

GSM-GPRS Based Intelligent Wireless Mobile Health Monitoring System for Cardiac Patients

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ABSTRACT: This paper provides the design of a medical monitoring terminals use lpc2148 and GSM/GPRS chip based on wireless technology. Here I focus on designing a mobile health monitoring system for people who stay alone at home or suffering from heart disease. Developing a hardware which will sense heart rate blood pressure and body temperature, using GSM modem all information lively transmitted to smart phone, from smart phone all information transmitted to server using GPRS. At server the received data compared with standard threshold minimum and maximum values and if it crossed this threshold limits then SMS will be sent to the relative of patient and doctors along with measured values. For transmitting data from Smartphone to the server using GPRS, here we need to create a website on date will be continuously transmitted from Smartphone to the website and from website data will be downloaded continuously on the server.

Keywords: ARM7 LPC2148, GSM/GPRS, and wireless sensor networks

I.INTRODUCTION

In recent year, with the miniaturization of biomedical sensors, the fast development and population of information processing and wireless data transmission technology, the reaches of wireless medical monitoring system has become a hot topic. The aim of developing remote health monitoring systems is to monitor online medical parameters and to reach this information from anywhere. Because of the less cost in wireless communication technology implementation of them to monitoring system have become easier. By utilizing the wireless technique to transmit information between medical sensor and

monitoring control center, the free space of patients is enlarged, and the efficiency of the modern management of hospitals is improved.

The rest of the paper is organized as follows. Section II overviews the system structure of the proposed system, section III describes the hardware development, section IV advantages of the proposed system, section V describes the results analysis of the proposed system, and section VI and VII sections describes the feature work and conclusions.

II. SYSTEM STRUCTURE

The monitoring terminal, and generally consists of three modules: The sensor module, the control module, and the wireless communication module. The sensor module is used for accruing medical information from the outside, and then converts them to digital signals. The control module is in change of coordinating the task of different modules, controlling the sensor, processing data, and executing communication protocols.

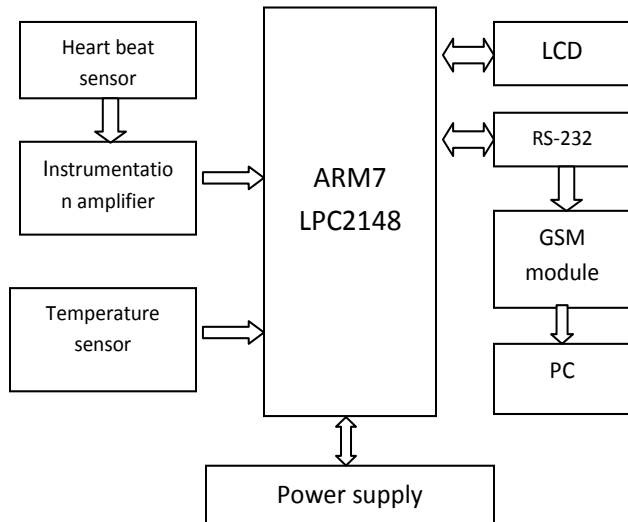


Fig 1. BLOCK DIAGRAM OF SYSTEM

The control chip uses lpc2148. Lpc2148 is a model that belongs to ARM7 series, a fully integrated mixed-signal micro-controller. It has a high-speed signal core, 64k bytes of flash memory, and hardware implementation of the SPI interface

The wireless monitoring terminal block diagram is shown in fig 1. Whose core is the lpc2148 MCU. It is connected with GSM/GPRS by RS-232 interface, and can read and writing inner register of, realizing the wireless transceiver of information. It can get information such as psychological parameters from external sensors by ADC and DAC modules. It is connected with the simulator and pc by JTAG and UART series interface. Therefore realizing the download and online debug programs. Through the external interrupts, it could control the calling button to get the calling information from patients and process by interrupts.

III.HARDWARE DEVELOPMENT

FUNCTION OF ARM7 LPC2148:

The ARM7 is general purpose 32 bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on reduced instruction set computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed complex instruction set computers (CISC). This simplicity results in a high instruction

throughput and impressive real time interrupt response from a small and cost-effective processor core.



Fig 2. ARM7 lpc2148 chip

Feature of the ARM7 lpc2148

- ❖ In-system/In-Application programming (ISP/IAP) via on-chip boot-loader software.
- ❖ 8 to 40kb of on-chip static Ram and 32 to 512kb of on-chip flash programming memory.
- ❖ 128 bits wide interface/accelerator enables high speed 60MHZ operation.
- ❖ Single flash sector or full chip erase in 400ms and programming of 256 bytes in 1ms.
- ❖ USB 2.0 full speed compliant device controller with 2kB of endpoint RAM.
- ❖ The lpc2148 provides 8kB of on-chip RAM accessible to USB by DMA
- ❖ Single 10-bit D/A converter provides variable analog output.
- ❖ Two 32-bit timers/external event counters, PWM unit and watchdog.
- ❖ Low power real-time clock with independent power and dedicated 32khz clock input.
- ❖ Up to 45 of 5v tolerant fast general purpose I/O pins in a tiny LQFP64 package.
- ❖ Up to nine edge or level sensitive external interrupts pins available.

The LPC2141/2/4/6/8 incorporate a32KB, 64KB, 128KB, 256KB and 512KB flash memory system respectively. This memory may be used for both code and data storage. The programming of the flash memory may be accomplished in several ways:

over the serial built-in JTAG interface, using In system programming(ISP) and UART0, or by means of In application programming (IAP) capabilities. The application programs using the IAP functions, may also erase and/or programs the flash, while the application is running.

FUNCTION OF GSM/GPRS MODEM:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dialup modem. The main difference b/n them is that a dial up mode sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.



Fig 3. GSM modem

A GSM modem can be an external device or pc card. Typically, an external GSM modem is connected to a computer through a serial cable or a USB cable. A GSM modem in the form of a pc card is designed for use with a laptop computer. A GSM modem requires a SIM card from a wireless carrier in order to operate.

A SIM card contains the following information:

- Subscriber telephone number (MSISDN)
- International subscriber number (IMSI, International Mobile Subscriber Identity)
- State of the SIM card
- Service code (operator)
- Authentication key
- PIN (Personal Identification Code)
- PUK (Personal Unlock Code)

The core of data communication about this system lies in wireless communication control terminals that uses GSM modules to transfer long-distance data extensively and reliably. It support instructions of AT commands. SIM300 can be integrated with a wide range of applications. SIM300 a tri-band GSM/GPRS engine that works on frequencies EGSM 900MHZ, DCS 1800 MHZ and pcs 1900MHZ SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4 with a tiny configuration of 40mm x 33mm x2.85mm, SIM300 can fit almost all the space requirement in our applications. Therefore, the MCU can connect with GSM modules very expediently through serial interfaces.

FUNCTION OF RS-232

(RECOMMENDED STANDAND -232):

RS-232 (Recommended standard-232) is a telecommunication standard for binary serial communication between devices. It supplies serial ports. The devices are commonly refereed to as a DTE(data terminal equipment) and DCE (data communication equipment) and could include items like a computer and modem respectively. RS-232 hardware can be used for serial communication up to distance of 50 feet.

Pin functions:

- ✓ Data : TXD on pin 3, RXD on pin 2
- ✓ Handshake : RTS on pin 7, CTS on pin 8, DSR on pin 6, CD on pin 1, DTR on pin 4
- ✓ Common : common pin 5 (ground)
- ✓ Other : RT on pin 9.

The method used by RS-232 for communication allows for a simple connection of three lines

TXD : carries data from DTE to the DCE

RXD : carries data from DCE to the DTE

SG : signal ground.

FUNCTION OF HEAR BEAT SENSOR:

Heart beat sensor is designed to give digital output of heart beat when a finger is placed on it. When the heart beat detector is working the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the beat per minute (BPM) rate. It works on the principle of light modulation by blood flow through fingering at each pulse.

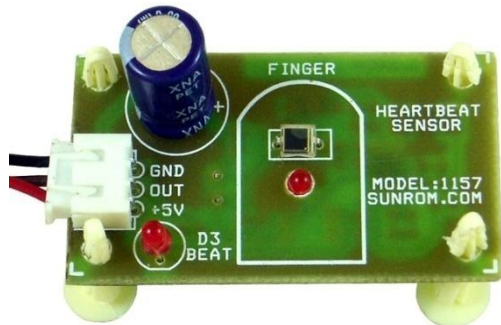


Fig4. Heart beat sensor 3 pin connector

Features:

- Microcontroller based SMD design
- Heart beat indication by LED
- Instant output digital signal for directly connecting to microcontroller
- Compact Size
- Working Voltage +5V DC

Applications:

- Digital Heart Rate monitor
- Patient Monitoring System
- Bio-Feedback control of robotics and applications.

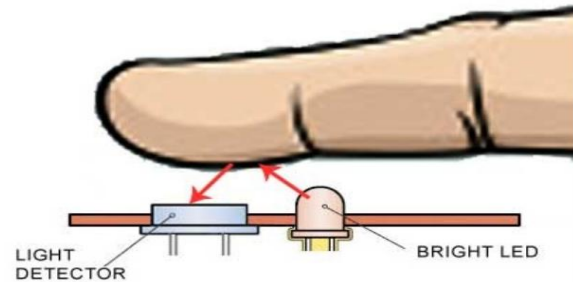


Fig5. Heart beat sensor

The sensor consists of super bright red LED and light detector. The LED needs to be super bright as the maximum light must pass spread in figure and detected by detector. Now, When the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector with each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which output +5v logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

FUNCTION OF TEMERATURE SENSOR:

The measurement of temperature is one of the fundamental requirements for environmental control, as well as certain chemical, electrical and mechanical controls. Many different types of temperature sensors are commercially available, and the type of temperature sensor that will be used in particular application will depend on several factors. For example, cost, space constraints, durability, and accuracy of the temperature sensor are all considerations that typically need to be taken into account

Various types of temperature sensors are known including liquid-in-glass (LIG) thermometers, bimetallic thermometers, resistance thermometers, thermocouples and radiometers. Depending upon the temperature to be measured, the required accuracy of the measurement, and other factors such as durability and accuracy of the temperature sensor are all considerations that typically need to be taken into account.

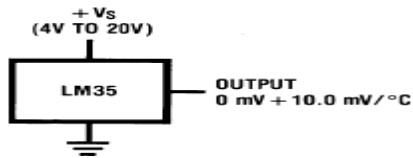


Fig 6. Temperature sensor

In this paper we use LM35 as a temperature sensor. LM35 is a precision IC temperature sensor with its output proportional to the temperature (in °C). The sensor circuitry is sealed and therefore it is not subjected to oxidation and other processes. With LM35, temperature can be measured more accurately than with a thermistor.

The operating temperature range is from - 55°C to 150°C. The output voltage varies by 10mV in response to every °C rise/fall in ambient temperature i.e., its scale factor is 0.01V/°C.

IV.ADVATAGES OF PROPOSED SYSTEM

- a) Provides high level safety to human life.
- b) Suitable for Indian condition.
- c) Low cost and less compels system for installing and application.
- d) Easy to operate
- e) Compare with compact sensor it gives better performance.
- f) Modern technology have developed that prompts comfortable and better life which is disease free.

V. RESULTS ANALYSIS

In this setup the health parameters under observations are body temperature, heart beat rate, blood pressure systolic (BPS) and blood pressure diastolic(BPD). In the first experiment the faithful measurement at patient terminal and at medical server were observed and found to be absolutely safe. So it can be deduced that the faithful transmission of data from patient terminal to medical server is successfully implemented.



Fig7. Complete circuit to read heartbeat and temperature

Secondly, the patient terminal output are verified against the measurement of these same parameters using standard medical equipment’s was found to be fairly faithful as shown in fig. The noted variations are attributed to the conditions under which the parameters are recorded.

S.NO	DATE	USER DETAILS	Sensor1 (FIRE)	Sensor2 (L.R)	Sensor3 (SMOKE)	Sensor4 (P.L.R)	sensor5 (ULTRASONIC)	sensor6 (TEMP)	S
1	9/16/2013 11:42:21 PM	AMV_DL_05	-	Heartbeat:067 bpm BP(systolic/Diastolic):114/46	-	-	-	026 C	-
2	9/16/2013 11:39:23 PM	AMV_DL_05	-	Heartbeat:066 bpm BP(systolic/Diastolic):116/48	-	-	-	026 C	-

Fig 8. heartbeat and temperature readings

Thirdly, patient after warring the WBASN gadgets was allowed to perform simple exercise so that the health parameters will vary to cross the predetermined thresholds. The system successfully generated the relevant data and the SMS from the medical server to alert the concern physician.

VI. FEATURE ENHANCEMENT

There is always chance to improve any system as research AND development is an endless process.

- Patient voice recognition system: IC HM2007 can be used to recognition the

voice samples of the patients for the better security purpose.

- A camera can be fitted into the system so as to enable the base station to get a real time view of the battlefield
- Automatic surveillance robot: A robot with all the medical future as well as advanced feature like ammunition can be build.

VII.CONCLUSIONS

Tests find that this system can successfully set up the GSM network. The monitoring terminal can precisely check the heart rate and body temperature of patients, and send them to coordinator and then surveillance center through wireless network. The error of the monitored body temperature, heart rate, and other information is very slight, which satisfies practical usage, and meets the demand of the design. By extending other sensor module, it could realize the monitoring of more psychological parameters and reliable transmission.

The most important part of the project is that it monitors a moving patient rather than a stationary or a bedridden patient.

This system ensures that the patient receives medical attention in the nick of time before it is too late. Continuous monitoring of health and cost effective disease management is the only way to ensure economic viability of the healthcare system. This paper presents an integrated health monitoring mobile platform for connected.

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