Smart Cyclist Backpack

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Background/Project Goal

- **PROBLEM**: Roughly 800,000 Americans commute by bicycle every day in the United States, and cyclers comprise up to 0.5 million fatalities in road traffic per year worldwide. There is a gap in the current market for a solution that aims to specifically promote cycler safety and protect them from danger on the road. Seeing the hole in the cyclist commuter market, BrightWay aims to develop a product that is both functional and is able to promote biker safety on the road.
- **GOAL**: To create a smart backpack that promotes safety for everyone on the road. This smart backpack safety system consists of a background collision detection warning system using a camera module , and a drowsiness detection haptic feedback system using a heart rate monitor and an array of haptic sensors.

Progress/Challenges

Progress

- Stress Detection Algorithm -
  - Tpot on SWELL data for efficient algorithm generation
- Trained car recognition algorithm using OpenCV and Cascade Classifier with Python
- Optimized PiCamera camera feed with OpenCV using multiprocessing and image trigger method
- Achieved object detection with LinearSVM (still need to increase accuracy)
- Successfully ran OpenCV/Cascade car detection algorithm on Raspberry Pi with the Raspi camera module
- Began interfacing and developing the cycler danger warning system with obtained haptic sensor array hardware

Challenges

- Originally intended to use Arduino UNO as main developing platform, however ran into issues with Python compatibility and switched to Raspberry Pi 4
- Experienced package compilation issues with OpenCV as well as problems linking library to Python on Raspberry Pi

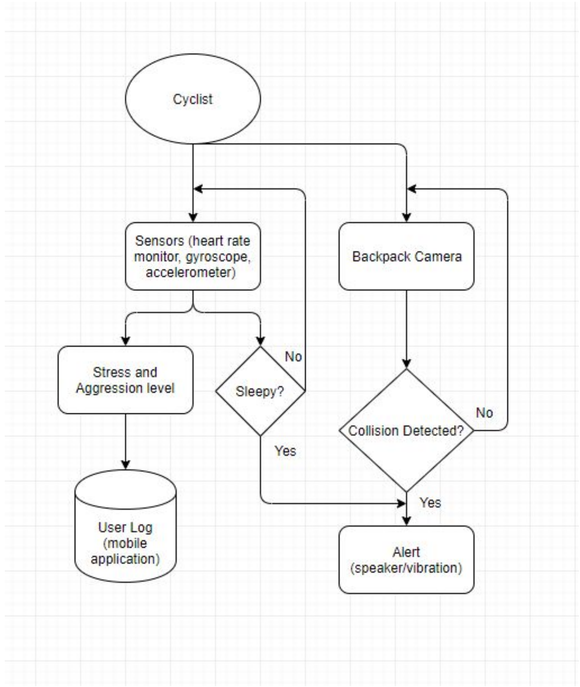

Fig. 1 General device flowchart

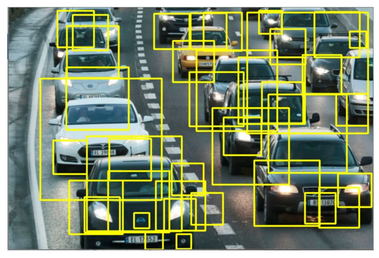

Fig. 2 OpenCV Haar Cascade Classifiers

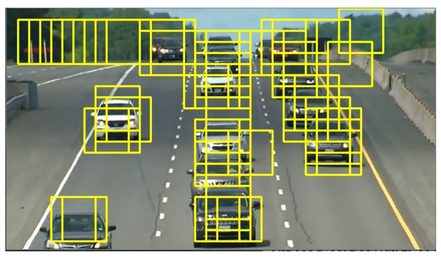

Fig. 3 OpenCV detection with LinearSVM

Next Steps/Future Work

- Stress Detection Algorithm -
  - Apply the obtained model to a different dataset with stress measured from galvanic response from the feet.
  - Use the model on actual data (Zephyr HxM data)
- Hardware assembly and real-world testing
- Collision Detection using OpenCV -
  - Condense duplicate detections into a region of interest
  - Detect speed and distance of region of interest
  - Optimize framerate for OpenCV and PiCamera
- Communication -
  - Asynchronous communication between client (sensors) and server (raspberry pi)
  - Time synchronization
- Finalize Warning System -
  - Finish interfacing with sensor array (accelerometer/gyroscope, vibration motors, alarm speakers)
  - Consolidate sensor array and perform human-testing (vibration strength, speaker decibel rating)
  - Connect sensor array to car detection algorithm and test functionality

References

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