Hardware Implementation of Cost Effective Arduino based Health Monitoring System

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Abstract—When it comes to Electronics & Communication Engineering the basic thing what students do is observe a signal from a source using a display like CRO, Digital Oscilloscope and so on. Regardless of how expensive they are we still use those display devices just because we got no other choice. There are some certain ways to display a waveform which most of the people are not aware of. As a matter of fact, we can even display a waveform using a mobile application. In our project work we are trying to display a waveform on a mobile application using Bluetooth. In our case we will be using Max30100 to generate heart rate graph and to measure the heart beat(BPM). And LM35 temperature sensor to calculate body temperature. The output grouped together and displayed on Roboremo (Mobile application). We employ Bluetooth module (HC-05) in order to transfer the collected data to the mobile application. All the processing work is done under Ardunio UNO. The main advantage is that we can monitor the health of old people easily with out any huge equipment. We can send the collected data to respective doctors and can receive the response from them quickly. Thus indirectly we are holding the ECG in our pocket. Portability being its main advantage, this system can be carried anywhere easily. The purpose of this project is to develop Bluetooth enabled Smart Health Monitoring System. In this project we are sensing health parameters like Heartrate, Body Temperature and SpO2 (Blood Oxygen) level. The Health parameters are displayed on Android App on Bluetooth enabled devices like smart phones.

Keywords— Health, Arduino, Bluetooth, Monitoring, Heartbeat.

I. Introduction

Technology is getting used each wherever in our everyday life to meet our requirements. We have a tendency to use different sensors for various applications sometimes we may even use same sensors otherwise for different applications. Whatever it should be the ultimate output is life has enhanced its speed with the technology boosters. We cannot solely increase the speed of life however additionally increase security with sensible concepts to create use of this technology. One amongst the perfect ways that of victimization technology is to use it to sense serious health issues so economical medical services is provided to the patient in correct time. This idea to supply efficient health service to patients has born to the project heart beat watching system with interfacing to Bluetooth. Heart beat monitor and show Steffi Graf system may be a transportable and a best replacement for the previous model medical instrument that is a smaller amount efficient. Heart beat rate is calculated manually exploitation stethoscope wherever the likelihood of error is high as a result of the heart beat rate is in between seventy to ninety per minute whose prevalence is less than one sec, thus this device is thought-about as a really sensible various rather than a stethoscope.

The functioning of this device relies on the reality that the blood circulates for each one heart beat which may be detected by employing a circuit fashioned by the mixture of an LED. Relying upon the speed of circulation of blood per second the heart beat rate per minute is calculated. This device consists of a small controller that takes the input from the heart beat detector and calculates the heart rate of the patient. The micro controller conjointly takes the responsibility to convey constant data to the remote mobile victimization Bluetooth. An embedded system could be a combination of package and hardware to perform an obsessive task. A number of the most devices employed in embedded merchandise are Microprocessors and Microcontrollers. Microprocessors are usually mentioned as general purpose methods as they merely settle for the inputs, process it and provide the output. In contrast, a microcontroller not solely accepts the info as inputs however additionally manipulates it, interfaces the data with varied devices, controls the data and so finally provides the result.

The central processing unit (c.p.u) can be any one of the following microprocessor, microcontroller, digital signal processing.

- Among these Microcontroller is of low cost processor and one of the main advantage of microcontrollers is, the components such as memory, serial communication interfaces, analog to digital converters etc.., all these are built on a single chip. The numbers of external components that are connected to it are very less according to the application.
- Microprocessors are more powerful than microcontrollers. They are used in major applications with a number of tasking requirements. But the microprocessor requires many external components like memory, serial communication, hard disk, input output ports etc.., so the power consumption is also very high when compared to microcontrollers.
- Digital signal processing is used mainly for the applications that particularly involved with processing of signals

At home we use a number of embedded systems which include microwave oven, remote control, vcd players, dvd players, camera etc…. In office automation, We use systems like fax machine, modem, printer etc…

Fig. 1 Fax Machine, Printing Machine

Today a lot of industries are using embedded systems for process control. In industries we design the embedded systems to perform a specific operation like monitoring temperature, pressure, humidity ,voltage, current etc.., and basing on these monitored levels we do control other devices, we can send information to a centralized monitoring station. In critical industries where human presence is avoided there we can use robots which are programmed to do a specific operation. In computer networking embedded systems are used as bridges routers etc.. and inTelecommunications cellphones, webcameras etc.,

Fig. 2 Computer Networking, Cell Phone, Webcamera

II. HEALTH MONITORING SYSTEM

In this section the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig.3
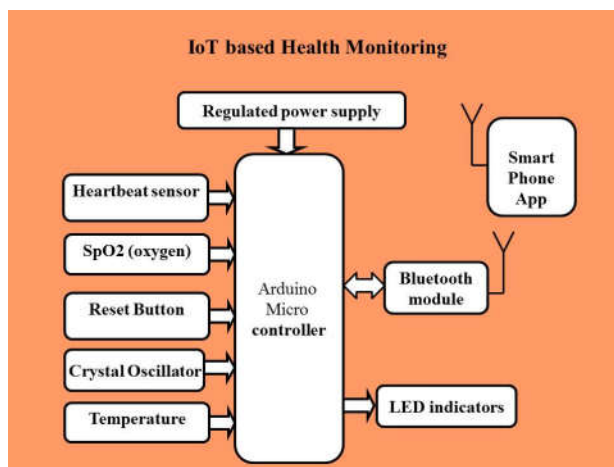

Fig. 3 Microcontroller based Health Monitoring Block diagram

The main blocks of this project are Micro controller (Arduino), Reset button, Crystal oscillator, Regulated power supply (RPS), LED Indicator, Max30100 Heartbeat sensor, Temperature sensor, Bluetooth Modem

This is the MAX300100 board that reads vital sign or pulse oximetry. The chip has AN integrated optical device that derives its reading from emitting two wavelength of sunshine from the 2 LED's then measures the absorbance of pulsing blood through a photo detector. The signal is processed by a compact noise analog signal process unit and communicated to the Microcontroller through the i2C Interface. The MAX30100 operates from 1.8v and 3.3v voltage input and may be steam-powered down through software package with negligible standby current, allowing the ability offer to stay connected in the least times. The device is appropriate for wearable devices like good watch, medical watching equipment's, fitness assistant and smart suits. Required elements Arduino Microcontroller, Bluetooth (Arduino IDE Integrated), teeny MCU (TeensyDuino Integrated), Buzzer / Alarm (Optional) LCD / OLED i2C show (Optional) Solder Less Bread board Jumper Wire. Principles And Technologies 2.1 Photo Plethysmography refers to the measure of changes within the volume of an organ of the body. These changes are typically thanks to changes within the blood flow to and from the organ, however might even be due to changes in the air flow. Photo plethysmo graphy (PPG), therefore, may be a style of plethysmography that uses optics to live changes in the blood volume in the micro vascular bed of body tissue. It's a non-invasive, easy and reasonable technique of police works the changes in the quantity of blood in a body tissue. [1, 2.] In PPG, a well perfused surface of the skin is well-lighted by light from a semiconductor diode (LED) preferably, green LED or red LED. The sunshine transmitted or mirrored by the skin surface, collected by means that of a photodiode is then accustomed confirm changes in blood volume. The photodiode is placed either on the opposite aspect of the skin surface to sight the transmitted light, or on an equivalent side because the light to detect the transmitted light. Figure one: Operation of the heart beat measuring instrument utilizing PPG to live blood O saturation. Derived from Omar and Arminius [2, 160]. Figure 1 higher than shows the operation of a pulse oximeter. On the left could be a depiction of transmission pulse oximetry and on the proper is a depiction of reflection pulse oximetry. As shown within the figure, each the crystal rectifier and also the photo detector are placed on a similar facet of the finger in the reflection pulse oximetry whereas the LED and the photo detector are placed on the alternative sides of the finger in the transmission pulse oximetry. The PPG wave consists of 2 components, the pulsatile AC component, that is attributed to the viscous synchronous changes in the blood volume per heart Operation of the heart beat measuring device utilizing PPG to live blood gas saturation. Traced from Omar and Arminius [2, 160]. And therefore the slowly varied or comparatively constant DC component, which is attributed to respiration, sympathetic system nervous activity and thermoregulation. Lightweight absorption by totally different tissues showing the PPG waveform supported arterial blood absorption at the top. Above shows the PPG undulation with its AC and DC parts. Whereas the AC component represents variable blood absorption, the DC component represents comparatively constant blood absorption by the arteries, veins, tissues and bones. These 2 parts are relevant for deciding the quantity of O within the blood however solely the AC component is required for shrewd the center rate, wherever every spike in the wave represents one heart beat. PPG is applied within the development of varied commercially accessible health observance and measured devices appreciate oximeter, for measuring blood O saturation, pulse rate meter for heart rate measurement, and pressure level monitor.

'Bluetooth', the short-range communication system technology designed to "connect" AN array of devices as well as mobile phones, PC's, and PDA's, and therefore the strategic choices that Motorola ought to build in incorporating this emergent technology into its product portfolio. The aim of this paper are going to be to supply a high-level summary of the technology to the pinnacle of Motorola' Communications Enterprise, and prepare this company officer to be strategically and functionally familiar with the technology with subordinates that have direct responsibility for integration Bluetooth into Motorola' product lines. The first sections of the paper detail the background of the Bluetooth technology and its associated Special-Interest Group, or SIG, (a conglomeration of corporations that has sought-after to scale back market uncertainty, thereby expediting the diffusion of Bluetooth devices). Bluetooth's perceived strengths over alternative wireless property technologies are mentioned and a few macro-level threats that will impede Bluetooth diffusion are outlined.

The remainder of the paper details potential Bluetooth markets (in terms of shopper and company applications) and examines Motorola' current Bluetooth product offerings (a mobile phone battery and laptop PCMCIA card every enabled with a Bluetooth chip). Finally, the paper provides steerage for Motorola' Bluetooth application development methods concerning the applications printed within the SIG' specifications, specifically accenting those applications that leverage existing complementary assets, and people that are essential to Bluetooth adoption in spite of previous expertise. Bluetooth may be a worldwide initiative spearheaded by a number of the leading powerhouses within the physical science industry, principally Ericsson, Intel, IBM, Nokia, and Toshiba. Following initial development by Ericsson, these corporations started the Bluetooth special-interest cluster in 1998 with the intent of developing a worldwide technology for wireless communication among various devices.

Bluetooth permits wireless knowledge and speech via a short-range radio to produce a low-priced answer for wireless data exchange. Targeted electronic devices embrace handsets, notebooks, PCs, and private digital assistants for the primary wave. For instance, this technology might modify Palm Pilots to synchronize with every other, PCs, or with a mobile phone. This effort to supply a good vary of wireless information Associate in Nursing oral communication to disparate devices could have a

major impact on the means individuals synchronize and share data, therein the time and easy communication improves radically. To date, no different effort has been therefore comprehensive, incorporating probably dozens of devices with eclectic user teams (most notably the house and business user). Given an increasing want amongst shopper and industrial users for quality and connectivity, Bluetooth proponents expect that the demand for Bluetooth technology can result in its fast adoption. Dataquest estimates that simple fraction of all new movable handsets can utilize Bluetooth by 2004. That amounts to over 570 million phones, as compared to lower than 1% this year, or 1.2 million phones (See Exhibit 1). Most believe that the expansion and supreme success of Bluetooth, like fax machines and email, are going to be enthusiastic about Metcalfe's Law, that states that the worth of a system will increase proportionately to the quantity of nodes in this system.

The Bluetooth SIG comes into being with a higher strategy than several alternative technology innovators. It marketed the Bluetooth idea and membership heavily, accentuating the potential of the technology to hardware and software system developers and manufacturers. Not like some earlier groups, this SIG inspired broad membership, because it charges no fees to join—no royalties, guarantees, or promises. This open normal has enabled the first five-member cluster to achieve quite 2,108 members to date; there's huge momentum behind this initiative. a lot of striking, the SIG has centered on a worldwide roadmap from the onset, supporting country-specific native laws and restrictions, so lowering hurdles at the purpose of initialization. The members of the SIG clearly perceive that Bluetooth can produce a "Mix and Match" market, and have worked to unite a broad vary of makers below one standard and minimize the uncertainty for manufacturers and consumers. From G. Moore's "Chasm" perspective, the users are any companies that may utilize the technology, and SIG has earned vital mass amongst these "users." The manufacturer is that the critical element of the adoption cycle, instead of the consumer, as a result of the advantages of the Bluetooth technology are smitten by the supply of a complementary style of Bluetooth enabled devices. Accordingly, the support from a good assortment of device makers is crucial to confirm widespread client adoption. Consequently, the SIG has dramatically shortened the merchandise adoption cycle and created market momentum which will surmount the opening between early and thought markets.

Bluetooth itself could be a low-power, short-range radio that may treat average from ten meters to a hundred meters. These radios are engineered on atomic number 14 victimization the foremost common chip fabrication technology, a CMOS (complimentary metal chemical compound silicon) process, though some are going to be built on silicon-germanium wafers. The module, that basically may be a goods radio, additionally includes a baseband hardware link controller, a link management interface, and software system applications to run the module. The Bluetooth SIG expects the modules can price $25-$30 every through the tip of 2000. Thereafter, the value is predicted to decrease because the volumes increase, probably to as low as $5-$10 per module.

Bluetooth has the potential to enhance personal communications (consumer and corporate) and productivity by making personal networks between all of a user' electronic devices. It operates within the unlicensed, internationally obtainable 2.45GHz band and could be a way more strong technology than different wireless technologies used for similar applications, most notably infrared-- which needs a line of sight link between act devices. Bluetooth's multidirectional capability makes the technology filmable to a large number of applications. Additionally, Bluetooth will alter up to eight devices at one time, forming a 'piconet', act amongst themselves.

Additionally, Bluetooth-enabled devices have bigger computing power dedicated to communications compared to previous generations of devices, letting the facility to translate between internal languages of all types of devices thought to be antecedently incompatible. As Associate in example, Bluetooth-enabled moveable electronic equipment would be able to play with Bluetooth-enabled speakers within the absence of headphones. Accordingly, as that example shows, Bluetooth's most significant hurdle may be adoption, that is a operate of the incontestable profit being offered by a sufficient range of enabled devices.
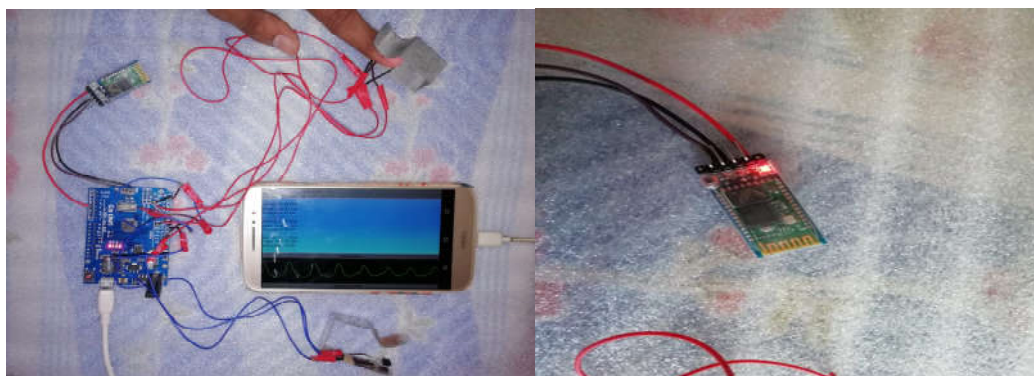
III. RESULTS

Fig. 4 LED indicator on HC-05 bluetooth module

The blinking red LED on the HC-05 Bluetooth module indicates that display device is not connected and is ready to pair. Tx and Rx LED's indicate if the data is being transmitted or not
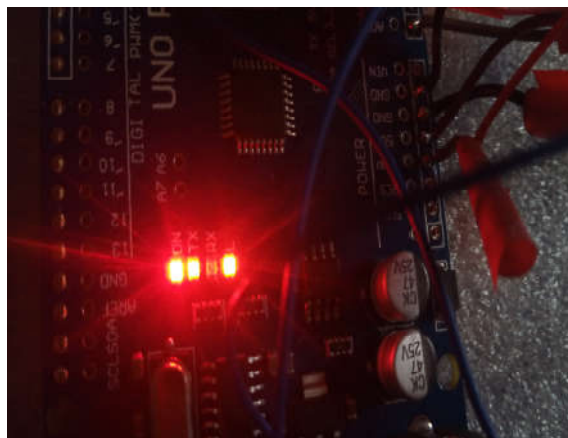

Fig. 5 Tx and Rx LEDs on Arduino UNO

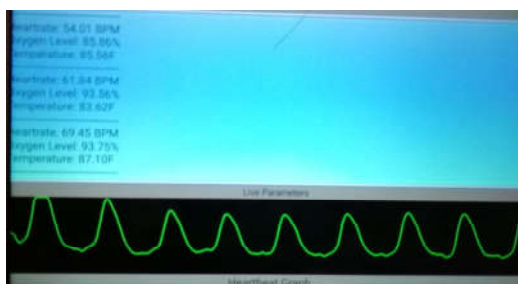Fig. 6 Heart rate graph obtained on the mobile application

Fig. 7 Output Parameters along with the graph

IV. CONCLUSIONS

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested. Our project "Micro Controller based heart beat monitoring on Smartphone App" is mainly intended to design a system, which gives very accurate result than the existing devices in the present day world. This system has a heart beat sensor and PC interfaced to the micro controller. The micro controller is programmed in such a way that it takes input from the heart beat sensor when a finger is inserted into it and displays the value on the PC continuously. This project can be extended by using RS485 which also uses wired mechanism, but distance can be increased. Also, wireless technology like Zigbee can be used which eliminates the wired mechanism. Also, GSM module can be used to send the monitored heart beat values.

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