A Wearable Sensor for Continuous Heart Sound Monitoring

Xu, Olivia (School: Troy High School)
Li, Anthony (School: Troy High School)
Jing, Lillian (School: Troy High School)

Cardiovascular disease is the direct cause of 20% of deaths in the United States, and 32% of deaths worldwide, making it one of the leading causes of death in the world. The continuous monitoring of heart sound can assist in the detection of cardiac abnormalities, evaluation of treatment response, and identification of cardiac complications. This project aims to create a cheap, sensitive, and robust sensor to continuously monitor heart sounds. The main body of the sensor is a 3D-molded silicone chamber which collects and amplifies heart sounds from the chest that are then recorded by a pressure sensor. To increase sensitivity, the pressure sensor was switched for a microphone, and the chamber was filled with water instead of air. Through continuous testing between models, we finalized our sensor design of a water-filled silicone chamber with a microphone placed in a pocket covered with a thin silicone membrane to prevent water damage. Both benchtop and human-subject tests have been performed. Through both tests, the water-filled microphone sensor is confirmed to be more sensitive. The sensor successfully collected heart sounds with high signal quality from human subjects while at rest. The sensor is still able to detect heart sounds while the subject is talking or in motion. But, advanced signal processing is required for a clear reading of the heart sound in these scenarios. Our sensor provides a low cost and sensitive method to continuously record heart sounds, allowing for more accurate and more convenient diagnosis and monitoring of heart conditions.