A Tele-medicine System for Measuring Heart Rate, Blood pressure, And Drug Level Detection

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Abstract - This paper presents a current invention for monitoring the patient health by continuous observation.From today's world of automation, the field of biomedical is no longer aloof. Application of engineering and technology has proved its significance in the field of biomedical. It not only made doctors more efficient but also helped them in improving total process of medication. The Patient monitoring system is also a new step in the automation of supervision for doctors. The basic idea behind this project is, it implies that weather a person is at home, on a trip, or at his work place, he/she can stay connected with the doctor and he can take immediate action if necessary. The Telemedicine system for doctors provides solution for this. It continuously provides following information to doctors. Heart pulse rate,Blood Pressure,andDrug Level detection.As used in hospital the same system can be used for a person who is not under the continuous observation of doctor, can check his/her vital signs using the sensors in this project if sensors output starts fluctuating above normal rate hence through GSM network sends an indication to doctor's mobile immediately.

Keywords: ARM processor,GSM

I. INTRODUCTION

Nowadays, the use of a vital sign's monitor is very common and not merely used at the hospitals as a monitoring system for patients. Generally, heart rate monitor was used by a person who cares about their heart to ensure that they have a normal heart rate. The early detection of the abnormal heart rate can help to prevent from the serious disease.the heart rate monitor is needed to determine the range of heart rate. This range of heart rate should be compatible with the normal rate to prevent from serious injury. Such digital display of target heart rate did not provide for ease of reading the display under the most conditions. This paper proposed an innovation to respond to this problems by providing a novelwearable bio med ical signal sensor devices for monitoring heartbeat,blood pressure. And drug level conditions at home easily, which displays the heart rate by LED-LDR Sensor and enabling a user an indication if any abnormality through GSM,and also blood pressure & drug or alcohol also monitored. The proposed innovation will be programmed to automatically suggest the user about their health conditions.

In this research work, we developed a group of sensors for measuring heart beat rate, Blood pressure level and drug level with real-t ime monitoring system based on GSM network. The heart beat,Blood pressure, Drug(alcohol) level measured by the sensor is processed by the ADC in the controller that data was read every second and stored on controller. The data from controller unit was sent to base node via GSM network. Arm controller hard ware and GSM module are packed in suitable case and can send a message and immediate call to doctor's mobile if any abnormal condition of patient.

This system can be used for a person who is not under the continuous observation of doctor, can check his/her vital signs using the sensors in this project . If the sensors output starts fluctuating above normal rate hence through GSM sends an indication to doctors mobile immediately.

II. HARDWARE DESIGN

The hardware design mainly consists of three sensors namely: Drug level(alcohol) detection Sensor, Heartbeat Sensor, Blood Pressure Sensor. These sensors are connected to the arm7 board(LPC2148). This controller is further connected to GSM module and lcd display. The transmission medium used here is GSM [Fig 1]

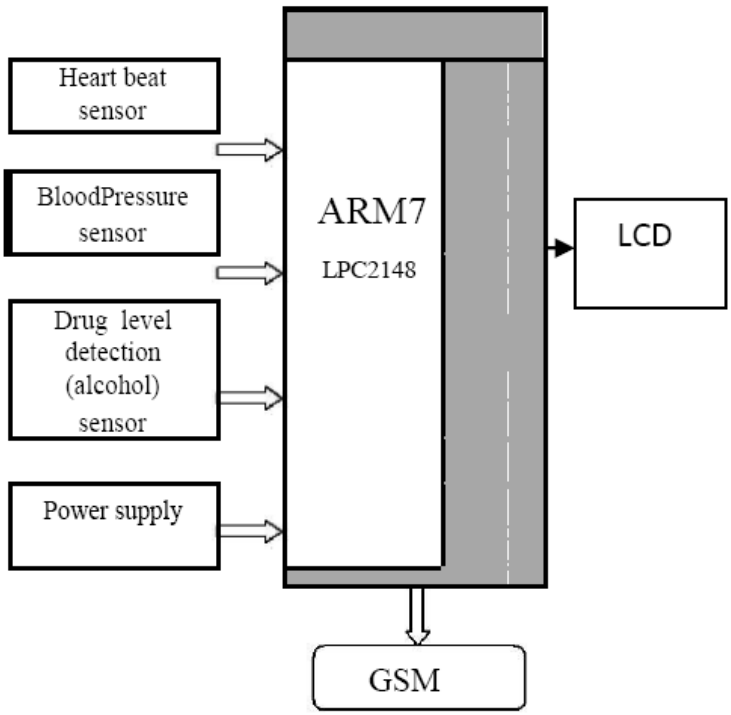


Fig:1 block diagram

A. Transmitter Module

i. Heart Beat Sensor

There are three sensors used in the transmitter module. They are the, Heartbeat Sensor, Pressure Sensor and Drug detection Sensor. The heart beat sensor used here is 1157 Heart beat sensor. This 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 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.

Light to Voltage Converter

A 5 V DC voltage is used to turn on the Red LED. The light transmitted through the finger is converted to a voltage by the light-to-voltage sensor using the following circuit.

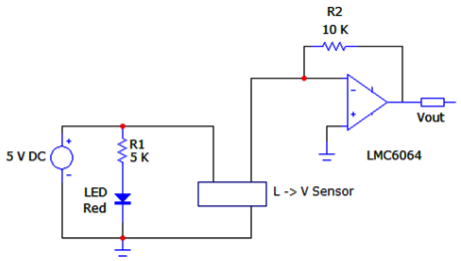


Figure: Schematic of Light to Voltage Converter

The pin details are the following: PIN1-power supply positive input, PIN2- active high output and PIN3- power supply ground [Fig 2]. Specifications are Operating Voltage is +5V DC regulated, Operating Current is 100 mA , Output data Level is 5V TTL level , Heart Beat detection is indicated by LED and Output High Pulse Light source used is 660n m Super Red.

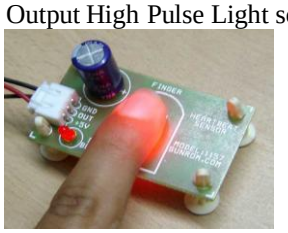


Fig.2 heart beat sensor

ii. ***BLOODPressure Sensor***

High blood pressure, also known as hypertension, occurs when the force (or pressure) of blood against your artery walls is too great, causing excessive strain on your blood vessels. This condition is dangerous because its damaging effects accrue over time and may not become apparent until an individual's blood pressure is shockingly high. This is why hypertension is sometimes known as a "silent killer."
The sensor used in this project is FGN type pressure sensor.

FGN/sensor
FPN/FGN Series Unamplified Uncompensated Pressure Sensor
Description
FPN/FGN (Gauge) Package (8 mm tube length) with mill volt uncalibrated output. Best used with silicon tubing or directly attached to manifold. The FPN is a dual in-line package while the FGN offers a surface mount package. Various pressure ranges are available.

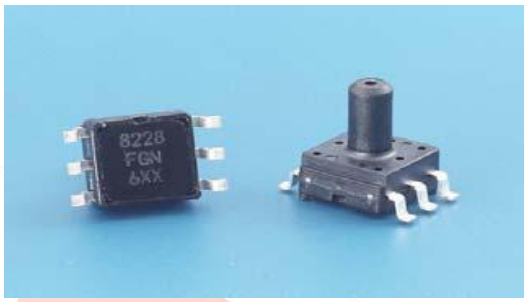


Fig.3:FGN pressure sensor

Features
- Lowest cost, high reliability
- Small Dual-In-line-Package
- Easy to mount on PCB
- Measures positive pressure andvacuum .
- Measuring pressure range: 13.79 to 206.8 kPa.
- Pressure type: Gauge pressure

Applications
- Industrial instrumentation
- Flow measurements
- HVAC applications
- Non-invasive blood pressure monitor- overpressure measurement.
- Medical devices

Working of BP Sensor
Blood pressure sensor is built up with the combination of pressure pump, pressure sensor separate rectifier circuit ,relay switches to on and off the pressure pump, and Steps required to calculate the blood pressure are:
1. Switch on the sensor
2. Start pressure pump which boosts the pressure
3. At a certain level pressure is measured by the pressure sensor and if the pressure exceeds the level it displays the level on the LCD screen and sends a message to the registered mobile number

iii. Drug Detection Sensor
The drug detection sensor used here is Gas sensor MQ-303A. It is a tin di -o xide semiconductor gas sensor which has a high sensitivity to alcohol with quick response speed. This model is suitable for alcohol detection such as portable drug detection or breath alcohol checker. The pin details are the following: PIN1-power supply positive input, PIN2- active high output and PIN3-power supply ground [Fig 4]. Specifications are Operating voltage is dc voltage less than 6V, resistance is4.5Ω ± 0.5Ω, current is less than 13mA , Power dissipation is less than 10mW.

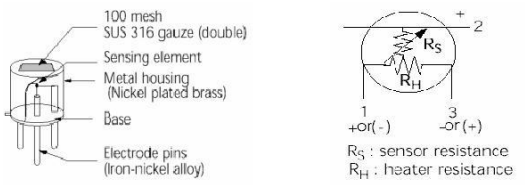


Fig.4 DRUG DETECTION SENSOR

The change of the sensor resistance (R_S) is obtainedas the change of the output voltage across the fixed or variable resistor (R_L). In order to obtain the bestperformance and specified characteristics, the values of the heater voltage (V_H) circuit voltage(V_C) and load resistance (R_L) must be within therange of values given in the standard operating conditions shown in the Specification table on the next page. Generally, the sensor enters into normal working conditions after several minutes' preheating, If you connect the sensor heater with a high voltage 2.2 ± 0.20V for 5-10 sec beforenormal testing , the sensor shall stabilize and enter into normal working conditions quickly.

B. DATA PROCESSING

The microcontroller used here is ARM7 LPC2148. The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications.

TheARM7TDMI solution provides thelow power consumption, small size, and high performance needed in portable, embedded applications.The principle feature of the ARM 7 microcontroller is that it is a register based load-and-store architecture with a number of operating modes. While the ARM7 is a 32 bit microcontroller, it is also capable of running a 16-bit instruction set, known as "THUMB". This helps it achieve a greater code density and enhanced power saving. While all of the register-to-register data processing instructions are single-cycle, other instructions such as data transfer instructions, are multi-cycle. To increase the performance of these instructions, the ARM 7 has a three-stage pipeline. Due to the inherent simplicity of the design and low gate count, ARM 7 is the industry leader in low-power processing on a watts per MIP basis. Finally, to assist the developer, the ARM core has a built-in JTAG debug port and on-chip "embedded ICE" that allows programs to be downloaded and fully debugged in-system.ARM's comprehensive product offering includes 16/32-bit RISC microprocessors, data engines, 3D processors, digital libraries, embedded memories, peripherals, software and development tools, as well as analog functions and high-speed connectivity products. Data processing is done based on below sensors values.

Heart Pulse Rate Sensor

The design and development of a low powered HRM device is presented that provides an accurate reading of the heart rate using optical technology. The device is ergonomic, portable, durable, and cost effective. We incorporated the optical technology using standard Light Emitting Diode (LED) and photo-sensor to measure the heart rate within seconds using index finger. A LPC2148 is programmed to count the pulse. The heart rate is digitally displayed on an LCD controlled by the same LPC2148 processor that counts the pulse.

Pressure sensor:

Blood pressure sensor is built up with the combination of pressure pump, pressure sensor separate rectifier circuit ,relay switches to on and off the pressure pump. If there is any abnormality in the measurement of systolic and diastolic the immediate message and call allertwil go to doctors mobile through GSM.

Alcohol Sensor

MQ-3 gas sensor is used to measure the alcohol level. Sensitive material of MQ-3 gas sensor is SnO2, which with lower conductivity in clean air. When the target alcohol gas exist, the sensor's conductivity is higher along with the gas concentration rising. Use of simple electro circuit, convert change of conductivity to correspond output signal of gas concentration. MQ-3 gas sensor has high sensitivity to Alcohol, and has good resistance to disturb of gasoline, smoke and vapor. The sensor could be used to detect alcohol with different concentration; it is with low cost and suitable for different application.

The above sensors data is compaired with the normal values if any abnormality, immediately the message and call allert will be send to doctor's mobile through GSM network.

C. Receiver Module

GSM

GSM (Global System for Mobile Communications, originally Group Special Mobile), is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe technologies for second generation (2G) digital cellular networks. Developed as a replacement for first generation (1G) analog cellular networks, the GSM standard originally described a digital, circuit switched network optimized for full duplex voice telephony. The standard was expanded over time to include first circuit switched data transport, then packet data transport via GPRS (General Packet Radio Services). Packet data transmission speeds were later increased via EDGE (Enhanced Data rates for GSM Evolution) referred as EGPRS. The GSM standard is more improved after the development of third generation (3G) UMTS standard developed by the 3GPP. GSM networks will evolve further as they begin to incorporate fourth generation (4G) LTE Advanced standards. "GSM" is a trademark owned by the GSM Association.

GSM is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. There are five different cell sizes in a GSM network—macro, micro, Pico, feta and umbrella cells. The coverage area of each cell varies according to the implementation environment. Macro cells can be regarded as cells where the base station antenna is installed on a master or a building above average roof top level.

Micro cells are cells whose antenna height is under average roof top level; they are typically used in urban areas. Pico cells are small cells whose coverage diameter is a few dozen meters; they are mainly used indoors. Fetal cells are cells designed for use in residential or small business environments and connect to the service provider's network via a broadband internet connection. Umbrella cells are used to cover shadowed regions of smaller cells and fill in gaps in coverage between those cells.

Figure :3 GSM Board

OBS ERVATION:

Heart rate:

Target zone	**Training Recommended**
Normal(72 BPM)	Normal rate.
Low(60-70 BPM)	Low heart rate.
High(>72 BPM)	Indicates the person is in abnormal state.

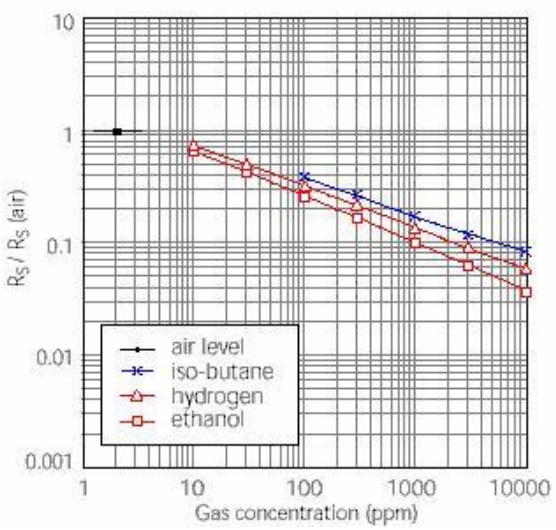
TABLE IDifferent Heart Rate levels

Blood pressure:

Pressure level	**systolic (mmHg)**	**diastolic (mmHg)**
Normal	90 - 130	60 – 80
Low	< 90	< 60
High	>140	> 90

TABLE II Different Blood Pressure levels

Sensitivity of Alcohol sensor:



RESULT:

Output displayed on LCD.

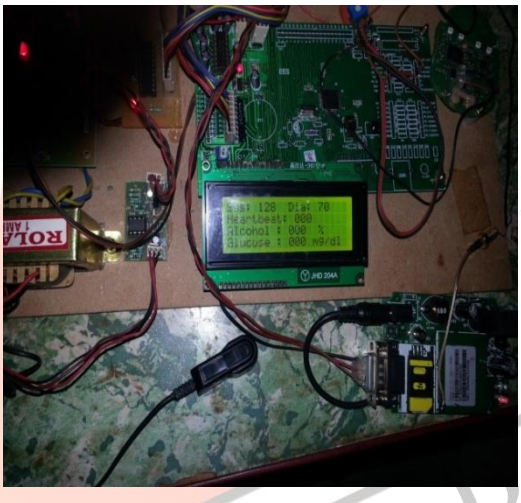


Fig. 4Hardware module

III. SOFTWARE DESIGN

The software can be separated into two parts: the firmware running in the micro-controller on the front end analogue circuit board, the application program written using kiel software & dumped into the controller using flash magic.

The program embedded on the microcontroller is written in Embedded C. The program contains the following:
Conversion of analogue signals (heartbeat, blood pressure, drug level) to digital values and Indication of abnormal rate. Packetization of the collected data and the transmission of them through the serial communicat ion interface.

B. Application Program Design:

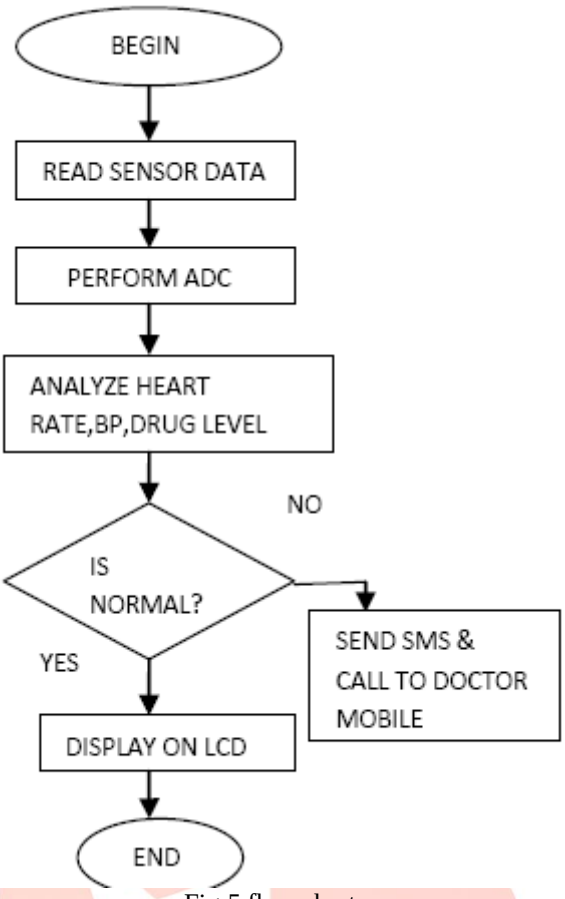


Fig:5 flow chart

I. CONCLUSION

Telemedicine system is very useful for senior citizens and physically challenged people who are suffering from variation of blood pressure level, and they can be rescued from sudden heart attacks. Using this system we can adjust the minimum and maximum levels of blood Pressure and heart beat level, if the persons BP and heart beat exceeds the levels then immediately the information will be passed through GSM to the concerned doctor so that we can save the life of the patient.For this Tele-Medicine System to Measure Heart Rate, Blood Pressure And Alcohol Level project we can add sugar test, now-a-days which is a common disease for a human being.

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