SMART DOG WEARABLE FOR SEIZURE DETECTION

BACKGROUND

Epileptic seizures, which result from excessive electrical activity in the cerebral cortex of the brain, impact approximately 1 in 130 dogs. Idiopathic epilepsy, where the cause is unknown, severally affects both the quality of life for the dog as well as the owner. Currently, seizures are detected by owners' visual recognition, which is suspected to be only partially accurate or using invasive methods such as EEG monitoring. A prospective paper suggested that it was possible to use non-invasive wearables for seizure detection in dogs [1]. While this concept of health monitoring has yet to be fully realized in animals, parallels can be drawn from technical innovation in human devices. Previous efforts to use machine learning to analyze dog movement from accelerometers attached to the dog found the models were effective at predicting non-seizure behaviors but had low sensitivity in seizure detection. In human medicine, recent studies have found that using multiple types of physiological data improves the accuracy of seizure detection by machine learning models. Creating a reliable non-invasive device that collects multimodal health data for seizure monitoring is likely to improve the quality of life for man and man's best friend.

GOAL

Design and build a non-intrusive dog wearable that collects continuous health data from an epileptic dog.

ACKNOWLEDGMENTS

The success of this project wouldn't have been achieved without the guidance of the ESE instructors as well as help from the makerspace employees.

Oregon State University

Data collection for....

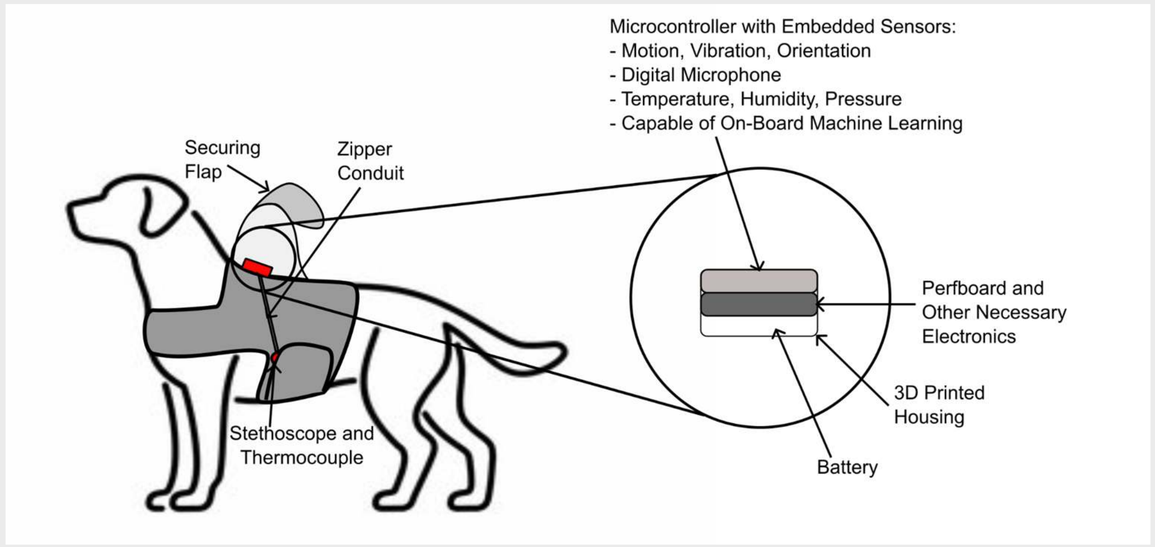

Figure 1: Smart dog wearable design.

DESIGN OVERVIEW

- Design is a wrap harness with sensors located around the dog.
- Four key design elements: The wrap harness, the microcontroller, the silicon stethoscope, and the thermocouple.
- Microcontroller is located on dog's back to stabilize motion sensor and keep out of dog's reach.
- Two stethoscopes and thermocouples located ventrally near the dog's heart for heartbeat detection and body temperature readings.
- Two stethoscopes and thermocouples were added for redundancy to combat the dog moving and the sensor potential being out of place.



Figure 3: Assembled electrical and housing.

FINAL PRODUCT

- The final wrap harness uses a material made of 75% polyester and 25% spandex it allows for easy adjustability while keeping all electronic components secured. (figure 5)
- The chosen microcontroller has a variety of onboard sensors including, accelerometer, gyroscope temperature, humidity and more.
- Important next step is to incorporate a Wi-Fi chip for data transmission and to train the Machine Learning model. Sample implementation can be seen in figure 6
- Additional testing of the microphone and implementation of the machine learning model can further reduce the size of the wearable.

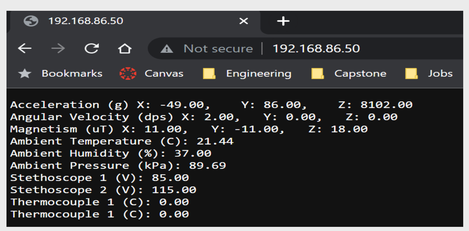

Figure 6: Sensor data accessed via wifi

STETHOSCOPE DESIGN

- To try and capture heart rate data and set our design apart from other wearables on the market, we made an acoustic transducer based on the design from Cotur, Yasin, et al. [2].
- The final design is a solid silicon puck that acts as a transducer for an electret microphone (Figure 2a). The microphone is sandwiched between 2 layers of silicon for added damping.
- The silicon transducer and the thermocouple are housed in a 3D printed case (Figure 2b).
- A low pass filter was included to reduce the signal noise from the microphone. Results from initial testing can be seen in figure 3



Figure 2: a) Silicon transducer with embedded microphone. b) Fully assembled stethoscope and thermocouple unit.

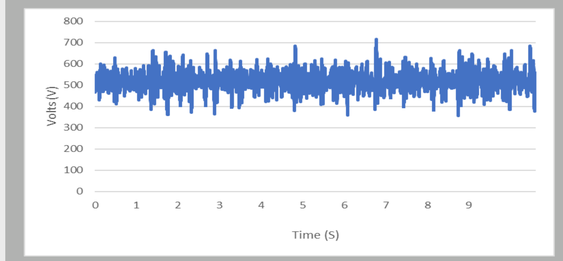

Figure 4: Raw output of stethoscope design



Figure 5: Smart dog wearable on 70lb dog.

soundbendor lab