Name(s)
Pranav D. Atreya

Project Number
S0801

Project Title
Portable Ultrasound Organ Tomography for Early Detection of Tumors and Blockages

Abstract

Objectives/Goals
Certain tests such as mammographies and colonoscopies are recommended for people every few years when they reach a certain age to detect medical conditions before symptoms arise. However the national percentages of people who commit to these tests are far below desired numbers due to inconvenience, cost, and the lack of local medical facilities. The objective of this project is to promote rates of early detection by creating a home-use ultrasound screening system for tumors and other types of deleterious conditions.

Methods/Materials
The system is built with hardware components such as a Raspberry Pi 3, an ultrasound transducer, and associated electrical equipment that together interact with custom developed Image Formation and Image Classification software. These software components were developed with the Python language to be compatible with external hardware. The Image Classification component was built using a Convolutional Neural Network developed with the TensorFlow library and trained on ultrasound images from scans of healthy body organs and organs with tumors, lymph node growth, or cysts present. The final scanning system was tested on models designed to simulate the medical conditions in observation.

Results
Testing was performed first on individual components of the system and ultimately on the final ultrasound diagnostic device. The ultrasound scanner hardware and the Image Formation software were tested on custom-built models that were designed to simulate the physical characteristics of tumors, cysts, and other medical conditions. The device was successful in its ability to perform scans and form a B-Mode ultrasound image from the data collected by the scan. This image was then passed to the ultrasound Image Classification software, which was able to determine the presence of a medical anomaly and classify what type of anomaly was present with 94% training accuracy and 77% test set accuracy.

Conclusions/Discussion
When tested on the models, the final diagnostic system was able to classify the ground truth with good accuracy. The system as a whole is portable and can be used for home-use. Ultimately this system will provide a person with the ability to perform small ultrasound diagnostic scans whenever they deem fit, and the results of the scan can prompt consultation of a doctor, thus improving rates of early detection.

Summary Statement
Built a home-use ultrasound diagnostic device and software to alert the user of suspicious growth for the purpose of improving rates of early detection.

Help Received
The work in this project was completed individually at home. I referenced a variety of sources for research material and used an online ultrasound image database for neural network training.