SMS BASED PATIENT MONITORING SYSTEM

BIOMEDICAL INSTRUMENTATION

[1]Chandrapal Raut
Department of electronics
& Communication
PCOE,Nagpur.
Chandrapal1981@yahoo.co.in

[2]Sonal chakole
Departmentof electronics
& communication
GHRCOE,Nagpur,
Chakole_sonal@yahoo.com

[3]Prof. V.G.Giripunje
Department of Electronics
& communication
PCOE,Nagpur,India
vyenktesh_g@rediffmail.com

[4]Prof. N. P. Giradkar
Department of Electronics Engineering
SRPCOE,Nagpur
[4]npgiradkar@gmail.com

[5] Dr. L.G. Malik
Department of Computer Engineering
GHRCOE,Nagpur
Lateshmalik@rediffmail.com

Abstract*— This paper propose the implementation of fully atomized ARM based system to acquire input data of the patient and to control it to its normal values remotely using GSM module. ARM processor acquires the data of the subject by sensors [1],[3]. This acquired data is then processed in the form of packets. These packets are then transmitted to the host (computer) where the real time data is compared with the normal value database. Any discrepancy found after comparison is directly transmitted to the concerned examiner in the form of SMS on the mobile no. already stored in the host computer automatically using GSM module.The complete system works in real time as the module works for the current information and thus we get the output in date and time[2]. This data is useful to the examiner for the analysis and control of various parameters of the patient.

Keywords— ***physiological parameters, data acquisition hardware, remote monitoring station, embedded system design, real-time analysis, GSM module, ARM processor***

I INTRODUCTION

Over the years we have seen the prodigy of doctors saving numerous lives. Telling this won't be an extravaganza that life saving doctors ,in some sections are considered as gods . Besides the profound knowledge of doctors there still are some sectors on which we can work and improve. The 24*7 presence of doctors or nurse or attendant near the patient is just hypothetical. The physiological trait of human body is unpredictable. There are several parameters in a human body which varies inconsistently during sickness . Some variations may be fatal . During these dire situations, there is technology which can help us to solve the entangled problem of uncertain physiological behavior and human attention [5],[6].We must have seen E.C.G. machines connected to patient's body through sensors. Conventionally doctors or trained nurses evaluate the condition of patient as per the readings on the E.C.G. But there are times when no doctor or nurse is available during the time of crisis. Therefore, our project is based upon this specific issue of how to reach a doctor in the time of need. Hence me and my group mates are trying to find out a remedy to this issue.

Our implementation is a working model which incorporates sensors to measure parameters like body temperature, heartbeat rate, respiratory temperature, ECG and transfer it to the computer so that the patient's health condition can be analyzed by doctor in any part of the hospital . Thus it reduces the doctor's workload and also gives accurate results . Further this system uses GSM technology which enables the viewing of all parameters on a mobile phone [7]. A microcontroller board is used for analyzing the inputs from the patient and any abnormality felt by the patient causes the monitoring system to give an alarm . Also all the process parameters within an interval selectable by the user are recorded online which is very useful for further analysis and review of patient's health condition. For more versatile medical application this project can be improvised by incorporating blood pressure monitoring systems , dental sensors and annunciation systems , thereby making it useful in hospital as a very efficient and dedicated patient care system.

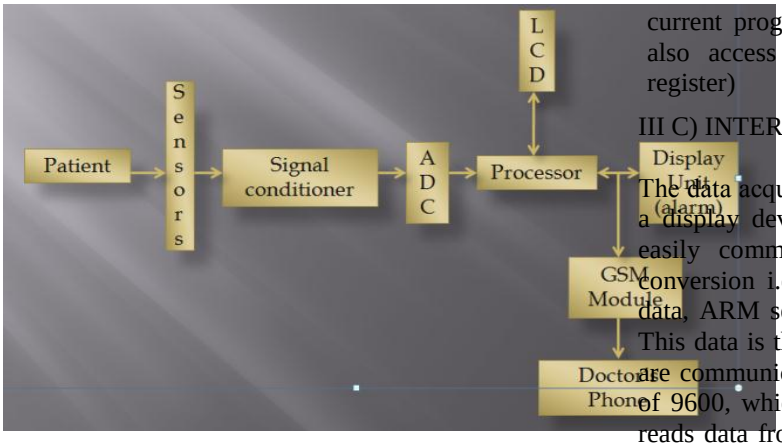

Fig. 1.The hardware structure of Embedded biomedical data acquisition system using GSM module.

II INTRODUCTION TO ARM

MAIN FEATURES OF ARM INSTUCTION SET

All instructions are 32 bits long .Most instructions execute in a single cycle .Every instruction can be conditionally executed. A load/store architecture. Data processing instructions act only on registers. Three operand format Combined ALU and shifter for high speed bit manipulation Specific memory access instructions with powerful auto-indexing addressing modes.32 bit and 8 bit data types and also 16 bit data types on ARM Architecture v4.Flexible multiple register load and store instructions .Instruction set extension via co processors.

II.A) PROCESSOR MODES

The ARM has six operating modes:- USER(unprivileged mode under which most tasks run)- FIQ (entered when a high priority interrupt is raised)- IRQ (entered when a low priority interrupt is raised)SUPERVISOR(entered on reset and when a software interrupt instruction is executed)

- ABORT (used to handle memory access violations) - UNDEF (used to handle undefined instructions)

ARM Architecture version 4 adds a seventh mode:

- SYSTEM (priviledged mode using the same registers as user mode)

II B) THE REGISTERS

ARM has 37 registers in total, all of which are 32-bits long

1 dedicated program counter, 1 dedicated current program status register, 5 dedicated saved program status registers, 30 general purpose registers. However these are arranged into several banks, with the accessible bank being governed by the processor mode. Each mode can access. A particular set of R0-R12 registers, A particular R13 (the stack pointer) and R14 (link register) , R15 (the program counter) , CPSR (the current program status register), And privileged modes can also access A particular SPSR(saved program status register)

III C) INTERFACING OF ARM WITH HOST

The data acquired by the ARM can't be seen directly, we need a display device which displays the acquired data. We can easily communicate through ARM with computer. After conversion i.e. analog to digital and processing of acquired data, ARM sends data to its serial port through the UART1. This data is then given to the input terminal of computer. We are communicating through ARM with computer at baud rate of 9600, which means ARM sends 9600 bits/sec. The ARM reads data from all the sensors one by one and processes the data simultaneously. To distinguish the data the ARM creates packet structure, and these packets are then transmitted to host.

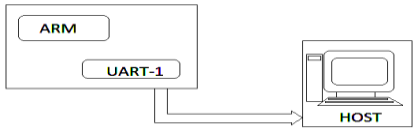

Fig.2 INTERFACING OF ARM WITH HOST

The packet consists of eight characters. The packet structure is as shown below.

AXBXXXC

Content between A and B are used to distinguish the sensors. The content between B and C is the data of that corresponding sensor. For e.g. If we are getting output as :- A0B177C, which means that output of sensor 1 is 177.Now these packets are transmitted to the hyper terminal of computer through serial port of COM 1. Only the baud rate is selected at 9600 and all other settings are restored by default. The analog value of physical parameter is converted to digital by ADC. The output of ADC is then read by ARM and the data is compared with the preprogrammed threshold value. The outcome is then processed and packets are created inside the ARM.We get the readings of any particular sensor after every one second. It is difficult to determine data from hyper terminal. So we write a C program for better looks and easy determination. While executing this program, the computer reads the packets and displays the sensed values.

II D) LPC2129 (ARM PROCESSOR)

2.4.1 GENERAL DESCRIPTION

The LPC2119/2129/2194/2292/2294 are based on a 16/32 bit ARM7TDMI-STM CPU with real-time emulation and embedded trace support, together with 128/256 kilobytes (kB) of embedded high speed flash memory. A 128-bit wide internal memory interface and a unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30% with minimal performance penalty. With their compact 64 and 144 pin packages, low power consumption, various 32-bit timers, combination of 4-channel 10-bit ADC and 2/4 advanced CAN channels or 8-channel 10-bit ADC and 2/4 advanced CAN channels

(64 and 144 pin packages respectively), and up to 9 external interrupt pins these microcontrollers are particularly suitable for industrial control, medical systems, access control and point-of-sale. Number of available GPIOs goes up to 46 in 64 pin package. In 144 pin packages number of available GPIOs tops 76 (with external memory in use) through 112 (single-chip application). Being equipped wide range of serial communications interfaces, they are also very well suited for communication gateways, protocol converters and embedded soft modems as well as many other general-purpose applications.

II E) FEATURES

16/32-bit ARM7TDMI-S microcontroller in a 64 or 144 pin package.,16 kB on-chip Static RAM,128/256 kB on-chip Flash Program Memory .128-bit wide interface/accelerator enables high speed 60 MHz operation, External 8, 16 or 32-bit bus (144 pin package only),In-System Programming (ISP) and In-Application Programming (IAP) via on-chip boot-loader software. Flash programming, takes 1 ms per 512 byte line. Single sector or full chip erase takes 400 ms, Embedded ICE-RT interface enables breakpoints and watch points. Interrupt service routines can continue to execute whilst
the foreground task is debugged with the on-chip Real Monitor software, Embedded Trace Macrocell enables non-intrusive high speed real-time tracing of instruction execution, Two/four interconnected CAN interfaces with advanced acceptance filters,Four/eight channel (64/144 pin package) 10-bit A/D converter with conversion time as low as 2.44 ms.• Two 32-bit timers (with 4 capture and 4 compare channels), PWM unit (6 outputs), Real Time Clock and Watchdog, Multiple serial interfaces including two UARTs (16C550), Fast I2C (400 kbits/s) and two SPIs™., 60 MHz maximum CPU clock available from programmable on-chip Phase-Locked Loop. ,Vectored Interrupt Controller with configurable priorities and vector addresses., Up to forty-six (64 pin) and hundred-twelve (144 pin package) 5 V tolerant general purpose I/O pins. Up to 12 independent external interrupt pins available (EIN and CAP functions).,On-chip crystal oscillator with an operating range of 1 MHz to 30 MHz.
• Two low power modes , Idle and Power-down.

II F) GENERAL DESCRIPTION:

This document describes the hardware interface of the SIMCOM SIM300 module that connects to the specific application and the air interface. As SIM300 can be integrated with a wide range of applications, all functional components of SIM300 are described in great detail. This document can help you quickly understand SIM300 interface specifications, electrical and mechanical details. With the help of this document and other SIM300 application

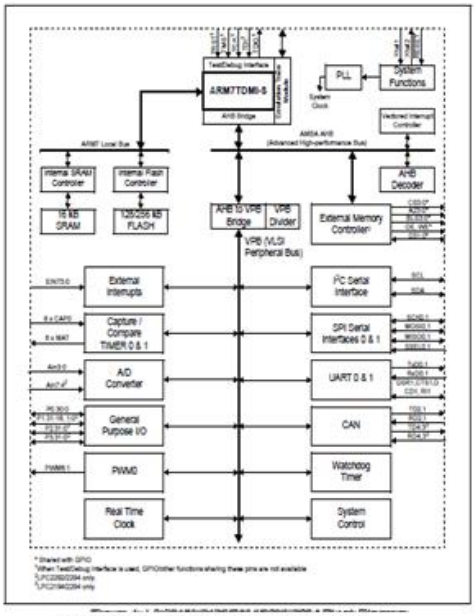

Fig.3 LPC2129 (ARM PROCESSOR)

notes, user guide, you can use SIM300 module to design and set-up mobile applications quickly.

Fig.4 GSM MODULE

3. PRODUCT CONCEPT

Designed for global market, SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz. SIM300 provides GPRS multi-slot class 10 capability and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 40mm x 33mm x 2.85 mm , SIM300 can fit almost all the space requirement in your application, such as Smart phone, PDA phone and other mobile device. The physical interface to the mobile application is made through a 60 pins board-to-board connector, which provides all hardware interfaces between the module and customers' boards except the RF antenna interface. The keypad and SPI LCD interface will give you the flexibility to develop customized applications. Two serial ports can help you easily develop your applications. Two audio channels

include two microphones inputs and two speaker outputs. This can be easily configured by AT command. SIM300 provide RF antenna interface with two alternatives: antenna connector and antenna pad. The antenna connector is MURATA MM9329-2700. And customer's antenna can be soldered to the antenna pad. The SIM300 is designed with power saving technique, the current consumption to as low as 2.5mA in SLEEP mode. The SIM300 is integrated with the TCP/IP protocol , Extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

III.Antenna interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual pplications SIM300 offers two alternatives: Recommended approach: antenna connector on the component side of the PCB,Antenna pad and grounding plane placed on the bottom side. To minimize the loss on the RF cable, it need be very careful to choose RF cable. We recommend the insertion loss should be meet following requirement: GSM900<1Db,DCS1800/PCS1900<1.5dB

III A) Antenna installation

III A **1 Antenna connector**

SIM300 use MURATA's MM9329-2700 RF connector on the module side, we recommend user use MURATA's MXTK92XXXXX as matching connector on the application side. Please refer to appendix for detail info about MURATA's MXTK92XXXXX.

III A **2 Antenna pad**

The antenna can be soldered to the pad, or attached via contact springs. To help you to ground the antenna, SIM300 comes with a grounding plane located close to the antenna pad.

SIM300 material properties: SIM300 PCB Material: FR4

Antenna pad: Gold plated pad

Module RF output power

Table 2：SIM300 RF output power Frequency	**Max**	**M**
E-GSM900	33dBm ±2db	5
DCS1800	30dBm ±2db	0
PCS1900	30dBm ±2db	0

Module RF receive sensitivity

SIM300 RF receive sensitivity Frequency	**Receive sensitivity**
E-GSM900	< -106dBm
DCS1800	< -104dBm
PCS1900	< -104dBm

Module receive/transmit frequency

SIM300 receive/transmit frequency Frequency	Receive
E-GSM900	925 ～ 960MHz
DCS1800	1805 ～ 1880MHz
PCS1900	1930 ～ 1990MHz

Antenna gain

Antenna gain Item	parameter	
Gain(dBi)	GSM	
	0.5	1
Pattern	Omnidirectional antenna	

Fig.5 OPERATIONAL BOARD OF GSM MODULE

ADDITIONAL ACCESSORIES

Two USB cables

Two serial cables with male and female terminals on each end

RS 232 module or USB to UART converter

Switching power supply for GSM

Fig.6 RS 232 module

IV APPLICATIONS

1) Bio-medical applications
2) Gas plants
3) Boilers in industries
4) Explosive storage

V Conclusions

The human body scanning system could be made more sophisticated by incorporating blood pressure and EEG sensors. Hospitable-wide wireless capability would allow doctor to attend the patients' database using their word held computers.The entire medical data acquisitions could be made wireless and wearable. Such a package would contain the circuiting for inputs from ECG sensors , EEG sensors , pressure measurements and pulse rate transducers . This wearable 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.

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