IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 05, Issue 01 (January. 2015), ||V3|| PP 42-47

Adoption of Statistical Techniques in Automation Process of physiological parameters

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Abstract: **-** Senior citizens have to make frequent visits to their doctor to get their vital signs measured. The objective of this work is to design and implement a reliable system that can be used on regular basis to monitor the vital signs and obtain the readings on the LCD and also on doctor's mobile. This work specifically deals with signal conditioning and data acquisition of measurement of temperature and pulse rate. Temperature is measured using LM 35 by placing it on the surface of the body and pulse rate using pulse sensor. This information is processed and displayed on the LCD and also sent to the doctor 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 for old people at home, in ambulance and at remote health centre's where the availability of doctor is always not possible. The theory, design procedures, experimental results and discussions of these systems are presented.

Keywords**:** *Vital signs, Signal conditioning, LM 35, Statistical techniques, Comparing, Doctor, System.*

I. INTRODUCTION

A number of surveys conducted in India by various government organizations, private Organizations and international organizations show that saving a patient's life is more important when the patient is in emergency. So the patient's vital signs like pulse rate, temperature, blood pressure and oxygen rate are very important and these parameters must be measured and monitored constantly.

In this paper a comparative study of temperature 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, that takes analog data and converts it into 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 pulse rate & LM35 is used to measure the temperature. Before sending the actual readings of the patient's temperature a missed call is given to alert the doctor and 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 I, 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 it is not in the normal range an alarm message is sent to the doctor.

In this paper [4] the pulse rate, temperature and arterial blood oxygen concentration parameters are taken. Temperature monitor has one wire digital temperature sensor which gives binary information. The readings are displayed on the LCD.

II. SIGNIFICANCE

If the readings taken by the doctor and using this system are close, then we can use this system for aged people in our homes, in ambulances and at remote health centre's. A doctor manually cannot measure temperature rate for hundreds of patients in a day where as this system can be used at a health centre where anyone can check their temperature and pulse rate and the reading's are sent to the doctor on his mobile and in case of emergency they can consult a doctor.

III. HYPOTHESIS

It was hypothesized that there would be no significant difference between the readings taken by the 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. EXPERIMENTAL

Vital signs are used to detect and monitor health problems. The normal temperature and pulse rate of a human being varies based on gender, activity, food consumptions and time of the day. The methods used to measure temperature and also the place of measuring changes the temperature values.

Temperature can be measured using various instruments like thermometer, plastic strip etc. Thermometer is kept under the tongue or under the arms for measuring the temperature accurately. The readings taken by placing the thermometer under the tongue is the best way of measuring and the values are very accurate, but it is time consuming process as it has to be cleaned using solution and old people find it difficult to see the readings due to their low eye sight. Another method is using a plastic strip ,placed on the surface of the skin specially on the forehead where the color of a particular line changes on the strip.

A plastic strip thermometer is a heat sensitive type used to indicate different temperatures as the color changes. Temperature shown from this method varies from 35.5 to 40.5.Values taken using this method varies with weather conditions in the surrounding atmosphere.

The health monitoring system includes temperature monitoring system. In this system we are using Microcontroller ATMEGA16L, Temperature sensor LM35, Liquid Crystal Display, MAX 232, GSM module.

VI. WORKING

The working of the block diagram shown in fig.1 is based on Sensing, Processing and Communicating.

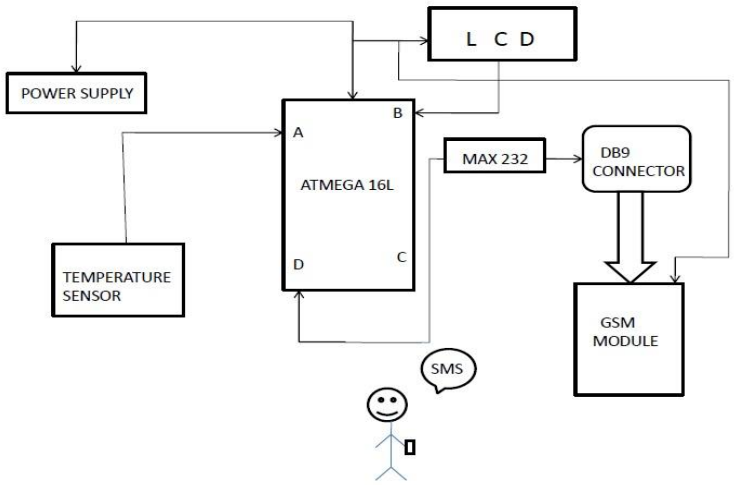

Fig.1 Block diagram

The temperature sensor, which is intended for measuring the human body temperature, measures the temperature. The measured output signal is connected to the microcontroller through port A. The patient's temperature is measured using LM35, processed through the microcontroller and displayed on the LCD. Based on the program in the microcontroller, through DB9 connector, with the help of max 232, the message is sent in the form of SMS through the GSM module on doctor's mobile phone. The working of the prototype board does the following

1. Processing-All the operations done by the microcontroller are based on the program.
2. Communication-Sending SMS to the phone number stored in the program through GSM module is done as a part of communication.

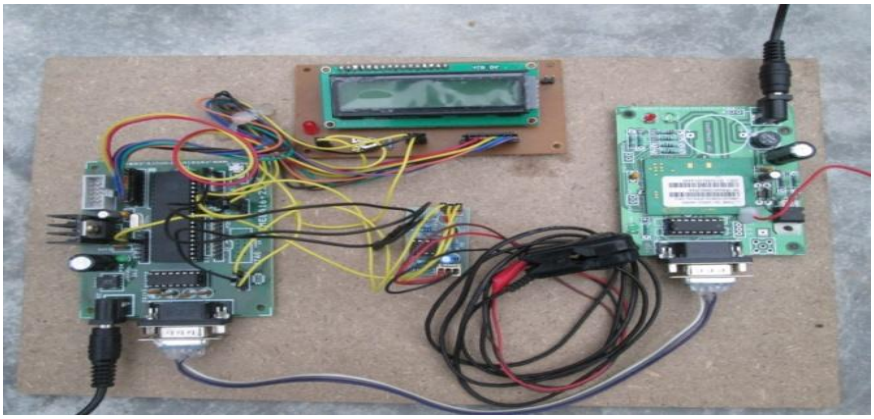

Fig.2.Hardware prototype board

VII. INSTRUMENTS

i)Temperature sensor

LM 35 is a high precision temperature sensor and has an advantage that its output voltage is linearly proportional to the Centigrade temperature. It can measure temperatures in the range of −55°C to +150°C. It does not require any external calibration. Used for remote applications and is of low cost.

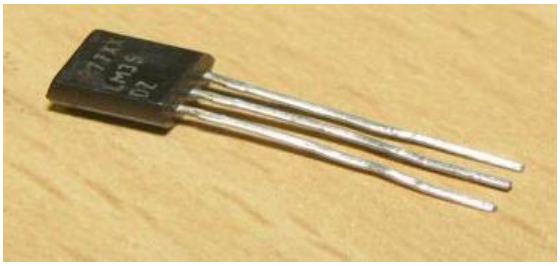

Fig.3.Temperature sensor

ii) Liquid crystal display

The Liquid Crystal Display connected to the microcontroller is 16x2 display. The standard is referred to as HD44780U, which refers to the controller chip which receives data from an external source and communicates directly with the Liquid Crystal Display. If an 8-bit data bus is used then, Liquid Crystal Display requires 11 data lines-3 for control bus and 8 lines for the data bus.

These three control lines are referred to as EN-Enable, RS-Register select and RW-Read/Write.TheEnable pin is used to tell the LCD that we are sending the data. Register Select is assigned low means data is treated as a command and if it is High, data which is sent is text data. Read/Write pin is given low means the data is written and when it is high, the data is read provided register select pin is assigned high.

Fig.4.Liquid Crystal Display

iii) Microcontroller

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

iv) Max 232:

As GSM works with digital data communication MAX232,which is used for converting parallel data to serial data using shift registers. RS232 standards are compatable with TTL.

v) GSM module

GSM is called global system for mobile communication. A SIM is inserted in the prototype board and according to the phone number given in the program using microcontroller, the message is sent to the doctor's

mobile about the patient's details. In this system SIM 300 is used which has highly reliable 24x7 Antenna, usage is simple with low cost and its status is indicated by an Light Emitting Diode.

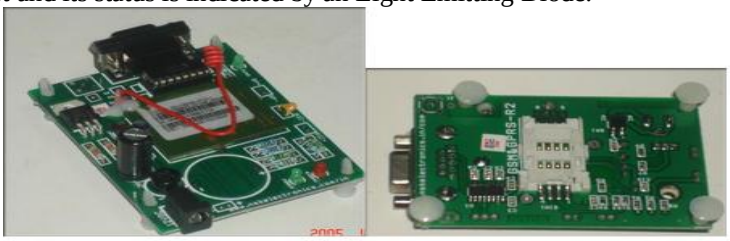

Fig.5.GSM Module

vi) Digital Skin Thermometer

Digital skin thermometer's are used by doctor's to measure the body temperature of the patient. This instrument provides the overall round figure value of the parameter. Range is in Celsius and Fahrenheit temperature scales. Fahrenheit Scale: 50°F to 102°F in increments of 2°F and Celsius Scale: 35°C to 40°C in increments of 1°C. Accurate to within +/- 1°C.

Fig.6.Temperature strip

VIII. DATA ANALYSIS

The temperature dependent data is processed to prove the reliability of the device. For comparing the readings taken from digital skin thermometer and temperature sensor LM35, we followed the statistical methods such as

i) Graphical representation:

A graph is the simplest and most powerful method of representing the numerical data in condensed form. It is the most effective way of realizing the relation between what is happening, what is likely to take place.

Graphs can be one variable or two variable .In two variable graphs the values of two or more variables is shown simultaneously with respect to same parameter on X-axis.

Merits: Graphs are attractive, impressive and interesting. Lot of mathematical knowledge is not required. It is used to determine the pattern and shape of distribution.

ii) Correlation:

The distribution involving two variables of observations on which values are recorded for each unit of observation is called "Bivariate distribution". The interest of study is whether these variables are related or not. The measure of degree of relationship between two variables is called correlation. Correlation can be positive, negative, simple partial or multiple types.

Use: Correlation analysis can help us to have an idea about the degree & direction of the relationship between two variables under study.

Merits: The relationship between two variables can be obtained just by inspection. Not effected by extreme values.

Merits of correlation: i) It helps in measuring the extent of relationship between two or more variables.

ii) We can predict about the future.

Iii) Regression:

The meaning of regression is "stepping back towards its average". It measures the nature and extent of correlation. It is the estimation or prediction of unknown value of another variable.

Definition: "It is defined as the mathematical measure of average relationship between two or more variables in terms of original units".

Linear& Curvilinear Regression: If two variables are correlated than the scattered diagram will be more or less concentration around a curve. This curve is known as curve of regression and the relationship is said to be curvilinear regression. If the relation is a straight line then it is called linear regression.

A line of regression is a straight line which gives the best fit in terms of least squares method. The equation used to find the expected values of the random variables are known as regression lines.

Use: Regression analysis is used for prediction and forecasting where its use has substantial overlap.

iv) t-test

It is calculated using ratio of difference between two means or averages to the measure of variability or dispersion of values. The t-test is positive if the first mean is larger than second and negative if it smaller.

v) F-test

It is the squares of two scaled sums of squares reflecting different sources of variability. The advantage of F-test is that there is no needs to pre specify which treatments are to be compared and need not be adjusted for multiple comparisons.

IX. RESULTS AND DISCUSSIONS

Statistical data analysis is done for temperature readings - correlation, Regression, t-test, F-test are applied. Here it is observed that the correlation coefficient is 0.808978 which shows a high degree positive correlation between the temperature 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 = 1.885051

t - Critical value = 2.001717

Clearly t- calculated value < t- critical value. It accepts Null Hypothesis.

F-Test Two-Sample for Variances

F calculated value=0.390356

F critical value=0.5374

F calculated value < F critical value =>Accepts Null Hypothesis.

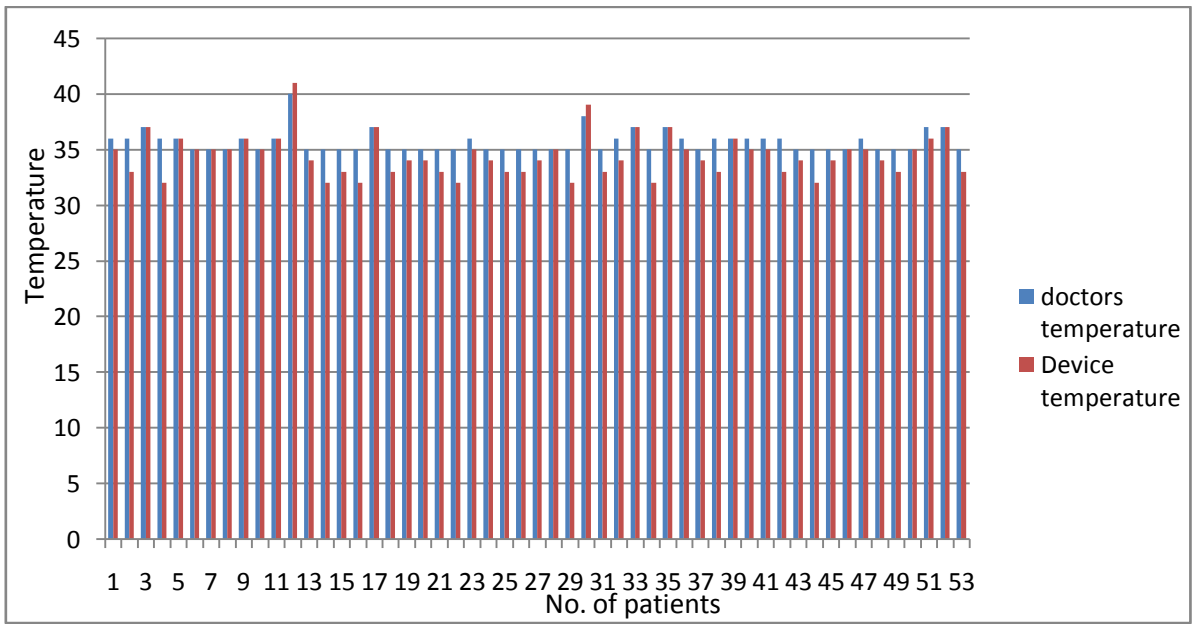

Fig.7.Multiple Bar Diagram

Fig.7. shows that the doctors measured temperature and the temperature measured by the device are almost equal.

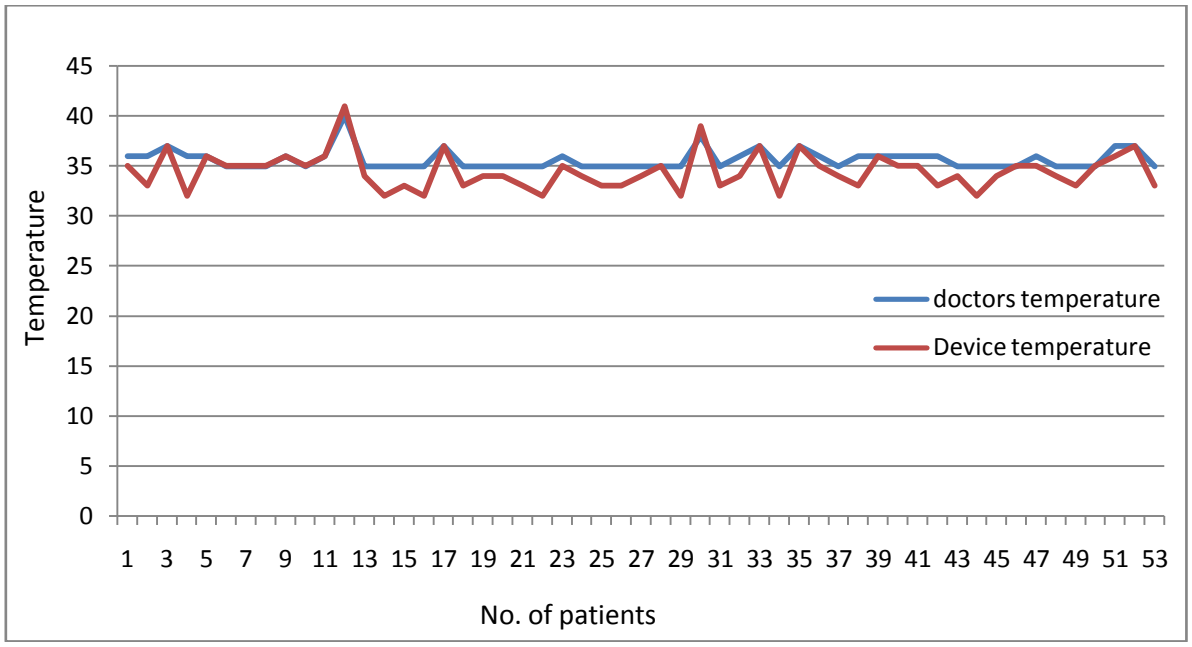

Fig.8. Graphical representation.

Hence the device can be used in the absence of doctor.

X. CONCLUSIONS

The patient-staff ratio is very low these days in the hospitals, so this kind of advanced equipment is necessary. Any abnormality felt by the patient is indicated on the LCD.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 temperature and readings taken from this system are almost equal. There is no difference. Hence the device is efficient and can be used in the absence of doctor.

XI. ACKNOWLEDGEMENTS

The authors are thankful to Dr.Chandrakala M.D, a visiting doctor at Loyola Academy Degree & P.G. college for extending her support to carry out the research work.

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