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A Non Invasive Wireless Pressure Sensor for Continuous IOP Monitoring

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Abstract-This paper presents, the second leading cause of blindness, is most accurately defined as a collection of diseases that have in common, damage to the optic nerve and loss of visual field with increased intraocular pressure (IOP) being the primary risk factor. According to National Institutes of Health (NIH) approximately 120 000 Americans are blind from glaucoma which accounts for 9–12% of all cases of blindness in the U.S.Worldwide 79.6 million people are expected to suffer from glaucoma by 2020 increasing from 60.5 million in 2010. Although there are treatments available, there is a need to develop improved diagnostic and therapeutic techniques to fight this disease. Increased IOP is one of the primary factors used to diagnose glaucoma and is also a clinically significant risk factor for its progression. Goldmann tonometry performed during the office visit is considered to be the gold standard for the measurement of IOP. However, given that IOP fluctuates over time, a single office visit gives only a snapshot of what the true IOP is between measurements, which is often weeks or months depending on the patient.

Index Terms— intraocular pres-sure, sensor, wireless powering.

I. INTRODUCTION

G LAUCOMA, an eye disease that causes damage to the optic nerves due to high intraocular pressure, leads to progressive, irreversible vision loss. It is the second leading cause of blindness [1]. Regular eye pressure monitoring can identify the patients at risk and help start early preventive mea-sures to avoid further eye damage. Current clinical devices such as Goldman tonometry and Pulsair pneumo tonometry do not provide continuous monitoring [2]. Additionally, in-clinic mon-itoring through these devices is not sufficient for at-risk patients because the intraocular pressure varies significantly throughout the day and can be substantially greater at times such as during intense physical activity or sleeping [1]. As such, a device that enables on-demand intraocular pressure monitoring (IOPM) in day-to-day life at home without the necessity to go to a specialistin a clinic is highly desirable.

The size of the system is crucial to reduce invasive surgical procedures. Due to the heavy absorption of signals in the human body, generally longer wavelengths (frequencies below 1 GHz) are used. This results in large antenna sizes, which are required for wireless communication from the implant to the external world. One way for miniaturization is to use higher frequencies(smaller antenna sizes) at the cost of larger attenuation of the signal in the human body. Another way to achieve compactness is integrating the antennas with the RF circuits on the same chip, but this also enhances losses due to the low resistivity of the typical silicon substrates (10 Ω.cm) [3]. The lossy environment of the eye makes the wireless communication and the subsequent antenna design even more challenging. The only relief is the short communication range required for this particular application (10 cm) [3].

Implantable IOPM is a new area of research, and not much work has been reported on this [4]. An implantable IOPM reported in [1] has a 27 -mm-long antenna that is unsuitable for the implant process. In [5], a wireless implantable IOPM is demonstrated, but relies on inductive coupling for data transfer. Recently, a passive IOPM system has been proposed that also utilizes inductive coupling [6]. The main drawback of passive systems is that they have very limited functionality and low accuracy level.

The limitation with inductive coupling is that it requires perfect alignment with an external coil [1]. This letter reports two separate implantable antenna designs for transmit (Tx) and receive (Rx) functions in a 1.4- mm^3 active IOPM system-on-chip (SoC). The antennas have been optimized in an eye environment, and a custom test setup has been created to emulate the eye for measurements.

II. DESIGN CONSIDERATIONS

In this system consisting the various hardware's and softwares .the hardwares are PIC micro controller,Sensor,PC,and lcd.The software's used in this systems are MP compiler. Here we used different Modules such as Power Supply Unit, Microcontroller Unit,Sensor Unit. Communication Unit,Display Unit,Software Unit.

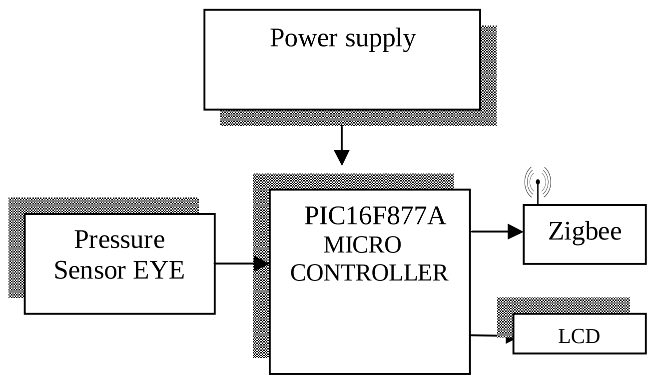
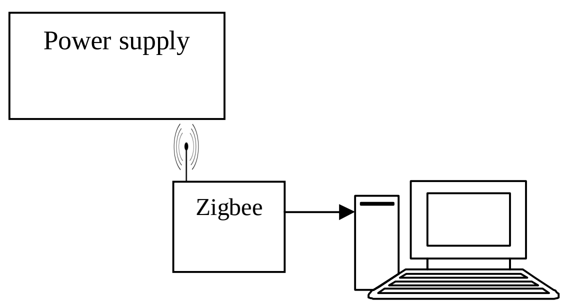


Figure 1:Block Diagram

PC SECTION



POWER SUPPLY UNIT:

The supply of 5V DC is given to the system which is converted from 230V AC supply. Firstly, the step down transformer will be used here for converting the 230V AC into 12V AC. The microcontroller will support only the DC supply, so the AC supply will be converted into DC using the bridge rectifier. The output of the rectifier will have ripples so we are using the 2200uf capacitor for filtering those ripples.
The output from the filter is given to the 7805 voltage regulator which will convert the 12V DC into 5V DC.The output from the regulator will be filtered using the 1000uf capacitor, so the pure 5V DC is getting as the output from the power supply unit. Here we are using the pic microcontroller which will be capable of getting the supply of 5V DC so we have to convert the 230V AC supply into 5V DC supply.

MICROCONTROLLER UNIT:

PIC16F877A

In this project we are using PIC16F877A microcontroller for controlling the devices which are connected in the controller. The eye pressure sensor is connected as the input of microcontroller. This controller has inbuilt ADC. So we can connect the sensor directly to the ADC channel. The Zigbee is connected to the controller. Thus the readed data is send to the PC using Zigbee.

The other Zigbee device is connected with the PC and the database is stored. Also the controller display the reading in LCD which is the output from the sensor.

SENSOR UNIT:

The sensor unit will sense the physical parameters and convert them into electrical signal and amplify the signal using the amplifiers.[6]This sensor is fixed in the eye lid. This sensor monitors the pressure of the eye. Then it sends the data to the microcontroller.

COMMUNICATION UNIT:

Communication unit will send or receive the datas from the microcontroller.The Zigbee device is connected in microcontroller as well as another Zigbee device is connected in the PC. This is used to communicate. [5] MAX232 is used to interface the PC with the microcontrollers to convert the voltage levels. It will convert the voltage level into TTL logic which is compatible to the microcontroller.

DISPLAY UNIT:

Liquid Crystal Display (LCD) is used as the displaying device. Here we are using the 2X16 LCD which is capable of accessing the datas in four bits as well as eight bits also. In this project we are going to display the pressure value of eye.PC is connected with the Zigbee and communicated to the microcontroller and the data is received through the microcontroller the data will be transmitted to the PC and the data will be monitored in PC using dotnet software.

SOFTWARE UNIT:

Software is used to compile the coding of the desired application for the corresponding embedded system,MPLAB Compiler This is the software used to compile the embedded C program. It generates the hex file which can be used to dump on the ic. Proteus 7.2 Proteus is software for microprocessor simulation, schematic capture, and printed circuit board (PCB) design. It is developed by Lab center Electronics. Proteus PCB design combines the ISIS schematic capture and ARES PCB layout programs to provide a powerful, integrated and easy to use suite of tools for professional PCB Design. All Proteus PCB design products include an integrated shape based auto router and a basic SPICE simulation capability as standard. We are using this software to simulate the hardware.[9]

III. MEASUREMENTS

In the Measurements Section we used the sensors ,there or two sensors one is ued for right eye side and another one is used for left side.here we used the pressure sensor the sensor can be kept on the eye lid or side of the eye,the pressure range of two eyes are different .the sensor will sense the pressure for each side and resuk=lt will be shown in the personal computer .the normal range of glaucoma pressure is 21.

IV. CONCLUSION

Thus this project shows how to monitor the pressure in the eye and then sends the data to the PC. The data can be send through zigbee. Also the data's can be stored in PC. If we want to see the data immediately after checking means that can be displayed in lcd. This project has a wide application in future. Because it easily portable. It is used to monitor the pressure of the eye. This can be used in home also. Thus easy to check & monitor eye. This check up is less cost than others. So this project has a wide welcome in future and we can also add the alarm. when the pressure is higher than normal the alarm indicate the sign.

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