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GSM Based Health Monitoring of A Patient by Using IoT

Dirisala Mohan Naga Sai Gopi, Addanki Lokesh Babu, Bhavirisetti Rudhra Madhava, Attaluri Abhishek, Dr. T. Kameswara Rao

Department of Computer Science, Vasireddy Venkatadri Institute of Technology, Namburu, Andhra Pradesh, India

ABSTRACT

Health has prime importance in our day-to-day life. Sound health is necessary to do the daily work properly. This project aims at developing a system which gives body temperature and heart rate using LM35 and pulse sensor respectively. These sensors are interfaced with controller Arduino Uno board. Wireless data transmission done by Arduino through Wi-Fi module. ESP8266 is used for wireless data transmission on IoT platform i.e. thing speak. Data visualization is done on Thing speak. So that record of data can be stored over period of time . This data stored on web server so that it can seen to who logged.

Keywords : Arduino, IoT, ESP8266

I. INTRODUCTION

With the development of world, Health monitoring system is used every field such as hospital, home care unit, sports. This health monitoring system use for chronicle diseases patients who have daily check-up. Normally it is difficult to keep track on abnormalities in heartbeat count for patient itself manually. The average heartbeat per minute for 25-year old ranges between 140-170 bpm while for a 60-year old it is around between 115-140 bpm and body temperature is 37degree Celsius or 98.6 Fahrenheit. Patients are not well versed with manual treatment which doctors normally use for tracking the count of heartbeat. There are various instruments available in market to keep track on internal body changes. But there are many limits in maintenance part due to their heavy cost, size of instruments and mobility of patients. So, researchers design a system as portable device. To design the system based on this performance. Different biomedical sensors like temperature sensor, heart rate sensor, blood pressure sensor are used for monitoring the health condition which is integrated on single system on-chip. If any varied change takes place it is notified. This notification would help to take an appropriate action at an instance of a time. This would save patients from the future health problem which would arise. This would also help patient's concern doctor to take an appropriate action at proper time

II. WIRELESS SENSOR NETWORK

A wireless sensor network (WSN) is a wireless network which consists of structurally distributed autonomous devices that use sensors to monitor physical or environmental conditions. These autonomous devices, or nodes, combine with routers and a gateway to create a WSN system. Sensor networks are the key to gathering the information needed by smart environments, whether in buildings, utilities, industries, home, ships, transportation systems automation, or elsewhere. Recent terrorist and guerrilla warfare countermeasures require distributed networks of sensors that can be expanded and have self-organizing capabilities. In such

applications, running wires or cabling is usually impractical. A sensor network is required that is fast and easy to install and maintain. The smart gateway is designed to enable WSN and public communication networks to access each other with seamless internetworking. In this design, the gateway consists of central control unit, database (DB), WSN module, WLAN AP, and GSM module.

Structure of Gateway The distributed measurement nodes communicate wirelessly to a central gateway, which provides a connection to the wired world where the data can be collect, process, analyze and present your measurement data. To extend distance and reliability in a wireless sensor network, you can use routers to increase an extra communication link between end nodes and the gateway. The gateway includes three external communication modules (ECM): WSN Module, WLAN AP, and GSM Module. WSN module, on one hand, is basically used for receiving data packages from the core of the WSN; on the other hand, it is used to send commands to the WSN or specific sensor nodes. It implements the protocol translation and provides the physical mechanism between gateway and WSN. In this design, a MIB520 USB Interface Board attaching with the sink node in WSN is used as the WSN module. A GSM module is needed when sending SMS to the subscribers using GSM networks, or sending data to remote server through GPRS if necessary. GT64 is an intelligent GSM/GPRS control terminal which puts together GSM networks with the 1800/1900 MHz RF bands. The communication can be realized via SMS over GSM or SMS over GPRS using standard AT commands. WLAN AP has two tasks. First, in order to connect to the internet, it acts as a client PC and accepts the IP address assigned by the internet server. Second, it sets up an ad-hoc network for subscribers and system maintainers so that they can connect to the smart gateway with laptop or PDA easily. In this paper we discussed through various researches what development has been done in Patient Health Monitoring System and our proposed work regarding the following paper.

III. WORKING OF CIRCUIT

Heart Beat Monitor with microcontroller ATMEGA16 (AVR). Heart Beat Monitoring circuit using LM358 The use of microcontroller is in every field even we can use it in the design and fabrication of biomedical equipments. An example is given here. The microcontroller AT89S51 (8051) is here used for development of a heartbeat monitoring system. By placing your finger in between, a LED and photo resistance, Person can easily detect the pulses of heart, the analog voltages are further processed with an operational amplifier LM 358, this chip has two built in Op-Amps. The TTL pulses or digital pulse are then feed to the external interrupt of AVR microcontroller. By using a software counter in the code, they can count the pulses, and the result the process is displayed on an LCD (2 line 16 characters). HB = 5184/t Where t is average of time delay between 2 consecutive pulses here use of first 5 pulses for calculation of HB.

IV. ARDUINO

The Arduino UNO board continuously reads input from these 3 senses. Then it sends this data to the cloud by sending this data to a particular URL/IP address. Then this action of sending data to IP is repeated after a particular interval of time. For example in this project, we have sent data after every 30 seconds.

V. BUZZER

A **buzzer** or **beeper** is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to a control unit that determines if

and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel, and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong. Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board. Another implementation with some AC-connected devices was to implement a circuit to make the AC current into a noise loud enough to drive a loudspeaker and hook this circuit up to a cheap 8-ohm speaker. Nowadays, it is more popular to use a ceramic-based piezoelectric sounder like a Son alert which makes a high-pitched tone. Usually these were hooked up to "driver" circuits which varied the pitch of the sound or pulsed the sound on and off.

In game shows it is also known as a "lockout system," because when one person signals ("buzzes in"), all others are locked out from signaling. Several game shows have large buzzer buttons which are identified as "plungers".

The word "buzzer" comes from the rasping noise that buzzers made when they were electromechanical devices, operated from stepped-down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

VI. GSM (GLOBAL SYSTEM FOR MOBILE COMMUNICATIONS)

GSM (Global System for Mobile communications) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

The rarer 400 and 450 MHz frequency bands are assigned in some countries, where these frequencies were previously used for first-generation systems.

GSM-900 uses 890–915 MHz to send information from the mobile station to the base station (uplink) and 935–960 MHz for the other direction (downlink), providing 124 RF channels (channel numbers 1 to 124) spaced at 200 kHz. Duplex spacing of 45 MHz is used. In some countries the GSM-900 band has been extended to cover a larger frequency range. This 'extended GSM', E-GSM, uses 880–915 MHz (uplink) and 925–960 MHz (downlink), adding 50 channels (channel numbers 975 to 1023 and 0) to the original GSM-900 band. Time division multiplexing is used to allow eight full-rate or sixteen half-rate speech channels per radio frequency channel. There are eight radio timeslots (giving eight burst periods) grouped into what is called a TDMA frame. Half rate channels use alternate frames in the same timeslot. The channel data rate is 270.833 kbit/s, and the frame duration is 4.615 ms.

GSM ADVANTAGES

GSM also pioneered a low-cost, to the network carrier, alternative to voice calls, the Short t message service (SMS, also called "text messaging"), which is now supported on other mobile standards as well. Another advantage is that the standard includes one worldwide Emergency telephone number, 112. This makes it easier for international travelers to connect to emergency services without knowing the local emergency number.

VII. THE GSM NETWORK

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address

the hardware. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS).

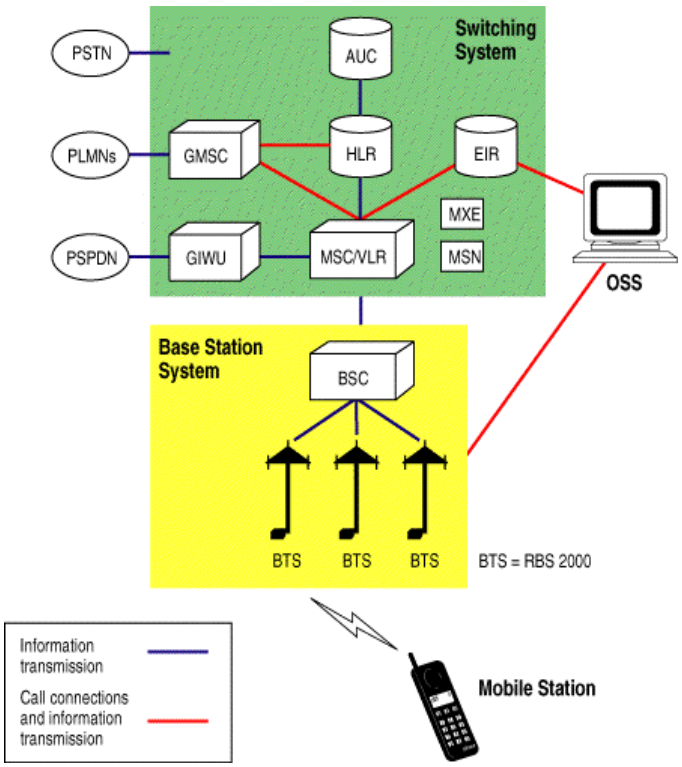


Fig 1. The Switching System

The switching system (SS) is responsible for performing call processing and subscriber-related functions. The switching system includes the following functional units.

- Home location register (HLR)**:** The HLR is a database used for storage and management of subscriptions. The HLR is considered the most important database, as it stores permanent data about subscribers, including a subscriber's service profile, location information, and activity status. When an individual buys a subscription from one of the PCS operators, he or she is registered in the HLR of that operator.
- Mobile services switching center (MSC)**:** The MSC performs the telephony switching functions of the system. It controls calls to and from other telephone and data systems. It also performs such functions as toll ticketing, network interfacing, common channel signaling, and others.
- Visitor location register (VLR)**:** The VLR is a database that contains temporary information about subscribers that is needed by the MSC in order to service visiting subscribers. The VLR is always integrated with the MSC. When a mobile station roams into a new MSC area, the VLR connected to that MSC will request data about the mobile station from the HLR. Later, if the mobile station makes a call, the VLR will have the information needed for call setup without having to interrogate the HLR each time.
- Authentication center (AUC)**:** A unit called the AUC provides authentication and encryption parameters that verify the user's identity and ensure the confidentiality of each call. The AUC protects network operators from different types of fraud found in today's cellular world.
- Equipment identity register (EIR)**:** The EIR is a database that contains information about the identity of mobile equipment that prevents calls from stolen, unauthorized, or defective mobile stations. The AUC and EIR are implemented as stand-alone nodes or as a combined AUC/EIR node.

The Base Station System (BSS)

All radio-related functions are performed in the BSS, which consists of base station controllers (BSCs) and the base transceiver stations (BTSs).

- BSC: The BSC provides all the control functions and physical links between the MSC and BTS. It is a high-capacity switch that provides functions such as handover, cell configuration data, and control of radio frequency (RF) power levels in base transceiver stations. A number of BSCs are served by an MSC.

- BTS: The BTS handles the radio interface to the mobile station. The BTS is the radio equipment (transceivers and antennas) needed to service each cell in the network. A group of BTSs are controlled by a BSC.

The Operation and Support System

The operations and maintenance center (OMC) is connected to all equipment in the switching system and to the BSC. The implementation of OMC is called the operation and support system (OSS). The OSS is the functional entity from which the network operator monitors and controls the system. The purpose of OSS is to offer the customer cost-effective support for centralized, regional and local operational and maintenance activities that are required for a GSM network. An important function of OSS is to provide a network overview and support the maintenance activities of different operation and maintenance organizations.

Additional Functional Elements

- Message center (MXE): The MXE is a node that provides integrated voice, fax, and data messaging. Specifically, the MXE handles short message service, cell broadcast, voice mail, fax mail, e-mail, and notification.
- Mobile service node (MSN): The MSN is the node that handles the mobile intelligent network (IN) services.
- Gateway mobile services switching center (GMSC): A gateway is a node used to interconnect two networks. The gateway is often implemented in an MSC. The MSC is then referred to as the GMSC.

GSM inter-working unit (GIWU): The GIWU consists of both hardware and software that provides an interface to various networks for data communications. Through the GIWU, users can alternate between speech and data during the same call. The GIWU hardware equipment is physically located at the MSC/VLR.

A. Heartbeat Sensor

Heartbeat sensor provides a simple way to study the function of the heart which can be measured based on the principle of psycho-physiological signal used as a stimulus for the virtual- reality system. The amount of the blood in the finger changes with respect to time.

The sensor shines a light lobe (a small very bright LED) through the ear and measures the light that gets transmitted to the Light Dependent Resistor. The amplified signal gets inverted and filtered, in the Circuit. In order to calculate the heart rate based on the blood flow to the fingertip, a heart-rate sensor is assembled with the help of LM358 OP-AMP for monitoring the heartbeat pulses.

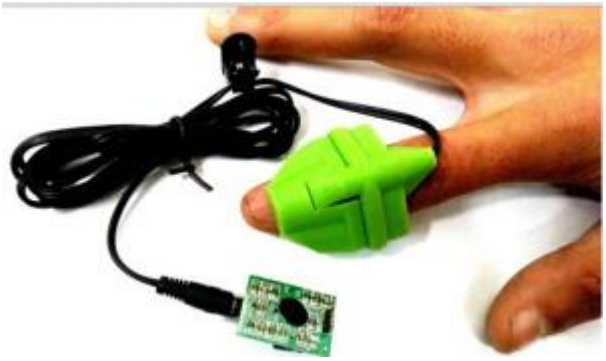


Fig 2. Features of Heartbeat Sensor

- Indicates heartbeat by a LED
- Provides a direct output digital signal for connecting to a microcontroller
- Possesses compact Size
- Works with a working Voltage of +5V DC
- Primary Applications of Heartbeat Sensor

1) Working of a Heartbeat Sensor

The heart beat sensor circuit diagram comprises a light detector and a bright red LED. The LED needs to be of super bright intensity because maximum

light passes and spreads if a finger placed on the LED is detected by the detector.

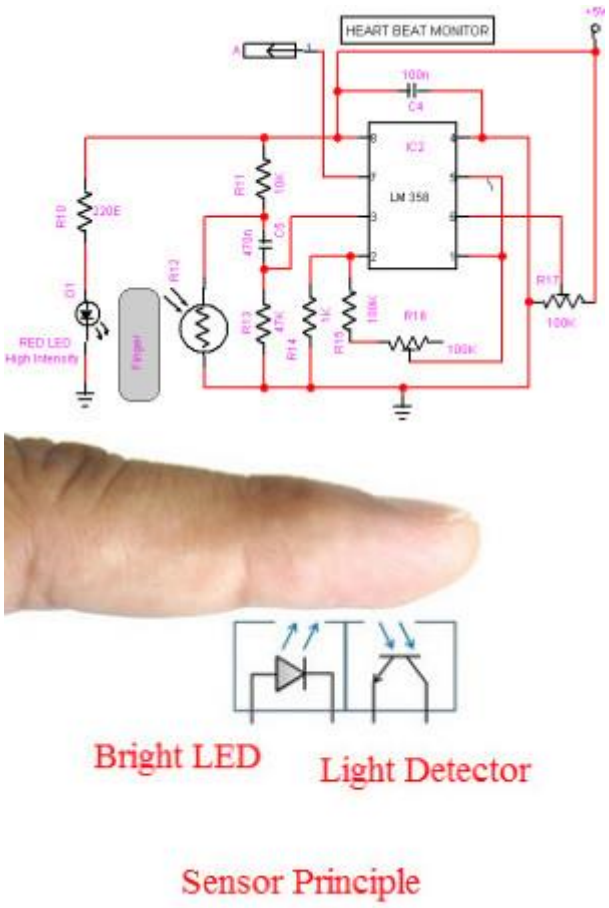


Fig 3. LCD (LIQUID CRISTAL DISPLAY)

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

Many microcontroller devices use 'smart LCD' displays to output visual information. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines(RS RW D7 D6 D5 D4). When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller.

CONTROL LINES

- EN: Line is called "Enable." This control line is used to tell the LCD that you are sending it data. To send data to the LCD, your program should make sure this line is low (0) and then set the other two control lines and/or put data on the data bus. When the other lines are completely ready, bring EN high (1) and wait for the minimum amount of time required by the LCD datasheet (this varies from LCD to LCD), and end by bringing it low (0) again.
- RS: Line is the "Register Select" line. When RS is low (0), the data is to be treated as a command or special instruction (such as clear screen, position cursor, etc.). When RS is high (1), the data being sent is text data which should be displayed on the screen. For example, to display the letter "T" on the screen you would set RS high.
- RW: Line is the "Read/Write" control line. When RW is low (0), the information on the data bus is being written to the LCD. When RW is high (1), the program is effectively querying (or reading) the LCD. Only one instruction ("Get LCD status") is a read command. All others are write commands, so RW will almost always be low.

Finally, the data bus consists of 4 or 8 lines (depending on the mode of operation selected by the

user). In the case of an 8-bit data bus, the lines are referred to as DB0, DB1, DB2, DB3, DB4, DB5, DB6, and DB7.

ENTERING TEXT

First, a little tip: it is manually a lot easier to enter characters and commands in hexadecimal rather than binary (although, of course, you will need to translate commands from binary couple of sub-miniature hexadecimal rotary switches is a simple matter, although a little bit into hex so that you know which bits you are setting). Replacing the d.i.l. switch pack with a of re-wiring is necessary.

The switches must be the type where on = 0, so that when they are turned to the zero position, all four outputs are shorted to the common pin, and in position "F", all four outputs are open circuit.

All the available characters that are built into the module are shown in Table 3. Studying the table, you will see that codes associated with the characters are quoted in binary and hexadecimal, most significant bits ("left-hand" four bits) across the top, and least significant bits ("right-hand" four bits) down the left.

TEMPERATURE SENSORS (LM35)

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1/4°C at room temperature and ±3/4°C over a full -55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy.

APPLICATIONS:

The LM35 can be applied easily in the same way as other integrated-circuit temperature sensors. It can be glued or cemented to a surface and its temperature will be within about 0.01°C of the surface temperature. This presumes that the ambient air temperature is almost the same as the surface temperature; if the air temperature were much higher or lower than the surface temperature, the actual temperature of the LM35 die would be at an intermediate temperature between the surface temperature and the air temperature. This is especially true for the TO-92 plastic package, where the copper leads are the principal thermal path to carry heat into the device, so its temperature might be closer to the air temperature than to the surface temperature. To minimize this problem, be sure that the wiring to the LM35, as it leaves the device, is held at the same temperature as the surface of interest. The easiest way to do this is to cover up these wires with a bead of epoxy which will insure that the leads and wires are all at the same temperature as the surface, and that the LM35 die's temperature will not be affected by the air temperature. The TO-46 metal package can also be soldered to a metal surface or pipe without damage. Of course, in that case the V- terminal of the circuit will be grounded to that metal. Alternatively, the LM35 can be mounted inside a sealed-end metal tube, and can then be dipped into a bath or screwed into a threaded hole in a tank. As with any IC, the LM35 and accompanying wiring and circuits must be kept insulated and dry, to avoid leakage and corrosion.

WIFI (ESP8266) MODULE

Express if Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power

constrained mobile platform designers. It provides unsurpassed ability to embed Wi-Fi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

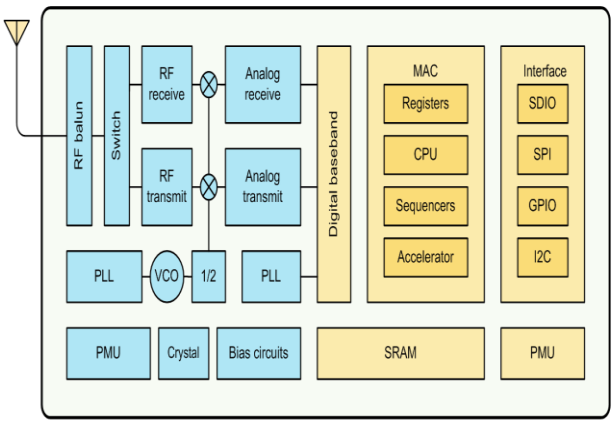


Figure 1. ESP8266EX Block Diagram

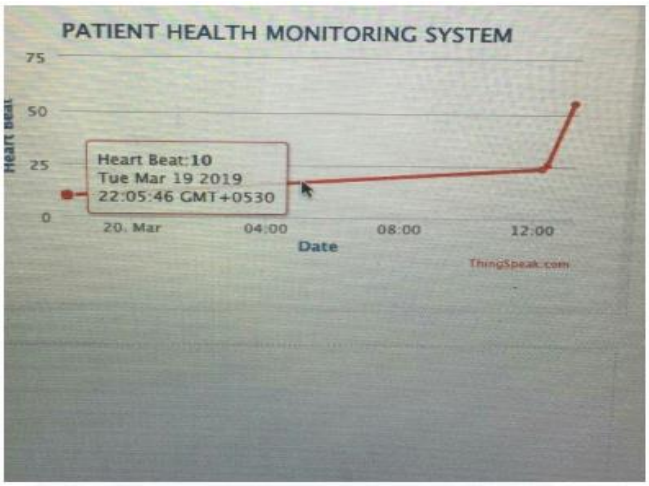
ESP8266EX offers a complete and self-contained Wi-Fi networking solution; it can be used to host the application or to offload Wi-Fi networking functions from another application processor.

When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications.

ARDUINO MICROCONTROLLER

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

VIII. RESULTS



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