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Comparative Study of Vital Sign Using Statistical Techniques

Bhamidi Rama[1,] I.V. Subba Reddy[2]
[1]*Dept. of Electronics Technology, Loyola Academy Degree & P.G. College, Old Alwal, Secunderabad-50010, Andhra Pradesh, INDIA*
[2*]*Dept. of Physics, GITAM University-Hyderabad Campus, Rudraram,Medak – 502 329, Andhra Pradesh, INDIA*

ABSTRACT : *Senior citizens have to make frequent visits to their doctor to get their vital sign measured. The objective of this work is to design and implement a reliable system that can be used by patients on regular basis to monitor the vital sign and obtain the readings on the LCD and doctor's mobile. This work specifically deals with signal conditioning and data acquisition of pulse rate. Pulse rate is measured using pulse sensor. This system consists of a pulse sensor to measure the pulse rate when the finger is placed in between. It works on the principle of flow of blood through the finger at each pulse. These pulses are sent to the microcontroller Atmega16 for a period of 30sec.The number of pulses are counted, which gives the pulse rate. This digital output is connected to the micro controller through IC741 to measure the beats per minute (BPM) rate .This information is processed and displayed on the LCD and also sent to the doctor's mobile phone using GSM. Statistical techniques like correlation, regression, t –test and F-test are applied for comparing the readings taken by the doctor and this system. This work is useful at remote health centers and for old age people at home and in ambulance where the availability of doctor is always not possible. The design procedures, theory, experimental results and discussions of these systems are presented.*
Keywords: *vital sign, signal conditioning, statistical techniques, comparing, doctor, device.*

I. INTRODUCTION

A number of surveys conducted by various government organizations in India, private Organizations and international organizations show that a patient's life is more important to save when he is in emergency. The patient's pulse rate, temperature, blood pressure and oxygen rate are the most important vital signs which must be measured and monitored constantly. In this paper a comparative study of pulse rate from prototype circuit board with the physical examination of the doctor is shown. The main purpose is to study how effective is this system compared to that of readings taken by a doctor. In the previous work[1] GSM based method is used to monitor the patient's heart beat and temperature. This is a wireless method in which sensors are used, which take analog data and convert to digital form. Microcontroller 89s52 is used along with auto alarm system which produce a sound when the readings are less or more than the normal value. In this paper [2] Heart beat sensor of SUNROM technologies is used to measure the pulse rate and LM35 to measure the temperature. Before sending the actual readings of the patient's temperature and pulse rate a missed call is given to alert the doctor, after that the readings are sent through a message using GSM technology. In this paper [3] Zigbee, GSM and SMS method of communicating between the patient and the server, Communication unit and expert software is used. Visual basic, embedded c and assembly languages are used for programming. The temperature and pulse rate are transmitted to the pc and from there information goes through the GSM to doctors mobile. If the value of temperature exceeds certain value or the pulse rate is not in the normal range ,then an alarm message is sent to the doctor. In this paper[4] Pulserate, Temperature and arterial blood oxygen concentration parameters are taken. Temperature monitor is DS18B20 a one wire digital temperature sensor is used which gives its output in the form of 9-bit binary information. For measurement of pulse rate two LED's with different wave lengths are placed opposite to a photo detector. The finger must be placed in between this and the readings are displayed in the LCD after processing through the microcontroller.

II. SIGNIFICANCE

If the readings taken by the doctor and using this system are close, then we can use this system at our homes for old age people, in ambulances and at remote health centers. A doctor manually cannot measure pulse rate for many patients in a day where as this system can be used at an health center where anyone can check their pulse rate and temperature and in case of emergency they can consult a doctor.

III. HYPOTHESIS

It was hypothesized that there would be no significance difference between the readings taken by a doctor and this device.

IV. DATA COLLECTION

The study was done on patients of different age groups with 53 samples. Data was collected by readings taken by the doctor and from this device.

V. DESIGNING

Vital signs are used to detect and monitor health problems. Pulse rate is defined as the number of times the heart beats per minute. It also varies depending on the gender and age. Doctors Pulse rate reading was measured by placing the finger on the wrist of the person.Doctors measure using first and second finger tips at the wrist where the beats are felt, when the arteries are pressed. These beats are counted for 60sec by keeping a watch. Pulse rate for children above 10yrs and adults is in between 60-100 beats per minute and for athletes 40-60 beats per minute.

The health monitoring system consists of heart beat sensor which measures heart beats ,LCD, Comparator, microcontroller, MAX 232, GSM module.

i)Heart beat sensor

Fig.3 shows a pulse sensor used to measure the pulse rate when the finger is placed in between. It works on the principle of flow of blood through finger at each pulse. The diaphram which is present inside the pulse sensor senses the heat, charge carriers are activated that produce current which is in the form of pulses. These pulses are sent to the microcontroller Atmega16 for a period of 30sec. So the number of pulses are counted ,which gives the pulse rate.When the heart beat detector is working, LED flashes with each heart beat. This digital output is connected to micro controller through IC741 to measure the beats per minute (BPM) rate. These values are displayed on the LCD and are sent to the doctors mobile in the form of messages using GSM technology.This system continuously sends the patient heart beat to the doctor.

Fig.1:Pulse sensor

ii)Liquid crystal display

The LCD connected to the microcontroller is 16x2 display. HD44780U is the standard which refers to the controller chip which receives data from an external source and communicates directly with the LCD. If an 8-bit data bus is used, then LCD requires 11 data lines (3 control lines and 8 lines for the data bus).These three control lines used are EN(Enable),RS(Register select),RW(Read/Write).

The Enable pin is used to tell the LCD that we are sending the data. Register Select pin is low means data is treated as a command and if it is High, data which is sent is text data. Read/Write pin is low means the data is written and if it is high , the data is read only if register select pin is high.

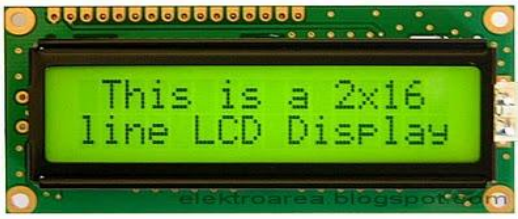

Fig.2: LCD Display

iii)Comparator

Comparator consists of an operational amplifier with high gain and balanced input. It compares the reference input with the given input. It is used to have output voltages which are compatible with digital logic.

iv)Microcontroller

This system uses ATMega16L which is low power 8-bit Microcontroller and has advanced RISC architecture. It contains an EEPROM of 512 bytes, internal SRAM of 1KB,USART,3 Timers/Counters, 0-8MHZ crystal oscillator with low power consumption in active mode of 1.1ma,0.35 ma-idle mode , power down mode<1µa along with real time counter ,four channel PWM,10-bit ADC,JTAG interfacing, Programmable Watchdog timer, Operating voltages 2.7V-5.5V.

v)Max 232

MAX 232 IC is a specialized circuit which makes standard voltages as required by RS232 standards. This IC provides best noise rejection and very reliable against short circuits. MAX232 IC is commonly referred to as line drivers.

To ensure data transfer between GSM modem and µC, the baud rate and the voltage levels of MicroController and GSM modem should be the same. The voltage levels for the microcontroller is logic1 means 5V and logic0 means 5/3V.

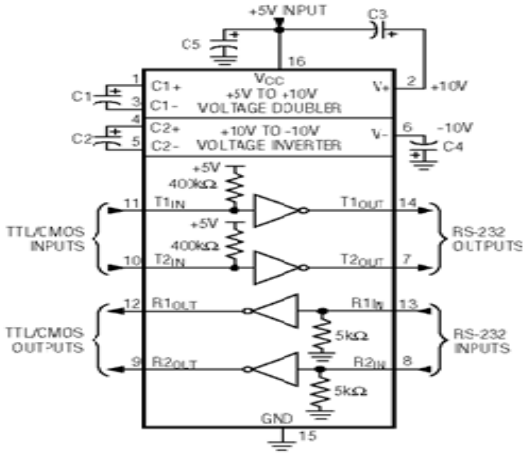

Fig.3: MAX232 IC

But for GSM modem for logic1 it is 5V and for logic0 it is 0V. So in order to overcome these differences in the voltage levels, MAX232 IC along with RS232cable is used. These IC's will change the voltage levels required for communication between microcontroller and GSM .

vi) GSM module

GSM is called global system for mobile communication. A SIM is inserted in this prototype board and according to the phone number given in the program written in the microcontroller, the message is sent to the doctor's mobile about the patient's vital signs. In this SIM 300 is used which has highly reliable 24x7 Antenna. Its usage is simple with low cost and its status is indicated by an LED.

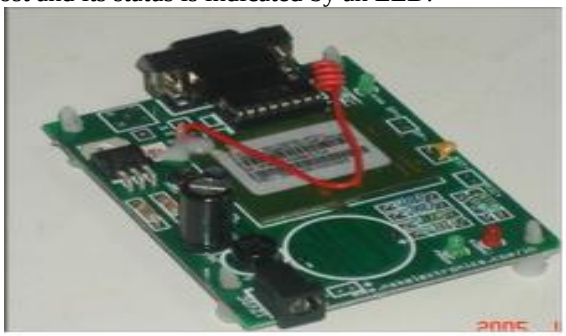

Fig.4: GSM Module

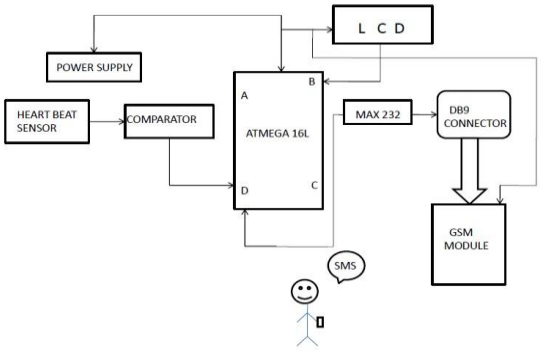

Fig.5: Blockdiagram

VI. WORKING:

The working of the block diagram is shown in fig.5 and the working is totally based on the following 1.Sensing 2. Processing and 3. Communicating.

The heart beat sensor will sense the body pulses and produces the electrical signal proportional to the heart beats. The produced output signal is connected to the microprocessor through port D. If the heart beat increases or decreases other than the standard value, then this information is sent to the microprocessor. This process of identifying the particular cross mark is totally done by the comparator. The comparator will constantly compare the heart beat signal with a prefixed reference value and the response is accordingly sent to the microprocessor port D.

After the microprocessor receives the signal it connects through DB9 connector, with the help of MAX 232, for Sending SMS through the GSM .

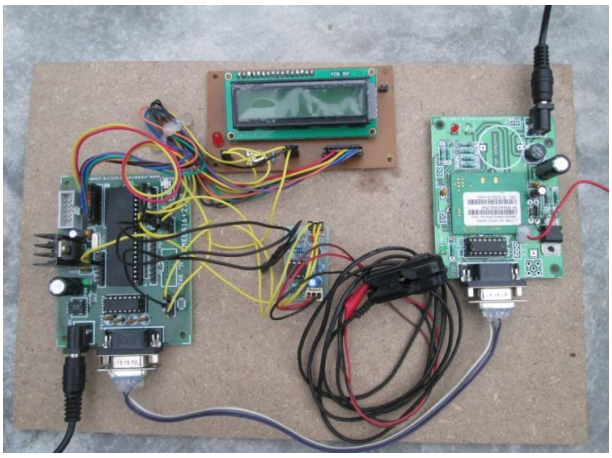

Fig.6: Hardware prototype board

VII. Results and Discussion

Data analysis is done for pulse rate readings - correlation, Regression , t-test, F-test are done. It is observed that the correlation coefficient is 0.895244 which shows a high degree positive correlation between the pulse rate readings taken by the doctor and to that of the readings taken from this system. The following are the results for the t-test and F-test

t-Test: Two-Sample Assuming Equal Variances

t- Calculated value = 0.0369

t - Critical value = 2.001717

Clearly t- calculated value < t- critical value. Hence the device can be used in absence of doctor.

F-Test Two-Sample for Variances

Fcalculated value=1.306805246

Fcritical value=1.882079434

Fcal value<Fcri value => it accepts null hypothesis.

Fig.7 shows the statistical representation of doctors pulse rate readings with that of the device pulse rate.

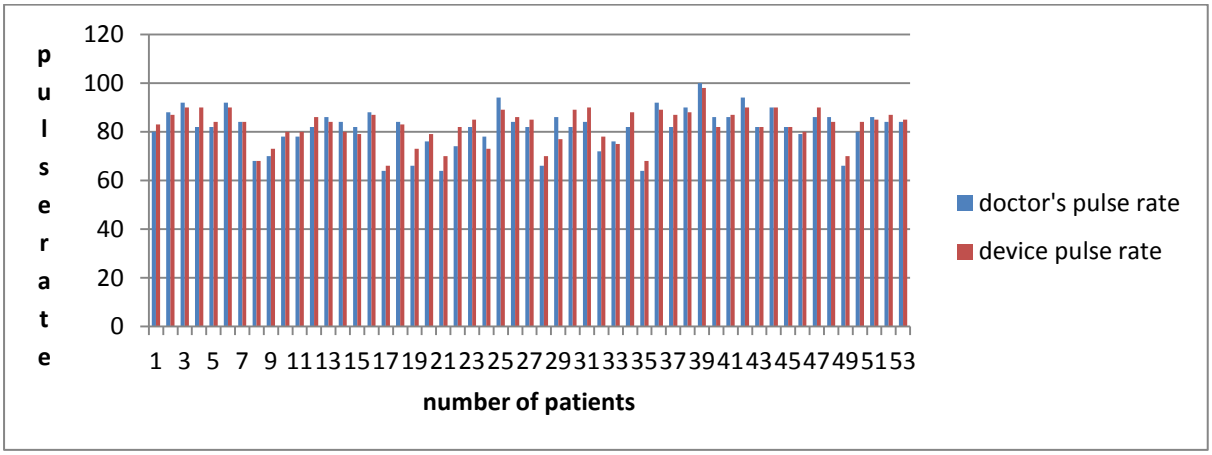

Fig.7: Statistical representation

Fig.7 shows that doctors measured pulse rate & the pulse rate measured by the device are almost equal.

Fig.8: Graphical representation of number of patients and pulse rate

From the above analysis it is found that both the readings are close and there is no significant difference between doctor's measured pulse rate readings and the readings taken from this system.

VIII. CONCLUSIONS

The patient-staff ratio is very low these days in the hospitals, so this kind of equipment is used to find the vital signs of the patient and is indicated on the LCD and also on doctor'smobile phone .This System works even when the patient is unconscious.The doctor can track the parameters of the patient from any place. Using t-test and Snedecor's F-test we conclude that the doctor's measured pulse rate and readings taken from this device are equal. There is no significant difference. Hence the device is efficient and can be used in the absence of doctor.

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Authors

Dr.I.V. Subba Reddy was born in India in 1975.He Completed his B. Sc., M. Sc., and Ph. D. Currently he is working as Associate Professor in Department of Physics, GITAMUniversityHyderabad. Dr.Reddy received several national level fellowships and got the prestigious Marie-Curie fellowship for Post Doctoral Researcher/Adjunct Professor in the year 2008 from the University of Lodz, Poland. Research Scientist/Visiting Professor in the year 2007 at Kyoto University, Japan and Post Doctoral Researcher in the year 2005 from National Central University, Taiwan. He received Chanakya Award under most promising Young Visionary category and is a National Award given by Public Relations Council of India (PRCI) in 2013.

Bhamidi Rama has completed B.Sc,M.Sc App.Electronics and M.Phil Electronics degrees.Currently she is working as Head of the Dept. of Electronics Technology at Loyola Academy degree & PG College .She has a wide teaching experience since 1995. Worked as Controller of Exams for the academic year 2010-2012 at Loyola Academy Degree and PG College. She is receiving the best department award from management for past 6 years. Coordinator for certificate courses sponsored by UGC. As a chair person for Board of Studies she played a key role in enhancing the syllabus according to the industrial needs. Her BRAIN CHILD is "LAB TO SCHOOL" program, where practical's of physics and chemistry of 9^{th} &10^{th} class are taken to prepare models. These are done under her guidance by degree students and are displayed at government schools. Her research areas are Microcontroller based systems and sensor system developments.