

Audio Input Devices

Introduction

Audio input into a system is received through a microphone and then processed. However, there is a wide array of microphone options, which are applicable to different situations. This paper is a review of many of these microphone technologies and the processing required for audio input.

Commercial Applications of Microphones and Audio Input Processing

The main commercial application of microphones is recording for music, television shows, radio shows, and movies. Cheaper options are available, but even the most basic home recording studio would require microphones in the \$100-\$300 price range. The three main types of microphones for basic audio recording are dynamic, ribbon, and condenser microphones. Dynamic microphones include a diaphragm that will move when hit by sound pressure waves; this movement produces a small electrical signal that represents the audio being recorded. This type of microphone is best when recording from multiple different sources such as once such as three instruments playing at one time but may sound less crisp than other options. Ribbon microphones also contain a diaphragm that is a thin strip of metal; because of the smaller size, the microphone is more responsive to changes in the audio input and will therefore produce a clearer recording. Condenser microphones have a diaphragm that when combined with a backplate and applied a small amount of voltage creates a capacitance that changes as the diaphragm moves in response to audio input. Condenser microphones can be small or large and are useful when recording acoustic instruments or a large ensemble [1].

Other commercial applications of microphones include medical, research, and military uses. One example of microphone usage in the medical field is for communication during an MR scan. These microphones use fiber optic technology because traditional microphones that operate using electrical and magnetic fields would interfere with the MR scan occurring [2]. These microphones cost upwards of \$650 [3]. A research and practical application is recording seismic waves where it has recently been shown that microphone may be able to be used to record these waves instead of requiring a receiver that has contact with the ground [4]. The scientific community and military can use the types of microphones mentioned above as well as laser microphones, which can detect sounds from long distances by looking at changes in the reflected laser beam. One application of this technology for science is in measuring underwater sound because a typical microphone will not work well due to changing water pressure as depth changes [5]. One example of this being used in the military is for remote chemical sensing [6].

Underlying Microphone Technology

Microphone technology records the changing sounds waves in the surrounding medium by using by noticing change in the movement of the sensor. For dynamic, ribbon, and condenser microphones this sensor is a diaphragm. For optical and laser microphones, the sensor will pick up the reflected signal and the changes will be analyzed. These sound waves are produced by disturbances in the medium that change the pressure in certain areas of the medium. A higher pressure differential represents a louder sound and larger amplitude in the sound waveform. How often the medium oscillates between regions of high pressure and regions of low pressure describes the frequency of the waveform, which corresponds to the pitch of the sound [7].

Building Blocks for Implementing the Technology

The hardware component is fairly simple and only requires the correct microphone for the specific application. The difficulty comes in when analyzing the signal in the digital realm. Care must be taken when creating the signal processing software so that the sampling rate is high enough to fully represent the incoming signal; typically, the sampling rate should be twice the rate of the highest frequency in the signal. If this is true, there will be no distortion in the signal after being processed [1]. This will require a computer whether that is in the form of a computer for larger projects or a microprocessor for smaller scale projects.

References

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