

Knee Sound Based Detector for Osteoarthritis Prediction

Mariapushpam¹ Meena² Parveenroja³ Uma⁴

^{1,2,3,4}Department of Bio Medical Engineering

^{1,2,3,4}Adhiyamaan College of Engineering, Hosur

Abstract— We are proposing a non-invasive, radiation-free, early stage detection system called the Knee Sound Detector to determine the seriousness of the knee joint condition for osteoarthritis patients. The system is based on sound recordings on the subject's knee. Osteoarthritis (OA) is a degenerative joint disease, which is commonly occurred in knee joint. OA has become the major cause of disability in a many countries. Recent diagnosis methods for example X-Ray, Magnetic Resonance Imaging (MRI), Joint Fluid Analysis, and Arthroscopy have several complications such as presence of radiation. To have a non-invasive, radiation-free, early stage detection, and relatively inexpensive approach, a novel Knee Sound Detector has been developed based on sound recording on the medical compartment of subject's knee.

Key words: Osteoarthritis (OA), Ultrasonic sensor, Microphone

I. INTRODUCTION

Osteoarthritis (OA) is a major common joint disease worldwide. It is a progressively degenerative process, mainly affecting the elderly. About 10% of the total worldwide population and more than half of the people aged over 50 years suffer from OA. It causes pain, swelling and reduced motion in joints. The knee is the most common part of the body to be affected by arthritic degeneration. One of the major problems during the examination of the causes or progression of this condition is the difficulty in detecting articular cartilage changes until they become gross, either anatomically or symptomatically.

Crepitus in the knee is often noted during clinical examination of OA patients. This knee sound signal generated during knee ROM, represents the acoustic to analog to digital signal. It is associated with the cartilage pathological condition such as roughness, softening, breakdown or cartilage loss and may be useful index of the Osteoarthritis status.

II. MATERIALS

A. Ultrasonic Sensor

An ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to balance to back. The accuracy of ultrasonic sensor can be affected by the humidity of the air it is being used in. Almost any project you will be using this sensor, this change in accuracy will be negligible. It receives the sound signal from the knee joint for detection.

B. Microphone

An microphone is a stable dielectric material with a permanently embedded static electric charge which, due to the high resistance and chemical stability of the material, will not decay. The name comes from electrostatic and

magnet. Electrets are commonly made by first melting a suitable dielectric material such as plastic or wax that contains polar molecules, and then allowing it powerful electrostatic field. Here, the microphone is used to convert the acoustic signal into an electric signal. This signal from the ultrasonic sensor is converted into an electrical signal. Microphone is interfaced with ultrasonic sensor.

C. PIC16F877A

The PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has total number of 40 pins and there are 33 pins for input and output. A microcontroller is a small computer on a single integrated circuit. Microcontroller are used automatically controlled devices. PICs are low cost, wide availability, serial programming capability. Microcontroller are used in automatically controlled devices. PIC is a family of Harvard architecture microcontrollers.

D. MAX 232

The MAX232 is an integrated circuit maxim integrated products that converts signals from a TIA-232 to RS 232. Its acting as a dual receiver and transmitter. It will control the voltage level. It has two transmitter and two receiver. The minimum voltage level is 4.5V and the maximum voltage level is 5.5V.

E. RS232:

We use serial communication. The RS232-9 pin port. It is also known as DB 9 pin connector. Communication port. RS232 has two communication that is DCE and DTE.

- 1) DCE: Data Communication Equipment. (Eg: Modem).
- 2) DTE: Data Terminal Equipment. (Eg: Satellite, Router and PC).

F. Block Diagram

The structure of this paper is organized as follow: The ultrasonic sensor is used to measure the distance to an object by the sound signals. This receives the sound signal from the knee joint of detection. And the microphone is used to convert the signal from ultrasonic sensor and convert into electrical signal. The analog electrical signal converted from the digital signal by using the PIC16F877A microcontroller. The analog electrical signal then converted into the digital signal by using the microcontroller. The analog electrical signal then converted into the digital signal by using the microcontroller.

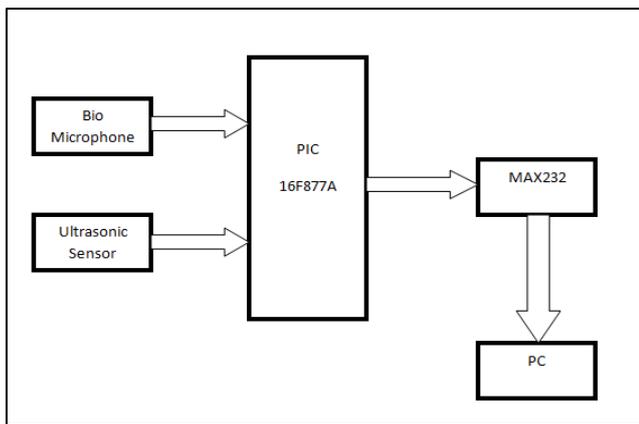


Fig. 1: Overview of the system

The analog electrical signal then converted into the digital signal by using the microcontroller. That the PIC16F877A microcontroller are interfaced with the analog to digital converter(ADC). The MAX232 is dual receiver and transmitter. The PIC16F877A is connected with the microphone and ultrasonic sensor. The sensor unit consist of op-amp and high sensitive microphone. That the microphone connected to LM358 is a low power dual operational amplifier. The role of analog to digital converter is convert the analog to digital values. The ADC voltage will refer the display prediction values is The. analog electrical signal then converted into the digital signal by using the microcontroller.

III. CONCLUSION

In this project, we find that VAG signal of the knee provides an economical alternative to X-ray examination in osteoarthritic patients, which can also monitor of knee joint pathology at an early stage. Our results showed good sensitivity and specificity rates. The sound signals were inputs into a LCD display and displayed according to the microphone signal. The output will be displayed in LCD display.

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