WIRELESS MEASUREMENT OF INTRAOCULAR PRESSURE

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ABSTRACT

Intraocular pressure is the tissue pressure within the eye, which is determined by the balance between the production and drainage of aqueous humor, the clear fluid inside the human eye. Normal range of IOP is 10-22 mmHg. Tonometry measures the intra ocular pressure. The increased intra ocular pressure is a reason behind many diseases of eye. In this paper, the device is set up which measures the intra ocular pressure by the usage of pressure sensor placed on the eyelid and interfaced with the pic microcontroller. It converts the physiological signal into digital signal and then it will be transmitted through wireless communication. The receiver section will receive the signal and the data will be displayed on the computer.

KEYWORDS: *Eye, Intraocular Pressure, Microcontroller, pressure sensor, wireless*

I. INTRODUCTION

Eye is the 2nd cranial nerve which has three layers of tissues, outer layer is fibrous layer contains cornea and sclera ,middle layer is vascular or uveal tract which have choroid, ciliary body and iris and inner nervous tissue layer have retina. There are many eye diseases like macular degeneration which is physical disturbance of the central of retina, bulging eye or apoptosis related to swelling of muscles and fat in eye, cataracts is the disease in which lens gradually becomes opaque and vision mist over, CMV retinitis is a type of retina infection which leads immune disorders and also adversely affect the people who have AIDS, diabetic macular edema is caused by fluid accumulation in fluid, glaucoma which is due to the imbalance of intraocular pressure and many more diseases like low vision, eyelid twitching ,ileitis, lazy eye etc related to eye .

In this paper we are measuring continuous intraocular pressure wirelessly. Intraocular pressure is mainly the fluid pressure in the eye. By measuring it we can diagnose and determine the evaluation of Glaucoma patients at risk. Glaucoma [1] is basically having higher intraocular pressure because of accumulation of intraocular fluid and damages the optic nerve which cause vision loss if not treated. There are over 67 million people all over the world suffering from glaucoma [2]. Out of which 12 million people are from India because they are not diagnosed. Here we have developed a device which will measure intraocular pressure of eye by using a pressure sensor and it can be read wirelessly in a screen.

II. OBJECTIVE

The idea behind the study of this topic is to know the procedure of measuring continuous intraocular pressure of eye wirelessly. There are several different methods of measuring intraocular pressure to detect glaucoma in patients and the level of risk they are at. But sensing it continuously and wirelessly is our proposed idea. In our device pressure sensor is connected to a pic microcontroller 16f877a which automatically converts analog to digital signal, this signal is read continuously and wirelessly in a distant screen. To get the proper output, all connections are properly done in the pins of the IC.

Pressure sensor which is used is highly sensitive, should be handled carefully. To give power supply we converted 230v ac to 5v dc then it is connected to IC. Here we used a 16*2 LCD screen for display and the intraocular pressure value can also be send to a distant screen through Zigbee wirelessly. Lastly we can visualize the final result by using the proper method.

III. LITERATURE REVIEW

Starting from 1865, the measurement of intraocular pressure was first done by Von Graefe; he developed the first instrument in that era. But the first relatively accurate instrument came in the mid 19th century which is developed by Maklakoff. Later, Goldmann's tonometer[3] came in the year 1950 which is still widely used and gives accurate intraocular measurement. Other devices like indentation tonometer, tono-pen, pneumatonometer, airpuff tonometer, contour tonometer are the few concepts of tonometry which came in over 100years. These methods are used to diagnose glaucoma in all over these decades. Elevated intraocular pressure of eye is measured by using tonometer and determined the risk of getting blind[4]. The continuous monitoring of intraocular pressure and read it wirelessly is more advanced method for diagnosing glaucoma. The device is portable and the output can be send to distant places wirelessly. Patients with higher risk of glaucoma needed to check their eyes regularly. They can check their intraocular pressure and can send it to doctors by using our proposed model.

IV. PROBLEM DEFINITION

The difficulties in measurement of intraocular pressure were the selection of appropriate components and to get the précised output. Eye signals for intraocular pressure has been measured in length of mill or micro so get them accurately was most difficult task. Resonance frequency of eye intraocular structure is 20-90 Hz[5].

Here are some of the challenges discussed below which we faced during developing this device:

1. Selection of appropriate sensor
2. Generation of distorted waveform
3. Interfacing between microcontroller, PC and the Zigbee
4. Coding
5. Determination of frequency range in Zigbee

V. SOLUTION METHOD

In this section of paper we will find out some methods to overcome the problems discussed in above part. To overcome these problems proper circuits, components with standard values. The distorted waveform in the power supply unit can be eliminated by using IC regulator. The eye pressure sensor can be used for measurement of intraocular pressure of the eye. To remove the trouble of interfacing MAX232 can be implemented. As RS232 is the pin in pic microcontroller which is found to be compatible with the voltage logic of PC, so it can be used for the purpose of communication. Again the major step was to find the proper frequency range in Zigbee which can work with the sensor. As it has different frequency ranges variying from 2.4 - 2.484 GHz, 902-928 MHz, and 868.0 – 868.6 MHz. The coding is done by MP LAB**.**

VI. METHODOLOGY

This device consists of two sections. First is hardware section which consists of pressure sensor, power supply, pic-microcontroller, LCD and zigbee. In software section, Proteus software is used for simulation and printed circuit board (PCB) design. PIC microcontroller 16f877a is complied by using embedded C in MPLAB. Block diagram has shown in below figure1.

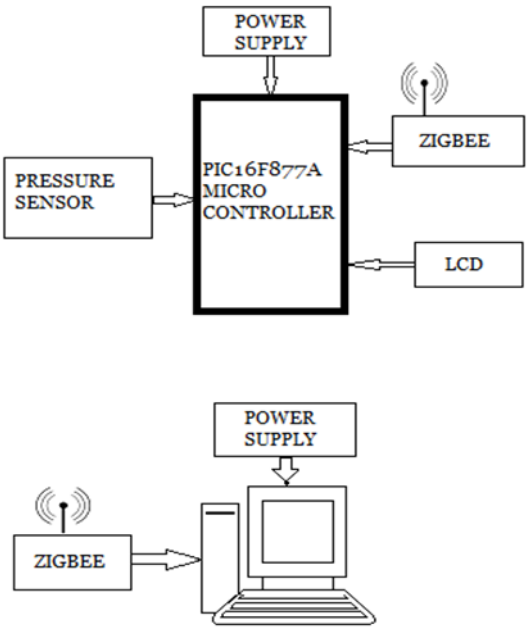

Figure 1: Functional Block of the System

4.1 Hardware section

First pressure sensor which is mounted in a sunglass placed on human eye non-invasively. Pressure sensor which detects intraocular pressure as physical quantity and them convert it into electrical signals by pressure sensor itself. Electrical signals are be transmitted to PIC167877A which needs 5v power supply to turn on. Circuit diagram has been shown below for power supply 5v to PIC.

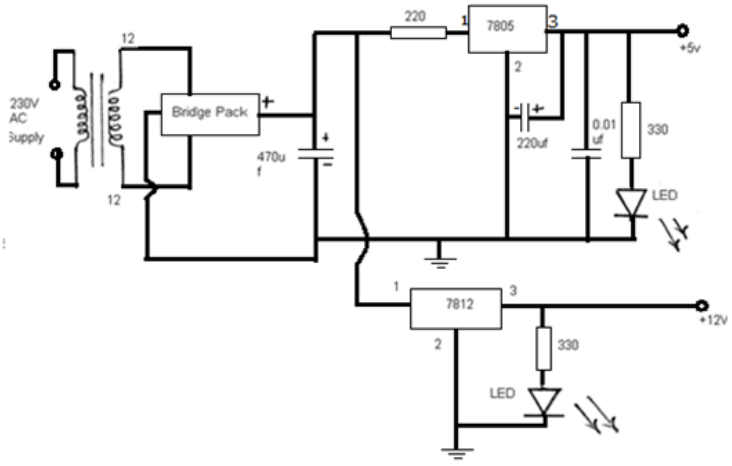

Figure 2: Implemented Circuit Diagram of the System

In this section 220 volt has been converted into 5 volt. First by using step down transformer we convert 220 volt AC into 12 volt AC after that this 12 volt has been transformed to bridge rectifier which converts 12 volt AC to 12 DC and ripple factors has been removed by capacitor(470uf) placed in parallel connection and then through voltage regulator (IC 7805) 12 volt converted into 5volt. This 5 volt is supplied to PIC as a power supply which is shown in the figure2.

LCD which is attached to PIC is a 2*16 LCD which shows the 'Eye pressure monitoring' value. This value can also be transmitted by using Zigbee. Transmitter part of Zigbee is attached with PIC. The receiver Zigbee which is kept in a distant place receives the signal and connected to a pc section by using max 232, it uses serial communication which means bit by bit signal transmission and the output is shown in the pc section.

4.2 Software section

I t is done by using three software. These softwares are Proteus, Embedded C and .NET. Through the proteus software first we have designed hardware simulation part and designed PCB board. MPLAB IDE is basically used to develop applications in microcontrollers. By using basic C programming language we write program and complied it. It generates a Hex file which is used to dump on the PIC microcontroller. By using .NET i.e. in Hyperterminal software, eye pressure value can be viewed in a pc section wirelessly in a distant place.

VII. RESULT AND DISCUSSION

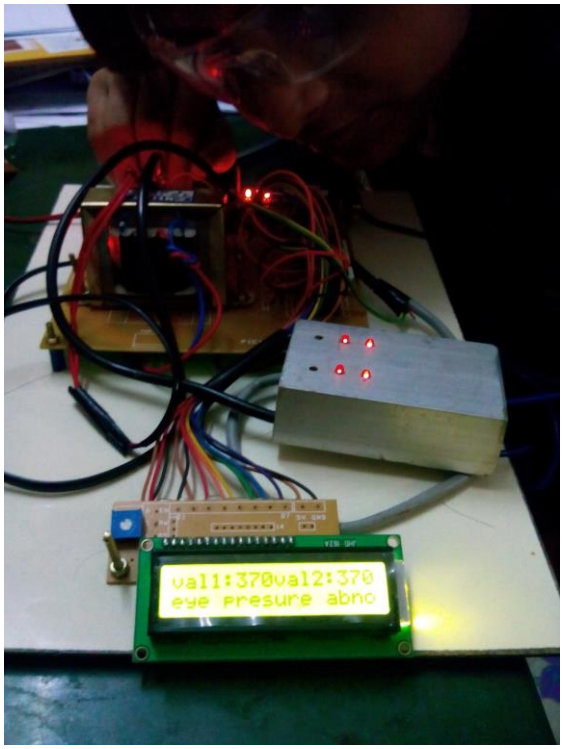

Figure 3: Different parts of the Prototype

This is our prototype which has been shown in Figure.3. The entire system is developed and studied with volunteers and found working satisfactorily. The final product is compacted after numerous experiments, verification and modification of algorithm. In this prototype an eye frame which have pressure sensor at both sides will be placed on the eyes. Pressure sensor is measuring in terms of Pascal. The threshold value for pressure is 250 and biasing value is 220. The output is displaying on the LCD as "Eye Pressure Monitoring". When the pressure will be higher than 250, the output will be shown as abnormal eye pressure value. The wireless range of zigbee is 100-150 meter. This system can be utilized for remote medical systems to assist the elderly patients, or for physicians to diagnose diseases related to glaucoma.

VIII. CONCLUSION

It is low cost noninvasive device which can use for both homes and hospitals. As future aspects in measurement of intraocular pressure we can use intraocular pressure lens which is noninvasive at place of pressure sensor [6].This device can be modified for measurement as well as control. The advantages of this implementation are: portability, low cost, scalability, immediate analyses and momentarily display the result in the computer, applicable to each family.

IX. FUTURE SCOPE

From the above experimental procedure it is clear that we can measure glaucoma in patients by using our prototype. The future scope of work is miniaturization of the system to have portability; then it can be used as a more effective tool for giving care to the patients. Therefore, it is easy to say that these wearable technologies can play a key role in identifying glaucoma among the old-aged people as well as people having family history of glaucoma and regular visits to the doctors can be avoided.

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