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DESIGN AND DEVELOPMENT OF PATIENT MONITORING SYSTEM USING ANDROID APPLICATION
PATIENT MONITORING SYSTEM

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Abstract-- Care of critically ill patient, requires spontaneous & accurate decisions so that life protecting & lifesaving therapy can be properly applied. Statistics reveal that every minute a human is losing his/her life across the globe. More close in India, everyday many lives are affected by heart attacks and more importantly because the patients did not get timely and proper help .This project is based on monitoring of patients. We have designed and developed a reliable, energy efficient patient monitoring system. It is able to send parameters of patient in real time. It enables the doctors to monitor patient's health parameters (Temperature, Heartbeat, and ECG) in real time. Here the parameters of patient (temperature, heartbeat, ECG) are measured continuously and wirelessly transmitted using Bluetooth. This project provides a solution for enhancing the reliability and flexibility by improving the performance and power management of the patient monitoring system. In the current proposed system the patient health is continuously monitored and the acquired data is analyzed at a centralized AtMega16 microcontroller. This data is continuously transmitted to the doctor using Bluetooth. The Doctor can get a record of a particular patient's information by just accessing the database of the patient in the developed Android application in his mobile phone which is continuously updated through Bluetooth receiver module.

Keywords—Patient Monitoring, Heartbeat, ECG, Sensor, Bluetooth Module, Android.

I. INTRODUCTION

In spite of the improvement of communication link and despite all progress in communication technologies, there are still very few functioning commercial wireless monitoring systems, which are most off-line and there are still number of issues to deal with. Therefore there is a strong need for investigating the possibility of design and implementation of an interactive real time wireless communication system. Potential applications of wireless health system are remote routine checkups, emergency alarm to doctor and caretakers in emergency situation and predication on patient's health condition. So that early detection of patient health condition can help doctor to take necessary action to handle or avoid unusual situation in future. Doctor can continuously monitor patient's health condition from android application.

In this project, the system was designed and developed for the patient health monitoring using Bluetooth. The primary function of this system is to monitor the Temperature, Heartbeat and ECG of the patient. The data collected by the sensors is in the analog form and it is sent to the microcontroller. The microcontroller further sends the data to the LCD and at the same time Bluetooth module receives this data. This data is continuously transmitted to the doctor using Bluetooth. The Doctor can get a record of a particular patient's information by just accessing the database of the patient in the developed Android application in his mobile phone which is continuously updated through Bluetooth receiver module. The alarm will also ring if the threshold values of parameters are crossed.

II. DETAILED DESCRIPTION

The implementation of the system has been described using following:

- Block Diagram: The blocks in the diagram depict the major components of the system and their interconnections.
- Flowchart: This depicts the flow of the control as in the system.

A. BLOCK DIAGRAM

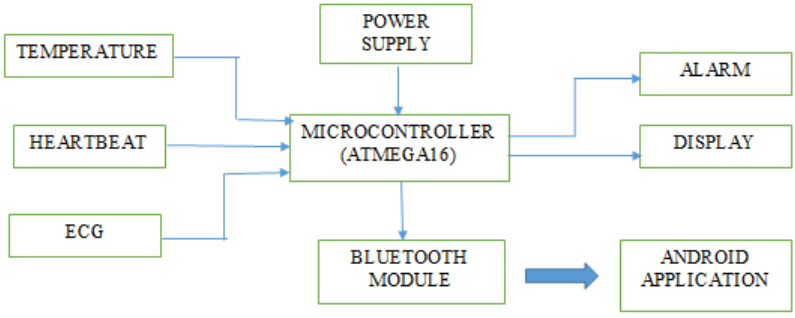

Figure 1. Block Diagram

The block diagram shown above is for "Design and Development of Patient Monitoring System Using Android Application". Here the monitoring of three parameters of patient's body is done; they are Temperature, Heartbeat and ECG.

The sensors used in this system are useful in measuring the above mentioned parameters. As a control unit ATMEGA16 microcontroller is used. This data from these three sensors which provides us with an analog voltage signal are fed to the microcontroller. The output from the microcontroller is displayed on the display device which is (16 x 2) LCD. This output is also going to be displayed on Android Application. To display these parameters on the Android App, a Bluetooth Module is used.
This helps the doctor to monitor the patient condition from his cabin or any location.

B. FLOWCHART

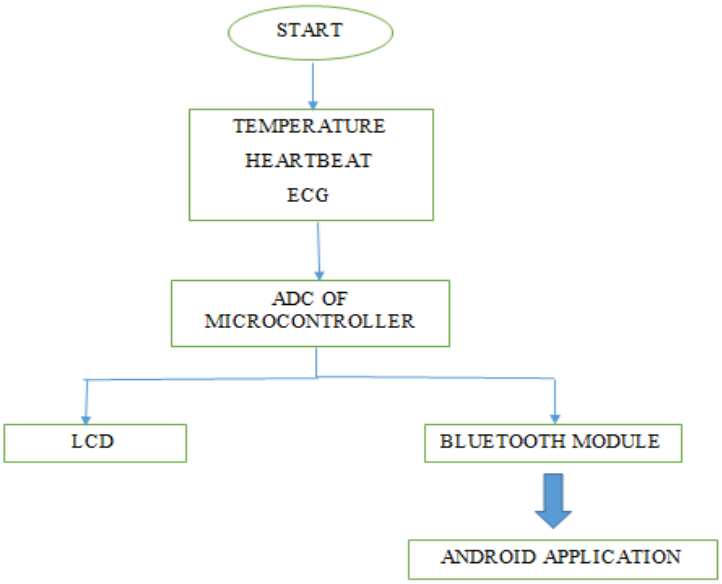

Figure 2. Flowchart

III. IMPLEMENTATION METHODOLOGY

A. HARDWARE IMPLEMENTED

- **POWER SUPPLY (7805):** 7805 is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value. The xx in 78xx indicates the fixed output voltage it is designed to provide. 7805 provides +5V regulated power supply. Capacitors of suitable values can be connected at input and output pins depending upon the respective voltage levels.
- **CONTROLLER MODULE (AtMega16 Microcontroller):** The ATmega16 is a part of the AVR family. It uses 16kB on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time. Flash, EEPROM and SRAM are all integrated onto a single chip, removing the need for external memory in most applications. The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.
- **TEMPERATURE SENSOR**: LM35 series are precision integration-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 does not require any external calibration or trimming to provide typical accuracies. This is three legs IC that directly gives analog output. This unit requires +5V DC for it proper operation.
- **HEART BEAT SENSOR:** It 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. The HBS01 Sensor Module uses optical sensors to measure the alternation in blood volume at fingertip with each heartbeat. The IR LED transmits an infrared light into fingertip (placed over the sensor unit), and the photodiode senses the portion of the light that is reflected back. The intensity of reflected light depends upon the blood volume inside the fingertip. So, each heartbeat slightly alters the amount of reflected infrared light that can be detected by the photodiode. With a proper signal conditioning, this little change in the amplitude of the reflected light can be converted into a pulse. The pulses can be later counted by the microcontroller to determine the heartbeat.

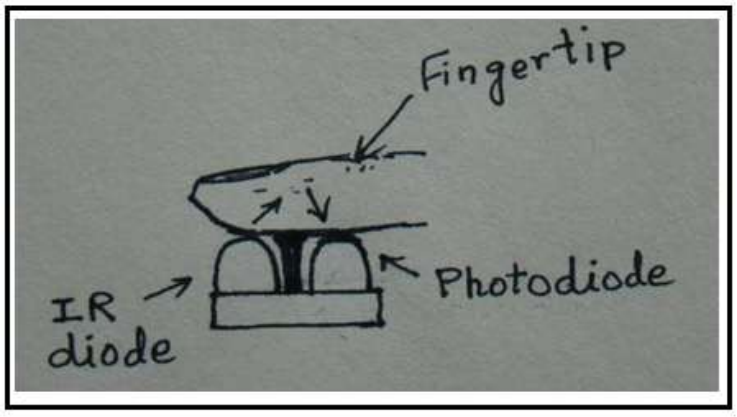

Figure 3. Heartbeat sensor

- **ECG SENSOR (IM118):** Usually more than 2 electrodes are used and they can be combined into a number of pairs (For example: Left arm (LA), right arm (RA) and left leg (LL) electrodes form the pairs: LA+RA, LA+LL, RA+LL). The output from each pair is known as a lead. Each lead is said to look at the heart from a different angle. Different types of ECGs can be referred to by the number of leads that are recorded, for example 3-lead, 5-lead or 12-lead ECGs (sometimes simply "a 12-lead"). A 12-lead ECG is one in which 12 different electrical signals are recorded at approximately the same time and will often be used as a one-off recording of an ECG, typically printed out as a paper copy. 3-lead ECGs tend to be monitored continuously and viewed only on the screen of an appropriate monitoring device, for example during an operation or whilst being transported in an ambulance. There may, or may not be any permanent record of a 3-lead ECG depending on the equipment used.

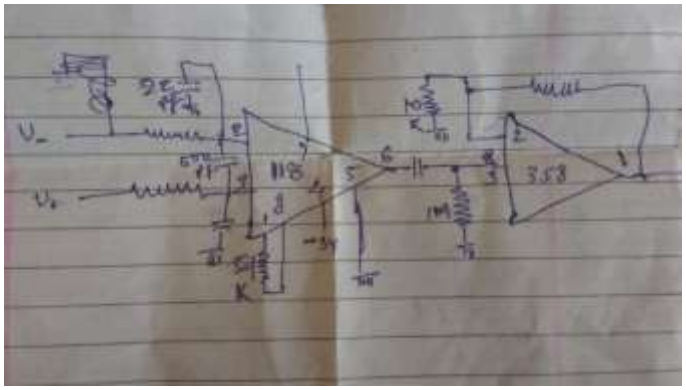

Figure 4. ECG sensor module

- **BLUETOOTH MODULE:** HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.
- **LCD DISPLAY:** A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in.

B. SOFTWARE IMPLEMENTED

- **Express PCB**: It is a PCB layout design program with Digi-key component database. You can easily search and position components in its interface, snap-to-grid feature allows you to neatly align the parts. Copper traces can be added by clicking on the pin of a component and dragging it to another pin. After you complete your layout, the Express PCB program tells you exactly how much it costs to have the boards made. You can order them online using the "Order boards via the Internet" command.

- **TINY CAD:** Tiny CAD is an open source schematic capture program. Use Tiny CAD to draw your own circuit diagrams. You can lay out circuit diagrams using the supplied libraries. Alternatively, there is a component library editor built into Tiny CAD – so you can easily create your own symbols. You may also find more libraries on the Yahoo group that other users have drawn for you. Once you have drawn your design, you can use the special functions to automatically add symbol references, check your design against rules of correctness and create a parts list. Tiny CAD can also export a net lists for import into PCB layout programs. Once you have your design you can copy and paste it into other packages such as Word (or better still Open Office). You may also print your design to any supported Windows printer. If your design is larger than a single page then it can be either scaled to fit on a single page or printed across many pages.

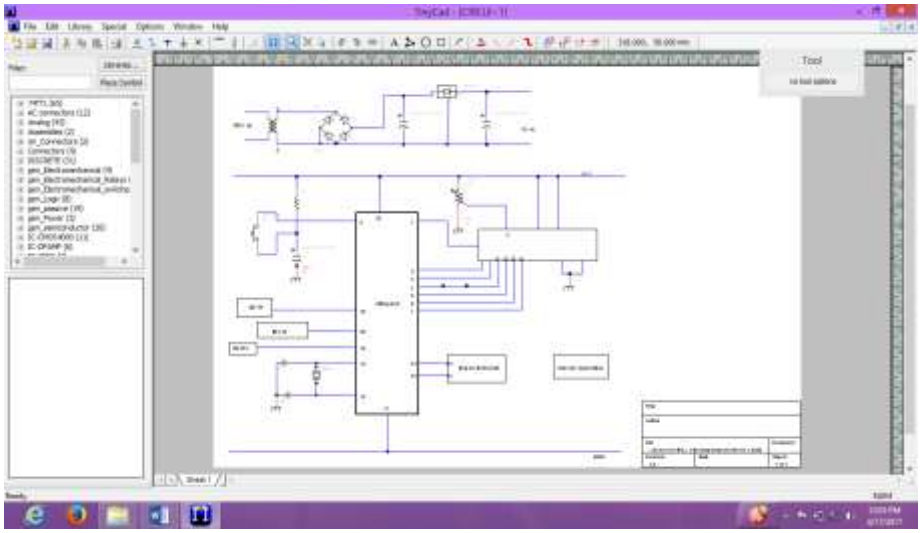

Figure 5. Tiny CAD

- **ANDROID SDK:** A software development kit that enables developers to create applications for the Android platform. The Android SDK includes sample projects with source code, development tools, an emulator, and required libraries to build Android applications. Applications are written using the Java programming language and run on Dalvik, a custom virtual machine designed for embedded use which runs on top of a Linux kernel.
- **ECLIPSE:** It is an integrated development environment (IDE) used in computer programming, and is the most widely used Java IDE.[6] It contains a base workspace and an extensible plug-in system for customizing the environment. Eclipse is written mostly in Java and its primary use is for developing Java applications, but it may also be used to develop applications in other programming languages via plug-ins, including Ada, ABAP, C, C++, COBOL, D, Fortran, Haskell, JavaScript, Julia, Lasso, Lua, NATURAL, Perl, PHP, Prolog, Python, R, Ruby (including Ruby on Rails framework), Rust, Scala, Clojure, Groovy, Scheme, and Erlang. It can also be used to develop documents with LaTeX (via a TeXlipse plug-in) and packages for the software Mathematica. Development environments include the Eclipse Java development tools (JDT) for Java and Scala, Eclipse CDT for C/C++, and Eclipse PDT for PHP, among others.

V. RESULT

Figure 6. Result of the system

VI. APPLICATIONS

- Wireless routine health checkup possible.
- Emergency alarms to doctors and caretakers.
- This system can be used in various hospitals.
- This system can be useful in such condition where the doctors are unable to reach to the patient.

VII. ADVANTAGES

- This system offers anytime and anywhere remote monitoring of patients.
- Real time communication is possible.
- Graphical readings can be send.
- Constant monitoring of more than one patient is possible.
- Human efforts and human errors reduce.
- Doctor can monitor the patient's parameters wherever he/she is.
- Low cost and less compels system for installing and application.
- Easy to operate.

VIII. DISADVANTAGES

- If Bluetooth connectivity is lost then system will not work.
- Data may get jumble.
- The fingertip placement should be exactly over the sensor unit otherwise it will cause the error while measuring the heartbeat.

IX. FUTURE SCOPE

- This circuitry can further made compact and can be used as a wearable device, i.e. Wrist worn device continuously monitor the patient in real time. If real time operating system found any emergency satiation then send quick alarm to doctor and caretakers.

- The entire medical data acquisition could be made wireless. This module can transmit the data continuously over a fiber optic link or through an internet digital radio. The received data can be stored in separate memory and be processed by a microcontroller. This enhancement will enable monitoring of patients to be more flexible and strain-free.
- Specialist doctor can join via video conferencing if GPS and MATLAB is used instead of Bluetooth.
- System can be used in Ambulatory Services.

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