Digital Stethoscope for Diagnosis with AR/VR Organ Guidance

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Introduction

The stethoscope is an instrument used by medical professionals to listen to the internal organs of a patient. This assessment is medically known as auscultation. Based on the sounds, a medical professional can assess and determine the well-being of the patient and status of the lungs, heart, and intestinal tract.

Outside of the medical field, audio analyzing technology has improved so much that smartphones can not only understand words and phrases, but they can now distinguish between the voice of its owner and other voices. This project is the next step in audio analyzing technology, deep neural networks, and the internal organ auscultation process.

Recording sounds using a digital stethoscope, identifying the location of the sound, and classifying the type of sound using Deep Neural Networks can contribute to determining the diagnosis of a particular disease without medical training.

Motivation

Real-world applications of this device would allow underserved or low-resource communities the ability to monitor health conditions and receive a diagnosis without tests, expensive medical devices, and medical professionals. Our product will include AR guidance and feedback to the user as they go through the auscultation process. The audio is then automatically analyzed by our software. Ultimately, this product will increase healthcare access because high costs, access to medical supplies, and access to trained medical professionals will not act as a barrier for undererved communities.

Method

The AR/VR Guidance System, Audio Analysis and Diagnostics, and The Digital Stethoscope Device

The AR/VR Guidance System uses the image of the user via a device’s camera and uses anatomical anatomical data to overlay auscultation points on top of the user’s body on the screen. The software then tracks the hands of the user to ensure the stethoscope is in the correct position.

The Audio Analysis portion of this project receives the sounds collected from the stethoscope and translates them into a spectrogram. A spectrogram is a visual representation of sound displayed in a time vs. frequency graph.

Using the spectrometry, we would superimpose the graph of the sound wave collected by the stethoscope onto other graphs from our database of normal and abnormal sounds. The classification process of this project utilizes Deep Neural Networks.

Deep Learning is a subfield of Artificial Intelligence that is used to sort through unstructured data types such as audio. Deep Neural Networks are multiple layers of algorithms that are meant to recognize underlying relationships and patterns in a given data set using sophisticated math modeling.

First, we record the sounds collected as our input, and using a data set of previously identified sounds we will later provide within the stethoscope. According to the sound features, next the features identified in the spectrogram are extracted using VGG-16 (a neural network) and a random forest classifier is applied to label periods within the total sound accordingly based on the present features. Next the features identified in the spectrogram are extracted using VGG-16 (a neural network) and a random forest classifier is applied to label periods within the total sound accordingly based on the present features.

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Future Work

● Continue to build the internal organ sound database to increase diagnostic accuracy
● Develop AR/VR Guidance App for smartphones
● Improve diagnostic process and user experience by allowing the user to provide a description of their symptoms

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