transmitted to the remote monitoring station. Verma et al. [9] developed a wireless system that allows patients to measure their won vital signs, such as heart rate & temperature. Health professionals could also remotely monitor patient's vital parameters through messages sent by GSM along with date & time, patient's location, name of the patient. The patient's location was given by the GPS.

III. METHODOLOGY

In this study, we are monitoring patient's vital parameters such as heart rate, blood oxygen saturation and body temperature. We monitor heart rate and oxygen saturation parameter based on photoplethysmography principle (PPG).

Pulse oximetry (PPG) is a non-invasive photometric technique that provides information about the

arterial blood oxygen saturation (SpO₂) and heart rate, and has widespread clinical applications. There are two types of PPG: 1) Transmittance and 2) Reflectance. We have used Transmittance type of sensor because it gives more accurate results than reflectance type of PPG.



Transmittance

Fig.1. PPG sensor principle

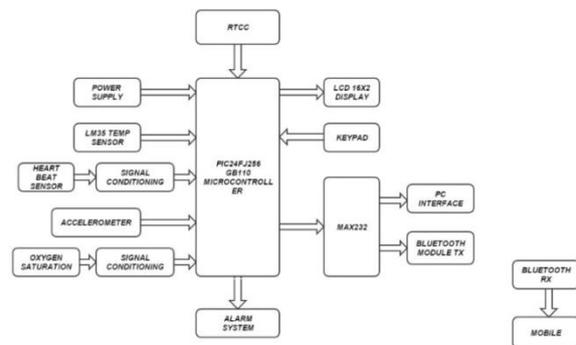


Fig.2. Block diagram

A. Block Diagram

Figure 2 shows the block diagram of system. It consists of heart rate sensor, blood oxygen saturation sensor, body temperature sensor and accelerometer. It has Bluetooth wireless communication with android app of smart phone as well as a communication link with personal computer.

B. Algorithm

Temperature sensor and accelerometer will sense real time readings. When user places his finger on heart rate and oxygen saturation sensor and presses the respective keys it will show the real time heart rate readings from the IR LED and Photodiode pair on LCD. The data obtained from all the sensors are transmitted to android app on smart phone via Bluetooth wireless communication link and as well as PC.

C. Experimental Setup

To conduct the experimentation an embedded system is designed. Designed system consists of following hardware components.

- **Microcontroller:** In this project we have used PIC24 microcontroller. It has wide range of interfaces including I²C, SPI, USB, UART, A/D, programmable comparators, PWM, LIN, PSP, and Ethernet. It is a 16-bit Flash microcontroller with USB on-the-go (OTG). It has 256KB of flash program memory along with 10bit 16 channel ADC. Internal oscillators are 31 kHz to 8 MHz with on chip LDO voltage regulator.

- **Temperature Sensor:** LM35 is a precision integrated-circuit temperature sensor whose output voltage is linearly proportional to the Celsius temperature. The LM35 does not need any external calibration or trimming to have accuracies. This is 3 legs IC that directly gives analog output. This unit requires +5V DC for its proper functioning [12].
- **Accelerometer:** The ADXL 335 accelerometer is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage outputs IC.
- **Bluetooth:** In order to transmit sensor data to the smart phone, a Bluetooth is used as a wireless transmission interface. This is simple, cost effective, compatible and reliable. We have used HC-05 Bluetooth module. It is an easy to use. The Bluetooth SPP (Serial Port Protocol) module is designed for transparent wireless, serial connection setup.
- **Heart Rate Sensor:** Heartbeat is sensed by using high intensity type LED and photodiode pair as shown in Fig -3. The variety in forces caused by the pressure pulse is detected by illuminating the fingertip's skin with the illumination from an LED using a photodiode detector. With each pulse, a deluge of blood is forced through the vascular system, expanding the capillaries in the finger, and varying the amount of light that returns to the photo detector [11].



Fig.3. Hardware circuit

Figure 3 shows experimental and hardware setup. Proteus 8 is used for simulation, schematic capture, and printed circuit board (PCB) design. The whole program is written in embedded C using MPLAB IDE [10].

IV. RESULTS AND ANALYSIS

The waveform for heart rate sensor is shown in figure 4. The experimentation is conducted on number of patients as shown in following table I.

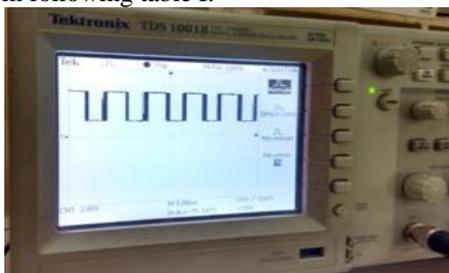


Fig.4. Heart rate sensor waveform

TABLE I: RECORDED DATA OF VARIOUS SUBJECTS

SI No	Subjects	Heart Rate (bpm)			
		Designed Device Output		Standard Device Output	
		Relaxed State	Stressed State	Relaxed State	Stressed State
1	Student 1	67	112	66	114
2	Student 2	62	112	63	112
3	Student 3	72	124	73	125
4	Student 4	74	130	74	132
5	Student 5	64	112	65	114
6	Student 6	72	128	72	130
7	Student 7	63	110	64	112
8	Student 8	78	135	77	136

The blood oxygen saturation data values is plotted on android app as shown in figure 5.



Fig.5. Android app showing sensor data

V. CONCLUSION

This project is developed in order to alert patient or any person or athlete about their fitness at home. They can have a record of their health parameters on PC as well as they can monitor the health on the android app via Bluetooth communication at home. People can monitor their health regularly with the help of this project. This system also alerts the family member of the patients in case of critical conditions. From the above study, it can be concluded that the designed low-cost heart rate counter can function satisfactorily as well as that of a standard device.

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BIOGRAPHIES



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