Patient Monitoring System

Mrs. Kanchan S. Bhosale
Electronics and Telecommunication Engg.,
Fr. C. Rodrigues Institute of Technology, Vashi,
Navi Mumbai, India.

Prof. Yogesh Chandurkar
Electronics and Telecommunication Engg.,
Fr.C.Rodrigues Institute of Technology, Vashi,
Navi Mumbai, India

***Abstract*—This paper describes a simple educational model of a non-invasive blood pressure measurement apparatus using Microcontroller and LCD. Based on the Oscillometric principle, Glucose meter by Amperometric method is used to measure the blood glucose. The main purpose is to make the system as cost effective and efficient.**

Keywords*—Blood Pressure sensor, Glucose sensor, Temperature sensor, Controller, LCD.

I. INTRODUCTION

Blood pressure measurement using mercury sphygmomanometer is one of the oldest methods in health service, still of great importance in today's medicine diagnostics. In recent years the usage and sales of simple and inexpensive electronic Oscillometric blood pressure (BP) devices for home and office increased dramatically. With growing anawareness of ecological and environmental threats of mercury, commonly used in today BP standards.Measurement is done in three stages: inflation, measurement and deflation. In Oscillometric method cuff is placed on the left arm and is connected to an air pump and a pressure sensor. Cuff is inflated until a pressure greater than the typical systolic value is reached, and then the cuff is slowly deflated. As the cuff deflates, when systolic pressure value approaches, pulsations start to appear. These pulsations represent the pressure changes due to heart ventricle contraction and can be used to calculate the heartbeat rate.

Normal blood pressure is 120/80 mmHg in which 120mmHg systolic and 80mmHg Diastolic Pressure. Unit of pressure mmHg define column of mercury one millimeter high.

Diabetes mellitus is a worldwide public health problem. This metabolic disorder results from insulin insufficiency and hyperglycemia and is reflected by blood glucose concentrations higher or lower than the normal range of 80 -120 mg/dL (4.4 - 6.6 mM).A glucose meter is medical device used to determine the concentration of glucose in the Blood. The glucose concentration is measured in units of milligram per deciliter(mg/dl) or millimole per liter (mmol/L).The two most common methods used in electrochemical measurement of glucose are the Colorimetric method and the Amperometric Methods. Body Temperature can be measure by Temperature sensor only.

II. OBJECTIVE AND SCOPE OF THE PROJECT

The main aim behind this project is to develop wired system that measure the biological parameters of Human body in real time, process the results and gives the proper diagnosis instantly.

Designing a system and methodology for evaluation of typical metrological parameters describing Oscillometricmethods for BP measurements, now a day's employed in most non- invasive BP (NIBP) measurement instrument, would be of great importance in new knowledge on confirming NIBP devices with unknown measurement algorithms as shown in Fig.1.[1]. Oscillometric method determines the Mean Arterial Pressure (MAP) by taking the cuff pressure when the pulse with the biggest amplitude appears. From Fig.2 Systolic and Diastolic values are calculated using algorithms that vary among different medical equipment developers.Blood Pressure Monitor calculates Systolic and Diastolic pressure by taking into consideration that Systolic pressure is approximately equal to the pressure measurement taken in the cuff when a pulse with 70% of the amplitude of the MAP pulse appears while the cuff pressure is above the MAP value.The Diastolic pressure will be taken at the point in which the oscillations start to disappear. Diastolic pressure is approximately equal to the cuff pressure value registered when a pulse with 50% of the MAP pulse amplitude appears while the cuff pressure is under the MAP value.

The oscillation signal varies from person to person. In general, it varies from less than 1mmHg to 3mmHg.

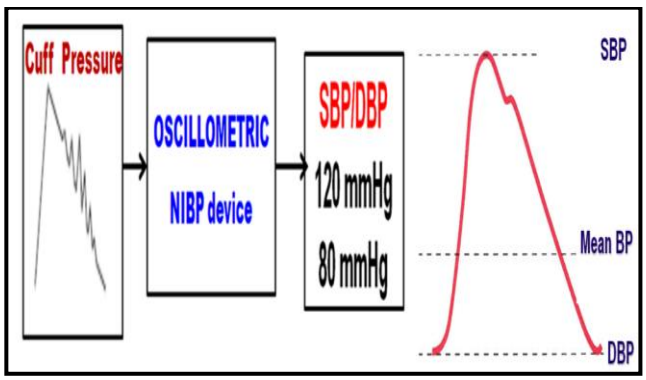

Fig.1: Basic Oscillometric method

In glucose measurement concentration will measure be by Amperometricmethod.Amperometric enzyme electrodes, based on glucose oxidase (GOx), have played an important role in simple blood sugar testing and are expected to play a similar role in the move toward continuous glucose monitoring [10]. In this method, the electrochemical test strip contains acapillary that is used to draw in the solution placed atone end of the test strip. The test strip also contains anenzyme electrode containing a reagent such asGlucose Oxidize. Glucose undergoes a chemicalreaction in the presence of enzymes and electrons areproduced during the chemical reaction.

Theseelectronsare measured and this is proportional to theconcentration of glucose in the solution.

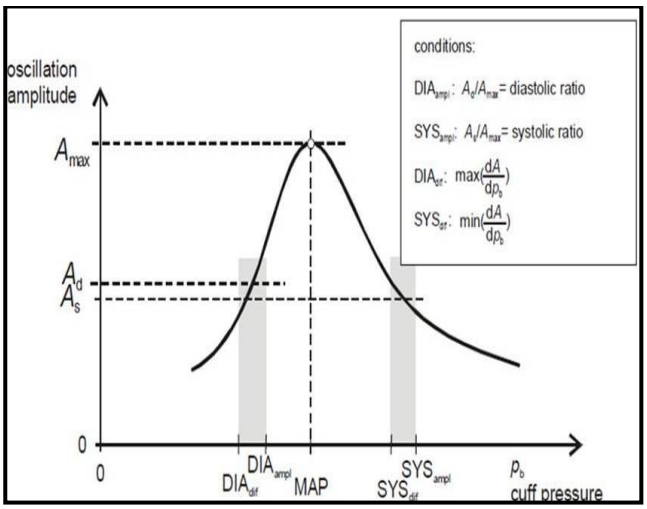

Fig.2: Pressure oscillations envelope versus cuff pressure and characteristic parameters (DIA, SYS, and MAP) determined using two algorithms (amplitude and differential algorithm).

III. HARDWARE IMPLEMENTATION

The hardware section for Blood pressure measurement incorporates Pressure sensor, instrumentation amplifier and 2-Pole High pass filter. Whereas Glucose meter incorporates Glucose test strip, current to voltage converter and filter. Temperature sensor incorporates LM35. All Three measuring instruments interface with controller through Analog to Digital converter.

Pressure sensor is using MS4426 PC board mountable Pressure sensor. MS4426 is temperature compensated, piezoresistive silicon pressure sensor package in DIP. Instrumentation amplifier is accurate using low power. Output of Pressure sensor is in mV. Maximum output is (0-150Psi) 18mV-150mV. So we have to choose instrumentation amplifier gain with 150. Then output will be 0V to 3.5V can be achieved. We are using INA 128 to achieve require Gain of 150. As per data sheet of INA128P Gain range is 1-10000

Glucose test strip needs reference voltage -400mV, which is given by using LM358N.current to voltage converter is achieved by Op-Amp.

IV. SYSTEM INPUTS

A. Pressure sensor :

MS4426 [Fig.3] is the temperature compensated, piezoresistive silicon pressure sensor. Piezoresistive silicon pressure sensor is also called strain gauges.Pressure sensors typically employ the piezo−resistive principle to convert pressure to anelectricalsignal.A silicon chip is micro−machined to give a diaphragm around which fourresistors are diffused in a bridge configuration. Application of pressure on the diaphragmresults in a change in the value of these resistors which creates a differential voltage outputproportional to the applied pressure.

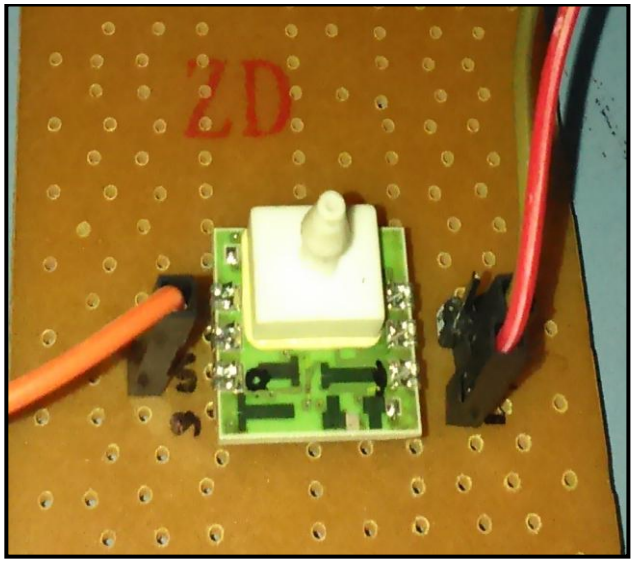

Fig 3: Pressure sensor MS4426

B. Glucose Test strip

Fig.4: Glucose test strip

Amperometric Sensor is used for Glucose measurement.Electrochemical biosensors are well suited for addressingthe needs of personal (home) glucose testing and have playeda key role in the move to simple one-step blood sugar testing.Glucose monitors rely on disposable screen-printed enzymeelectrode test strips.Each strip containsthe printed working and reference electrodes, with theworking one coated with the necessary reagents (i.e. enzyme,mediator, and additive, surfactant, linking, and binding agents) and membranes as shown in Fig5. The reagents are commonlydispensed by an ink-jet printing technology and depositedin the dry form.Ittakes advantage of glucose oxidation with a glucoseoxidase enzyme.Variousmembranes (mesh, filter) are often incorporated into the teststrips and along with surfactants are used to provide uniform sample coverage and separate the blood cells [10]

The presence of glucose oxidase catalyzes the chemical reaction of glucose with oxygen, which causes anincrease in pH, decrease in the partial pressure of oxygen and increase of hydrogen peroxide because of the oxidation ofglucose to gluconic acid.

$$Glucose + O_2 Gluconicacid + H_2O_2 \quad (1)$$

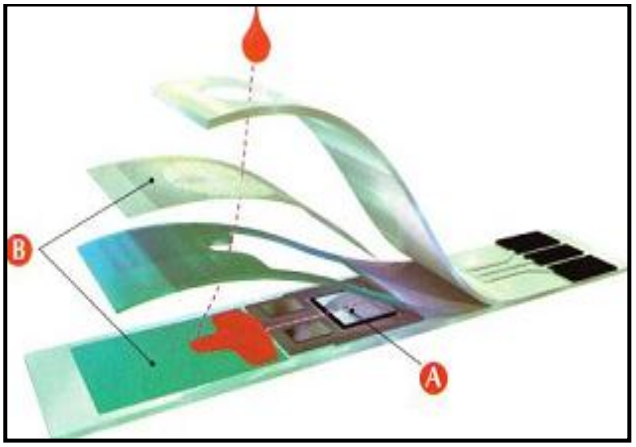

Fig.5: Cross section of a commercial strip for self-testing of Blood glucose (based on the Precision biosensor manufactured by Abbott Inc.): (A) electrode system; (B) hydrophobic layer (drawing the blood).

V. SOFTWARE IMPLEMENTATION

In Software implementation we used Multisim 11.0 from National Instruments. Instrumentation Amplifier Gain is decided by placing the R_G resistor between Pin 1 and Pin 8 and is given by following equation.

$$Gain = 1 + \frac{50k\Omega}{R_G} \qquad (2)$$

Equations:

BP= CO X SVR (3)

Mean Arterial Pressure

MAP = (CO X SVR) +CVP (4)

$MAP \approx P_{dias} + (P_{sys} - P_{dias})/3$ (5)

BP= Blood Pressure

CO = Cardiac Output

SVR = Systemic Vascular Resistance

P_{dias} = Diastolic Pressure

P_{sys} = Systolic Pressure

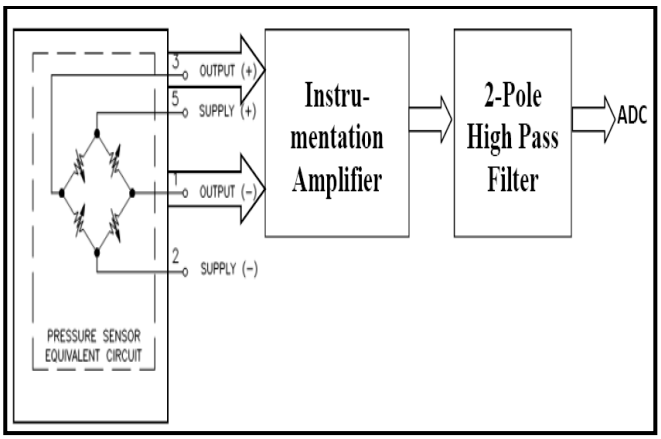

Fig.6:Pressure sensor interfacing with instrumentation Amplifier

Glucose test trip has three electrodes. Reference electrode, Working electrode and counter electrode. Glucose Test strip [Fig.4]A precise reference voltage (V_{REF}) as shown in Fig.7 is applied to the reference electrode and a precise bias voltage (V_{BIAS}) is applied to the op amp. This way the precise potential difference is maintained across the working electrode and the reference electrode. This voltage is the stimulus which drives the test strip's output current [7].

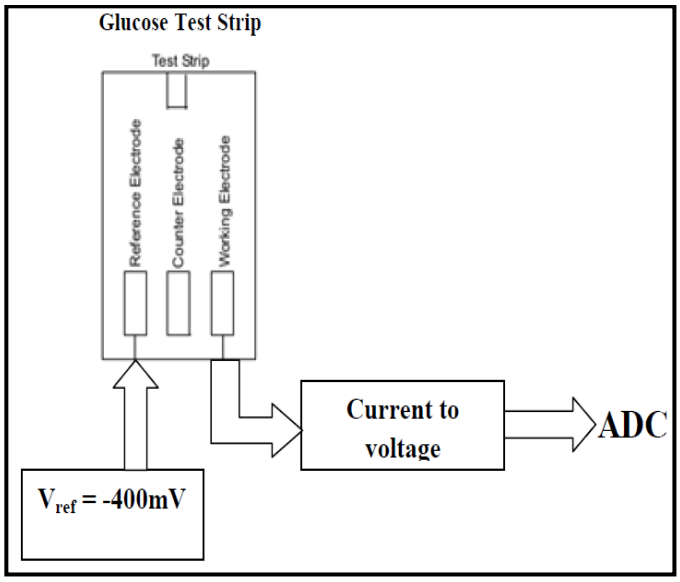

Fig.7: Reference voltage -400mV given to Glucose Test Strip

VI. FUTURE SCOPE

Two Pole high pass filter is to design to get cut off frequency *f1*=0.338Hz and *f2* = 0.386Hz. These all calculated parameters are in Analog form. So we have to do Analog conversion into Digital By using appropriate ADC before interfacing with controller. After measurement display this value on LCD. Interfacing of Temperature sensor is still remaining.

VII. CONCLUSION

The purpose behind to use of Oscillometric method is Mercury sphygmomanometer having drawback in signal analysis due to physiological variation of the Korotkoff sound patterns. Whereas Oscillometric method have advantage over mercury sphygmomanometer is BP measurement even Korotkoff sound is poor. In Oscillometric method doesn't require microphonic sensor. Only drawback is very sensitive to movements due to the bandwidth of the signals, so the arm must be immobile. In colorimetric method meter should calibrated frequently, so we have choose Amperometricmethodwhich measures the electrical current generated at a specific point in time by the glucose reaction. The main aim of this paper is to implement a health diagnosis system which is portable.

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