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A PORTABLE HUMAN HEALTH MONITORING SYSTEM

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Abstract

Telemedicine may be regarded as the future modern medical analysis and calculation. As people are more aware about their health analysis outside hospital, these technologies are becoming popular. By method of home care, we can analysis the basic physical parameter. Main motive of home care telemedicine is to furnish the patient with wireless, low-cost and friendly interface system. This proposed system tests the health parameters of an individual by measuring his/her blood pressures, glucose level from sweat, heart rate and temperature using Blood pressure monitoring device, Heart beat sensor, Temperature sensor respectively. The measured value gets displayed on LCD output screen and in case if any of the parameter enters in critical stage, concerned person will be communicated via SMS. GSM module is used for the purpose of sending SMS, so that patient gets the medical assistance within time.

Keywords: Temperature sensor, blood pressure sensor, sweat sensor, heart rate sensor and GSM.

I. Introduction

In this paper, we present a portable human health monitoring system with a group of sensors which monitor basic parameters of a human being. Parameters like body temperature, heart rate, blood pressure and glucose level from sweat. In this case, we monitor a patient who has suffering from the diabetes and hypertension problems. This patient would be fitted with sweat sensor, heartbeat, blood-pressure, temperature sensors that monitor the heart activities and all the parameters so on.

Heart disease is the main cause for early death in many countries. The number of cardiac deaths is rapidly increasing day by day. In modern medicine, there are so many method to observe heart disease, such as electrocardiogram(ECG), ultrasound and MRI etc.[1] Among these many methods, ECG is the popular method and low cost so that it can be used in all hospitals.

However in certain conditions a fast, slow, or irregular heartbeat may leads to heart attack. Many of the cardiac deaths occur outside the hospital. So, new methods are required to reduce the time and taking immediate action

within time. Hypertension is a major public health issue across the global. According to some surveys, around one in three adults in India have hypertension problems.

As the number of patients increasing day by day it's became a major concern to take an immediate action outside the hospital.

So that various methods are Available to calculate blood pressure. [2]High blood pressure is one of the reason for heart disease and stroke, and also it causes damage to the arterial blood vessels, the eyes, kidneys and it leads to heart failure.

Diabetes is also one of the major problem in the world. According to World Health Organization (WHO) nearly 200 million people are suffering from diabetes in the world and this can be doubled by 2030. As per WHO survey about 80% of the diabetes deaths occur in many countries.

[3] According to International Diabetes Federation. There are nearly 50 million diabetics patients present in India. It is very essential to taken awareness about diabetics and how it will affect the human body. If blood sugar level is very high, it affect the heart, eyes, kidneys, nerves, and other parts of the body. Sometimes people with diabetes even don't notice that they have that disease.

II. System Overview

Currently many systems are available in the market for analysing different parameters. To analysis each and every parameter in the body we need different systems or products. In order to reduce the cost and power consumption and portability we proposed a system with a various sensors embedded into a single system.

A. Existing system

The existing system is taken from a zigbee based animal health monitoring system. In this system, the physical parameters of the animal such as remuneration, temperature, heart beat rate and humidity is analyzed and measured. Sensor device implementation is done using PIC18F4550 [5].

The system consist of sensor, processor, and zigbee module. Different sensors are used to calculation remuneration, humidity, temperature and heartbeat. A thermistor is used for temperature measuring purpose as it gives high sensitive resistor versus temperature.

To detect the humidity of the body DHT11 sensor is used. For calculating the heart beat Polar spot tester (PST) is implemented. Overall system will help in analyzing the physiological parameters and establish a communication via Zigbee module [6].

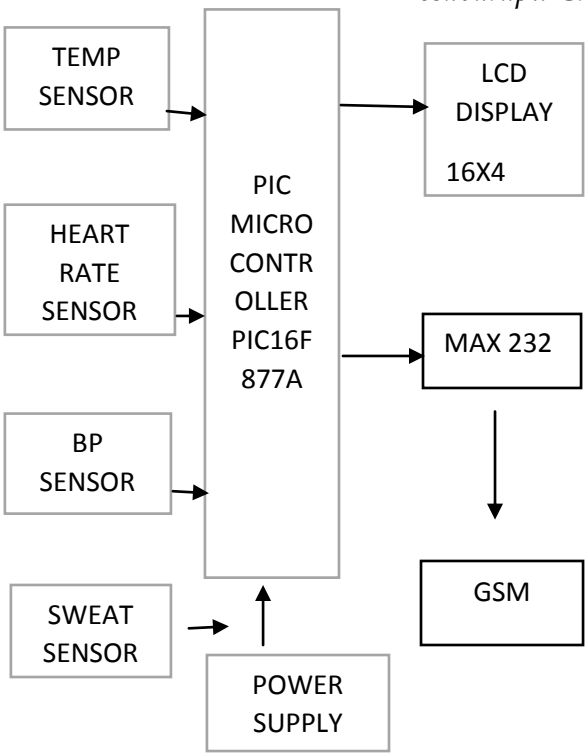

Fig 1.1: Block diagram of proposed system.

Fig 1.1 illustrate the basic blocks of the proposed system. All the programing and coding part are done in the PIC16F877A microcontroller. All the sensors i.e. Heartbeat sensor, blood pressure sensor , sweat sensor and the pulse sensor examine the patient and then sends the data to the microcontroller where the MAX232 module converts the analog signal to the digital signal. All the parameters are displayed in the LCD display. And if any of the data falls under critical category then the microcontroller with the help of GSM module sends a message to the concerned person.

B. Proposed system

In this section, the proposed system and technologies used and working mechanism of various sensors.It consists of two main sections .the first section is to measure all the required parameters such as glucose level from sweat , blood pressure, pulse rate and body temperature. And second section is to send all data to PIC micro controller for displaying it on LCD display.it is a user friendly interface & GSM module it becomes very handy for the users for getting information for the system.

1) Temperature sensors

LM35 is an integrated circuit whose output value is directly proportional to the temperature (in ^{o}C).it does not need any external calibration for maintain an accuracy at room temperature because it is internally calibrated. LM35 doesn't required any output voltage be amplified. LM35 produce low output impedance, linear output. Parameter values commonly used in this system:

- Voltage ranges from 4 to 30v
- 5v or 12 v aregenerally used.
- Resistance $R_a = V_c / 10^{-6}$
- scale factor of LM35 is .01V/^oC
- Power range is from 80 KW to 600 KW , but most just use 80 KW

2) Heart rate sensor:

Fig 1.2 shows the original snap of the heart beat sensor. The heart rate is the one of the important parameter in the health assessment. The adult healthy human has a heart rate between 60and 100 beats per minute. Basically, the heart rate measurement is an indirect method.

The heart rate sensor used in this proto type is smart Q heart rate sensor. It consist of easy sense unit present in it

Figure 1.2: Heart rate sensor

Heart rate can be measured in two ways:

Heart beat can be measured manually by checking one's pulses at two locations- wrist (the radial pulse) and the neck (carotid pulse). By using a sensor Heart Beat can be checked based on optical power variation as light is absorbed during its path through the blood as the heart beat changes. The heart rate sensor is based on the principle of photo plethysmography. It calculate the change in volume of blood that flow from any organ of the body which causes a change in the light intensity through that organ (a vascular region). It consists of two regions one is Transmission and reflection. Light passes from the light emitting device is transmitted through any vascular region of the body and received by the detector. Light emitted from the light emitting device is reflected by the regions.

Basically heartbeat sensor consists of a light emitting diode and a detector. It monitors the light level travel through the vascular tissue of the fingertip and the corresponding variations in light intensities that occurs as the blood volume will changes in the tissue.

The Easy Sense unit can detect that the Smart Q Heart Rate Sensor light and produces the result accordingly. Procedure to use this sensor first keep the finger infront of the LED so that light will pass from vascular tissue of the fingertip to easy sense unit and it compared with each heart pulse so easy sense unit detect that signal and gives result in LCD display.

3) Blood pressure sensor:

The normal blood pressure of a human being is 120/80-140/90 MMHG. The sensor used in this proto type is Vernier Blood Pressure Sensor. It measures arterial blood pressure means both high and low pressure of a human being. It consist ofBlood Pressure Sensor, Standard adult size adjustable cuff (27 cm to 39 cm) and Bulb pump. It can measure arterial blood pressure and calculate both the systolic(120) and diastolic(80) blood pressure using the oscillometric method. In this paper blood pressure is calculated as per second value

The active sensor present in this unit is SenSym SDX05D4 pressure transducer. It has a membrane which bends as pressure changes. This sensor is used to measure differential pressure. It produces an output voltage which constantly varies with the pressure measured in the cuff. It has special circuitry to minimize errors caused by changes in temperature. It requires amplifier circuit that conditions the signal from the pressure transducer. With the help this circuit, the output voltage is linear with respect to pressure.

The oscillometric method is a direct method of measuring blood pressure. It is based on the principle of blood pumped through the muscle by the heart causes the arterial walls. When a cuff is placed around the upper arm to the brachial artery is inflated and then slowly flatten at a constant rate, an arterial pressure pulse forms. These pressure pulses pass from the heart, through the arm, and into the pressure cuff itself. When the muscle is fully compressed, blood flow stops along with the pulses. As the pressure in the cuff is slowly decreased, the blood pressure increases to the particular point that blood will flows through the muscle in short pulses. As the pressure in the cuff continuously decreasing more blood flows through the occluded artery and the pulses increases until maximum amplitude is reached. Further decrease of the cuff pressure minimizes the obstruction of blood flowin the artery and the pulses continue to decrease until the air is removed. Sensor gives the cuff pressure value.

4) Sweat Sensor:

The main aim of the sweat sensor prototype is to produce glucose level from the sweat.Sweat sensor is a devices used for glycaemia measurement (glycaemia = amount of glucose in blood). It measures amount of glucose in a sweat sample using electrical current formed in test strip and sent to glucometer for measurement. Test results are calibrated

to plasma and it sends that value to controller. This sensor works based on the principle of Third-Generation Glucose Biosensors. Its works on High-Performance Liquid Chromatography. Fig 1.3 shows the sweat sensor which is extracted from one touch product.

Fig 1.3: Sweat sensor module.

Sweat sensor is prototype which is obtained from the one touch ultra-product. Generally this product works on third generation glucose biosensors. It gives sugar level from blood. The exact product will work for sweat with some few changes. In this developed prototype IC 2SK4101LS is used to get a value from any sweat sample. This IC has a standard features like Low ON-resistance, low input capacitance, ultrahigh-speed switching, High reliability, Avalanche resistance.

Fig 1.4 illustrate the one touch test strips contains an edge to apply sample, confirmation window and contact bars insert into test port.

Fig: 1.4 test strip

Procedure to calculate glucose level from sweat:

- Initially collect sweat sample from a diabetic person or normal person.
- Dipped the test strip into the sweat sample and wait till that sample gets conformed by confirmation window
- Connect to the product by using three contact bars.
- Finally the output will display in the LCD display.

5) GSM Module:

It is defined as Global system for mobile communication. It consists of many subsystems such as mobile station (MS), base station subsystem (BSS), network and switching subsystem (NSS) and operation subsystem (OSS). The

mobile station includes mobile equipment and SIM (subscriber identity module).[6] This SIM is a subscriber module which store all call, message and all the subscriber related information. In this project GSM is used because sending a message to a concern person. If any parameter enter into desired level or critical level the GSM will automatically send a message.

III. Results and Discussion

The main aim of this paper is to develop a human health monitoring system (HHMS) which is capable to the measuring of body temperature, blood pressure, sugar level with sweat, and heart rate. Fig 1.6, 1.7&1.8 shows the various output from the LCD display when different outputs are given to the PIC microcontroller via different sensors. And it also displays the message on LCD screen about the analysis such as Low temp, low glucose, high blood pressure or etc. The PIC16F877A microcontroller and various sensor modules were used to the development of HHM system. The sweat sensor module used to find sugar level has been successfully developed. The measuring parameters will be helpful to analyse the human in normal and abnormal health conditions. During experiment the 5V power supply is used.Fig 1.5 above illustrate the full hardware component embedded in as a system. It contains of a transformer, LCD display to show the output, Pulse sensor to analysis the heartbeat, blood pressure sensor to monitor blood pressure , LM35 sensor is to calculate the temperature , sweat sensor to measure the glucose level from the sweat and a GSM module to send a message if required.

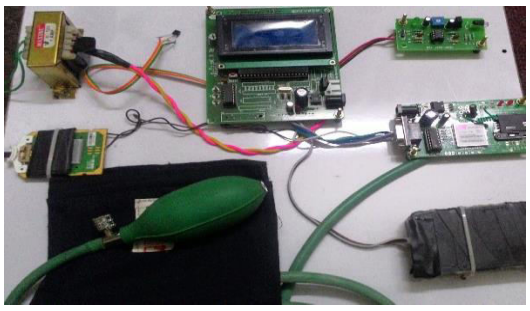

Fig 1.5: Experimental setup of heart rate, body temperature, blood pressure and sweat sensors.

Results obtained for various parameters:

Fig 1.6: Result for blood pressure and heart rate

Fig 1.7:Results obtained for blood pressure and temperature

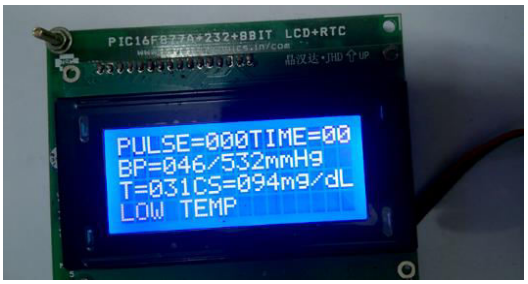

Fig 1.8: Results obtained for sugar level from sweat.

IV. Conclusions

In this paper, we have presented a prototype of a Human health monitoring system. The prototype system consists of various sensors like heart rate, blood pressure, temperature and sweat sensor.

This prototype system is tested for the real time monitoring of physiological parameters such as body temperature, blood pressure, heart rate and sugar level using sweat. In the development of sensing device, we have used the low power electronic components to minimize the power consumption and the device will run continually maximum times. The developed sensor module is low power consumption, easy to operate, new materials at lower cost, portability, and high performance. The major cost of the developed system is comes from various modules.For future study, the size of the proposed system can be minimised to Nano size and also with the help of one sensor we can find all the parameter values. In the sweat sensing module we have used a prototype of one touch product. The modification of the sweat sensor module to get exact sugar level from the sweat.

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