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Health Monitoring System Using Internet of Things

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ABSTRACT

The current evolution of monitoring your beloved ones becomes a difficult task in the modern day life. Keeping track of the health status of the your patient at home is a difficult task. Specially old age patients should be periodically monitored and their loved ones need to be informed about their health status from time to time while at work. So we propose an innovative system that automated this task with ease. Our system puts forward a smart patient health tracking system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues. Our system uses temperature as well as heartbeat sensing to keep track of patient health. The sensors are connected to a microcontroller to track the status which is in turn interfaced to an lcd display as well as IOT connection in order to transmit alerts. If system detects any abrupt changes in patient heartbeat or body temperature, the system automatically alerts the user about the patient's status over IOT and also shows details of heartbeat and temperature of patient live over the internet. Thus IOT based patient health tracking system effectively uses internet to monitor patient health stats and save lives on time.

Key Words: *PIC microcontroller, Sensor, Health track, Internet of Things (IOT)*

I. INTRODUCTION

Health monitoring systems become a hot topic and important research field today. Now-a-days the maximum new research is emphasizing on improving the quality and healthy life by designing and fabricating sensors which are either in direct contact with the human body (invasive) or indirectly (non-invasive). The main reason behind this development is rapid increasing of population worldwide.

The monitoring system allows an individual to closely monitor their changes in vital signs and also provide feedback which helps to maintain an optimal health status. The device is designed to integrate into a telemedical system, as it can even alert medical personnel providing life-threatening changes to occur. Zig Bee wireless module is used

to sense the remote patient data. Wireless sensors and sensor networks drag more attention to the research community because of its wide applications such as scalability, power management and flexibility of Architecture, All sensor data from the parameters which are in the direct contact with body parts such as Heart beat rate, Oxygen saturation level, body temperature, pH level, and ECG are transferred by using a group of ZigBee wireless module. The system adopted the wireless sensor ZigBee for using as a real-time health monitoring system on a patient.

II. LITERATURE SURVEY

David Niewolny in his paper describes, How the Internet of Things Is Revolutionizing Healthcare [1] is discussing about the reasons for emergence of IoT and designs of applications where IoT is used. The main issue is people have only limited time, awareness and accuracy, which means they won't be able to capture data about things networked in the

real world consistently. The answer is empowering devices to collect information on their own, without any human interference. A smart health monitoring chair is introduced by H. Beak, G. Chung, K. Kim, and K. Park for noninvasive bio-signal measurement. However, these solutions are almost exclusively implemented using off-the- shelf components. Its physical size, rigid nature, and short battery life become limiting factors for potential long-term use.Remotemonitoring[2] of medication uses

ZigBee technology was proposed by A. J. Jara, M. A. Zamora-Inquired, and A. F. Sarmatia for getting sensor values. Zigbee can transfer sensor values effectively but when there is a need of continuous data transmission ZigBee cannot be used. Reducing sampling rate solves the above problem but affects the quality of life.

Code Blue [3] a wireless infrastructure intended for deployment in emergency medical care, integrating low-power, wireless vital sign sensors, PDAs, and PC-class systems. Code Blue will enhance first responders' ability to assess patients on scene, ensure seamless transfer of data among caregivers, and facilitate efficient allocation of hospital resources. Besides, Code Blue's authors acknowledge the need of security in medical applications, but until now security is still pending or they intentionally left the security aspects for future work. Another BSN based healthcare system

UbiMon [4] was proposed in the department of computing, Imperial College, London. The aim of this project was to address the issues related to usage of wearable and implantable sensors for distributed mobile monitoring. Although Ng et al. proposed and demonstrated the ubiquitous healthcare monitoring architecture, it is widely accepted that without considering the security for wireless healthcare monitoring, which is a paramount requirement of healthcare applications, according to government laws.

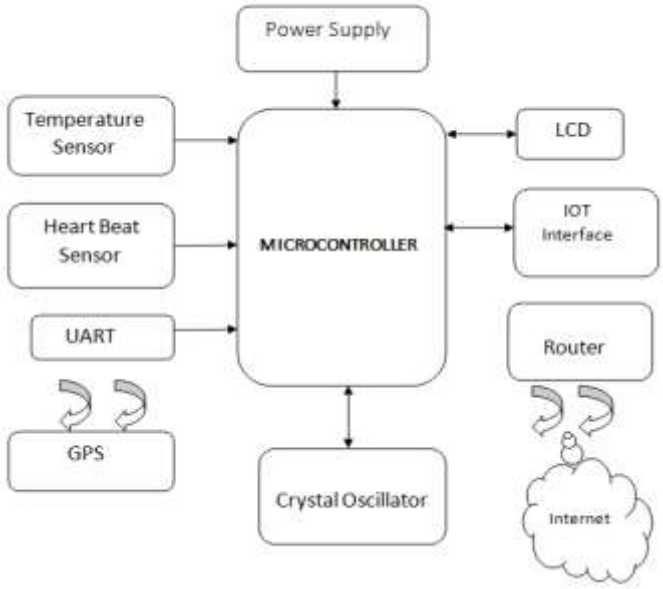

Figure 1. Health Check

III. PIC16F877A MICROCONTROLLER

The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART).

Microchip provides a waste verity of Microcontrollers from PIC family. Each MCU has its own advantage and disadvantage. There are many parameters that one has to consider before selecting a MCU for his project. The below points are just suggestions which might help one to select a MCU.If you are a beginner who is learning PIC then, selecting a MCU that has good online community support and wide applications will be a good choice. PIC16F877A and PIC18F4520 are two such MCUs

- Consider the operating voltage of your system. If they are 5V then select a 5V MCU some sensors or devices work and communicate on 3.3V in such case a 3.3V MCU can be selected
- If size and price is a limitation then you can choose small 8-pin MCUs like PIC12F508. These are also comparatively cheaper.
    - Based on the sensors and actuators used in your project, verify which modules you might need in for MCU. For example is you are reading many Analog voltages then make sure PIC has enough ADC channels and supportive resolution. If you project involves communication protocols like UART, SPI ,I2C, CAN etc make sure you PIC can support them. Some MCU can support more than one module of the same protocol.

Figure 1.1 PIC16F877A

IV. PINCONFIGURATIONAND DESCRIPTION Of PIC16F877A

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many pic microcontroller projects. PIC16F877A also have many applications in digital electronics circuits.As it has been mentioned before, there are 40 pins of this microcontroller IC. It consists of two 8 bit and one 16 bit timer. Capture and compare modules, serial ports, parallel ports and five input/output ports are also present in it.

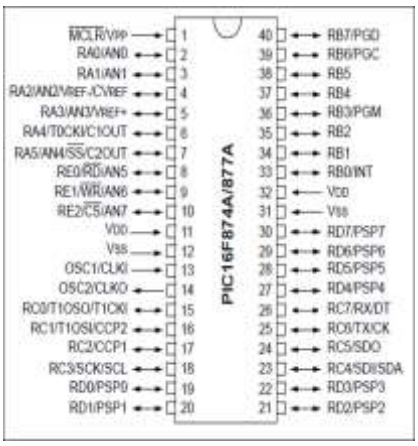

Figure 1.2. 2PIC16F877A Pin Diagram

As we have studied 5 input and output ports namely PORTA, PORTB, PORTC, PORTD and PORTE which can be digital as well as analog. We will configure them according to our requirements. But in case of analog mode, the pins or the ports can only act as inputs. There is a built in A to D converter which is used in such cases. Multiplexer circuits are also used. But in digital mode, there is no restriction. We can configure the ports as output or as input. This is done through programming. For PIC the preferable compiler is micro C pro which can be downloaded from their website. There is a register named as 'TRIS' which controls the direction of ports. For different ports there are different registers such as TRISA, TRISB etc.If we set a bit of the TRIS register to 0, the corresponding port bit will act as the digital output. If we set a bit of the TRIS register to 1, the corresponding port bit will act as the digital input.

V. SENSORS

1) Temperature sensor

The body temperature is measured by using the temperature sensor LM35[2]. It is a three terminal device. Pin number one is 5 volt voltage supply and three are for ground. Pin two is analog voltage output with respect to temperature. There is no need of extra circuitry to operate it. PIC16F877A microcontroller is used to read temperature value. The Relation between the temperature and analog output voltage is:1°C = 10m voltHence for every 1 degree increase in temperature there will be a increment of 10m volt in output voltage of LM35 sensor. The output of sensor is given to analog channel of PIC16F877A.

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Now after reading ADC value, using voltage and temperature relationship voltage is converted into temperature..These conversion has been done through programming.

Figure 2: Temperature sensor

2) Heart beat sensor

Heartbeat sensor TCRT100 in fig:3consists of both the infrared light emitter diode and the detector are arranged side by side in a leaded package. The output produced is a digital pulse which is synchronous with the heart beat.

Fig3: Heart beat sensor

The output pulse can be fed to an ADC channel of a microcontroller for processing and retrieving the heart rate in beats per minute (BPM). Photoplethysmography (PPG) is a non-invasive method used in measuring the variation of blood volume in tissues by a light source and a detector. The blood volume changes in synchronous to the heart beat, hence this technique is used to calculate the heart rate[4]. The basic types of photoplethysmography are transmittance and reflectance. In the transmittance PPG, a light source is emitted into the tissue and a photo detector which is in the opposite side to the tissue measures the resultant light. Due to the limited penetration of the light intensity through the tissue of organ, transmittance PPG is applied to the finger or the ear lobe which are the restricted body parts. However, in the reflectance PPG, the light source and the detector, placed on the same side of a body part. The light is then emitted into the tissue, the reflected light is therefore measured by the detector. As the light doesn't need to penetrate through the body, the reflectance PPG can be applicable to any parts of human body. According to the pulsate blood flow, the detected light reflected from or transmitted through the body part will fluctuates as the beat of the heart.

The PPG signal consists of two components, referred to as AC and DC. The AC component is mainly due to the pulsate variation in arterial blood volume that is synchronous with the heart beat. Therefore, AC component is rendered as the source of heart rate information. This AC component is superimposed with the large DC component which relates the tissues and the average blood volume. Thus, DC component should be removed to measure the AC waveform that consists of high signal-to-noise ratio. The DC component.can be get rid by passing the output from the sensor through a RC high-pass filter (HPF). The HPF sets the cut-off frequency to 0.7 Hz. In the next stage, an active low-pass filter (LPF) is made of an Op-Amp circuit. The LPF sets the cut-off frequency and gain to 2.34 Hz and 101, respectively. Thus the HPF and LPF, combination helps to remove the unwanted DC signal and also the high frequency noise which includes 60 Hz (50 Hz in some countries), this amplifies the low amplitude pulse signal (AC component) 10times.

The output obtained from the first signal conditioning stage leads to a similar HPF/LPF combination which under goes further filtering and amplification . So, the cascading of two stages leads to calculation of the total voltage which is 101*101 = 10201. These two stages consisting of filtering and then amplification process converts the input PPG signals to approximate TTL pulses, which are synchronous along with the heart beat. The heart rate (BPM) are related to the frequency (f) of these pulses which is denoted as follows,Beatsperminute (BPM)=60°f.

The rise of heart rate abruptly increases gradually during exercises and then returns slowly back to the rest value after exercise. The rate at which the pulse goes back to normal forms an indication of the fitness of the person. The heart rate lower than the normal forms an indication of a condition termed as bradycardia, while the rate higher than the normal are termed as tachycardia.

C)*pH Level Sensor*

pH changes occur in the oral cavity, which are indicative of bacterial activity leading to dental caries. pH measurement is necessary as it measures whether the solution is acidity or basic. The sustainability of living things are based on the maintenance of proper pH level. The internal mechanisms of all human beings and animals rely on the maintenance of the pH level in their blood. The blood contents in our veins must consists of a pH level between 7.35 and 7.45. The level exceeding this range nearly as one-tenth of a pH unit would be proved as fatal.

Fig4:7pHGlasselectrode

VI. CONCLUSIONS

As per paper work, health monitoring system design is based on researcher idea that meets to the patients need. As per consideration of conventional system, this system still in use from their manufacturing but it is very bulky to handle individually and size and cost are also more compared to the advance system and also it take more than 1minute for getting the exact result. As per consideration of advance system, each system has its own advantage. Each health monitoring system has different specification as per patient's requirement.
This system provides more medical instrument facility on single system on-chip compare to conventional system. This system takes less than 1 minute to calculate result related to health condition. Size also reduces compared to the conventional system because of integration of number of medical instrument on single chip. So, size, cost and complexity also reduce. This paper presents the design and implementation of wireless sensor network for health monitoring system by using ZigBee module. It is concluded that Programmable Interface Controller (PIC) has been the low cost implementation used for recording and transmitting the bio-medical signals by wireless technology and very useful to the remote patients. This system was developed to minimize the device's size and allow for daily life usage. This system can also be made to include other health monitoring module like EMG, EEG for complete monitoring system.

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