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Design And Implementation Of Smart Chair With Sensor Network For Patient Parameter Monitoring System Using Wireless Module

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Abstract: *This project aims to develop the emergence of wireless technologies and advancements in on-body sensor design can enable change in the conventional health-care system, replacing it with wearable health-care systems. Wearable monitoring systems can provide continuous physiological data, as well as better information regarding the general health of individuals. In existing method, to check the parameters of patient we required stethoscope, thermometer, sphygmomanometer and blood sample is required to measure glucose level. Drawbacks of existing method are high time consumption, less accuracy, man power is required and no database. Thus, such vital-sign monitoring systems will reduce health-care costs by disease prevention and enhance the quality of life with disease management. In this project, recent progress in non-invasive monitoring technologies for chronic disease management is reviewed. In particular, devices and techniques for monitoring blood pressure, body temperature, glucose level and heart beat are discussed. In addition, Internet of Things (IoT) is used in this project to transfer the patient's parameters to their mobile phones in the form of message as well as parameters will mail to their respective e-mail id. Scope of our project is less time consumption, high accuracy, data base, reduction of man power and this system is too convenient for patients.*

Keywords: *PIC16F877A, IoT, zigbee, Heartbeat sensor, LM35, Pressure sensor, Near IR sensor.*

I. Introduction

This project aims to develop the emergence of wireless technologies and advancements in on-body sensor design can enable change in the conventional health-care system, replacing it with wearable health-care systems. Wearable monitoring systems can provide continuous physiological data, as well as better information regarding the general health of individuals. In existing method, to check the parameters of patient we required stethoscope, thermometer, sphygmomanometer and blood sample is needed. Drawbacks of existing method are high time consumption, less accuracy, man power is required and no database. Today increasingly growing number of people with chronic diseases this is due to different risk factors such as dietary habits, physical inactivity, and alcohol consumption, among others. Infectious diseases are highly variable in their symptoms as well as their evolution and treatment According to world health organization research centre, 90% of people are affected by infectious disease. Our project is implemented to overcome this situation. Thus, such vital-sign monitoring systems will reduce health-care costs by disease prevention and enhance the quality of life with disease management. Our project is very hygienic and time consumption is less. Recent technology IoT is used to transfer the parameters quickly. The internet of things applied to the care and monitoring of patients is increasingly common in the health sector, seeking to improve the quality of life of people. We present a novel design of an Internet of Things (IoT) and telemedicine based health monitoring system-The Smart Chair. Sensors and associated hardware needed to monitor the vital physiological parameters of the human body are available on the chair, thereby leading to the idea of a Smart Chair. The raw signals from the sensors are processed digitally by an onboard microcontroller and analyzed for any common abnormalities in the health parameters of the subject. The results are then transmitted to a secured web server using a Wi-Fi module present in the system. The data can be viewed at any later time by a doctor. We have used a method called non-intrusive method which means we are not going to inject any needle or other equipment into the patient and we are not going to hurt the patient. The concept of Internet of things is recent and is defined as the integration of all devices that connect to then network, which can be managed from the web and in turn provide information in real time, to allow interaction with people they use it. For measuring patient's parameter, variable sensors are used. So we can measure accurately. Sensors are used today almost everywhere. A device that responds to a physical stimulus (such as heat, light, sound, pressure, magnetism or a particular motion) and transmits a resulting impulse (as for measurement or operating a control) .Here we are used temperature sensor, pressure sensor, IR sensor, and heart beat sensor. This sensor network is operated by programming the microcontroller.

Microcontroller is heart of our project. We are used PIC16F877A microcontroller. PIC microcontroller is convenient to use, the coding or programming of the controller is easier. One of the main advantages is that it can be write-erase as many times as possible because it use flash memory technology. Sensor networks, IoT etc…, all are interfaced with microcontroller. All the components are assembled in a chair is called "smart chair". By using this smart chair, we can measure the body temperature, blood pressure, glucose level, and heart beat of the patient. Pressure sensor can shows systole and diastole value separately. For measuring temperature, LM35 thermocouple is used. Because it has greater accuracy than themistor and RTD. Till now temperature is measured by using thermometer. But we introduced a new method. For measuring weight of the body, separate microcontroller is used. Embedded C language is used for programming the microcontroller. Embedded C is most popular programming language in software field for developing electronic gadgets.

Each processor used in electronic system is associated with embedded software. Embedded C programming plays a key role in performing specific function by the processor. We have used cool term software for display output. Cool term is a simple serial port terminal application that is geared towards hobbyists and professionals with a need to exchange data with hardware connected to serial ports such as microcontroller. Using the cool term software, the parameters were displayed in output screen of the desktop. In that screen, we can see the value of heartbeat, pressure, temperature and glucose level are shown separately with data measured by the sensor. Output screen consists of their name, age, parameter etc. Finally patient can easily understand about their body conditions or Parameters with the help of output screen**.** In this project, the patient's parameters transfer to their mobile phones in the form of message as well as parameters will mail to their respective e-mail id. Scope of our project is less time consumption, high accuracy, data base, reduction of man power and this system is too convenient to patient.

II. Proposed System and Architecture

The main idea of the designed system is to monitoring of the patients over internet. In this system PIC16f877a Microcontroller collects the data from the sensors and sends the data through Wi-Fi Protocol. The Protected data sent can be accessed anytime by the doctors by typing the corresponding unique IP address in any of the Internet Browser at the end user device(ex:Laptop, Desktop, Tablet, Mobile phone). All the components are interfaced with microcontroller. Power supply is connected to microcontroller. All the components are operated by programming the microcontroller. Wireless technology transfers the data to the PC. The buzzer will indicate the completion of the process by giving sound. The Microcontroller is connected to zigbee and IoT which provides information to doctor/patient (ex: Laptop, Desktop, Tablet, Mobile phone).

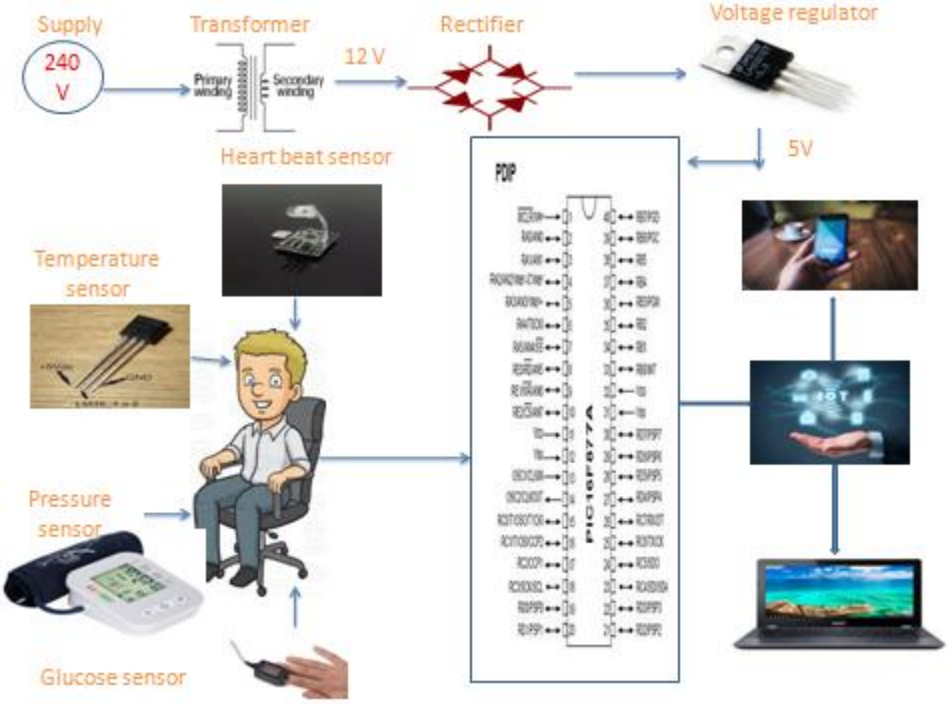

Fig.1 Proposed block diagram

2.1. Hardware Description

2.1.1. PIC16F877A microcontroller

The PIC16F877A is a PIC family microcontroller from Microchip Company. It has 64Kbytes of Flash memory and 1024 bytes of EEPROM. The key element of the PIC16F877A microcontroller is Low-control because of proficient XLP innovation joined and provides high performance hence best suited microcontroller for embedded applications. PIC16F877A is 40pin plastic dual-in-line package. The main feature is high performance RISC CPU, Adaptable oscillator structure, and Extreme low power management with XLP.

2.1.2. Heart beat sensor

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse. Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat.

This digital output can be connected to microcontroller directly to measure the Beats per Minute (BPM) rate. It works on the principle of Light modulation by blood flow through finger at each pulse.

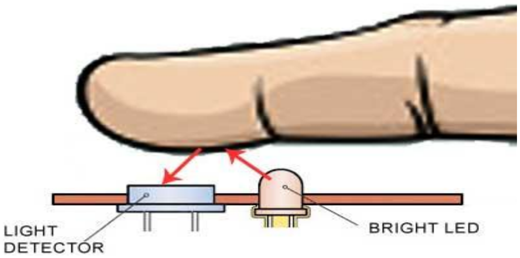

Fig.2 Heart beat sensor

2.1.3. LM35 Temperature sensor

A temperature sensor is a device, typically, a thermocouple or RTD, which provides for temperature measurement through an electrical signal. A LM35 is made from two dissimilar metals that generate electrical voltage in direct proportion to changes in temperature. An LM35 is a variable resistor that will change its electrical resistance in direct proportion to changes in temperature in a precise, repeatable and nearly linear manner.

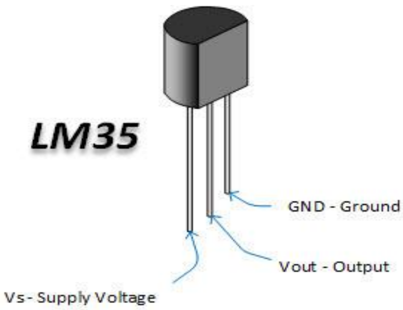

Fig.3 Temperature Sensor

2.1.4. Pressure sensor

A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers, among other names.

Fig.4 Digital Pressure calculator

2.1.5. Near IR glucose sensor

A pressure sensor is a device for pressure measurement of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications.

Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers, among other names.

Fig.5 Glucose Sensor

2.1.6. IoT (Internet of Things)

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect, collect and exchange data. IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, smart phones and tablets, to any range of traditionally dumb or non-internet-enabled physical devices and everyday objects. Embedded with technology, these devices can communicate and interact over the Internet, and they can be remotely monitored and controlled. While the Internet of Things (IoT) will ultimately have an enormous impact on consumers, enterprises and society as a whole, it is still at an early stage in its development. As mobile operators and their partners pilot new services across multiple sectors, ranging from health to automotive, they have identified several distinctive features of the Internet of Things. Device and application behavior will place new and varying demands on mobile networks.

2.1.7. Zigbee

While Bluetooth® focuses on connectivity between large packet user devices, such as laptops, phones, and major peripherals; ZIG-BEE is designed to provide highly efficient connectivity between small packet devices. As a result of its simplified operations, which are one to two full orders of magnitude less complex than a comparable Bluetooth® device, pricing for ZIG-BEE devices is extremely competitive, with full nodes available for a fraction of the cost of a Bluetooth node. ZIG-BEE devices are actively limited to a through-rate of 250 Kbps, compared to Bluetooth® much larger pipeline of 1Mbps, operating on the 2.4 GHz ISM band, which is available throughout most of the world. ZIG-BEE has been developed to meet the growing demand for capable wireless networking between numerous low-power devices. In industry ZIG-BEE is being used for next generation automated manufacturing, with small transmitters in every device on the floor, allowing for communication between devices to a central computer.

Fig.6 Zigbee Module

2.2. Software Description
2.2.1. Cool Term

Cool term is useful no matter which operating system you're using. However, it is especially useful in Mac OS where there aren't as many terminal options as there are in Windows. Download and open a Cool term window. To change the settings, click the Options icon with the little gear and wrench. You'll be presented with this menu: Here, you can change the enter key emulation (carriage return/line feed), turn local echo off or on, and you can switch between line mode and raw mode.

Line mode doesn't send data until enter has been pressed. Raw mode sends characters directly to the screen. Once all your settings are correct, the Connect and Disconnect buttons will open and close the connection. The settings and status of your connection will be displayed in the bottom left corner. If you need to clear the data in the terminal screen, click the Clear Data icon with the large red X on it. If you're getting annoyed with not being able to use the backspace, turn on 'Handle Backspace Character' under the Terminal tab under Options.

III. Experimental Result And Analysis Of The System

All the components are interfaced with microcontroller. Power supply is connected to microcontroller. All the components are operated by programming the microcontroller. Wireless technology transfers the data to the PC. The buzzer will indicate the completion of the process by giving sound. It's very easy to interface with microcontroller having UART at 5V level. Configure your microcontroller to communicate at baud rate set as per switch in RF modem and you are ready to receive or transmit. A 230V Ac supply is given to step down transformer. That step down transformer will step down the 220V to 12V.12V is given to bridge rectifier. Rectifier is used to convert AC to DC supply. Capacitor is used to reduce harmonics present in the dc supply. Voltage regulator is used to regulate 12V into 5V. The regulated voltage is given to crystal oscillator pin. Oscillator will generate clock frequency to microcontroller .Supply is given to the 40^{th} pin of pic microcontroller. Ground is given to the 20^{th} pin of pic microcontroller. Heartbeat sensor is interfaced with microcontroller at the pin 3 and 4. Pressure sensor is connected to 5^{th} pin. Temperature sensor is connected to 7^{th} pin. Zigbee is connected to 22^{nd} pin. Receiver is connected with pc to get the data from zigbee.

Fig.3 kit diagram

This whole setup is mounted on a wooden chair. When the patient will sit in the chair, the operator or patient should press the reset button. The reset button is used to reset all the devices which comes to rest position (clear the previous data).The patient should place their any of the finger into the heartbeat sensor for 30 seconds. He/she should place their wrist on the temperature sensor properly. The whole program is dumped into the chip and that chip is fixed on pic microcontroller board. Finally it shows the output in the screen by using the software called cool term.

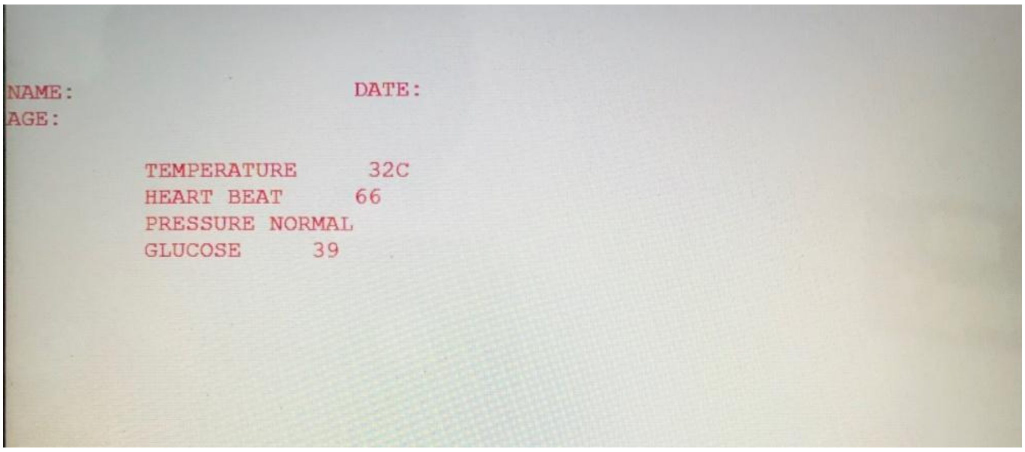

Fig.4 Desktop output screen

3.1. Analysis with real data

PARAMETER	ACTUAL DATA	DATA MEASURED BY SMART CHAIR	ERROR IN %
HEART BEAT	72 PER MINUTE	72 PER MINUTE	0%
TEMPERATURE	36.4 degree Celsius	37 degree Celsius	1%
PRESSURE	Systole=120-140 Diastole=70-90	Low –below 120 & 70 High-above140&90	0%
GLUCOSE	70	62	11.8%

IV. Conclusion

This project is mainly designed to make a hygiene atmosphere and to reduce the manpower. We are living in a very competitive world. So no one is ready to waste their time. So, nobody take care of their health. All are running towards achievements. But this project consumes less time and giving better measurements. The accuracy in measurement will give better medical report to you about your health. So, we can make healthy environment. This project is used to measure pulse, glucose level, and temperature of the body. This new technology has potential to offer a wide range of benefits to patients, medical personnel, and society through monitoring in the early detection of abnormal conditions, supervised rehabilitation, and potential knowledge discovery through data mining of all gathered information. The physiological data are stored and published to them through online. Hence, the healthcare professional can monitor their patients from a remote location at any time. It is easy to use, fast, accurate, high efficiency, and safe (without any danger of electric shocks). In contrast to other conventional medical equipment the system has the ability to save data for future reference.

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