Lab 2: Machine Learning and Facial/ Speech Recognition

Learning Objectives:
This lab is intended to acquaint you with the basics of machine learning, and more advanced techniques such as facial recognition or speech recognition using single-board computers. You will use the camera set up from Lab 1 for facial recognition.

Minimum Parts Required:
A Raspberry Pi and a camera or microphone.

Lab Overview

The goal of this lab is to create the primary user interface for your final project, if needed. You can choose to focus on facial recognition or speech recognition that will enable the user to have a more natural interaction with your project, or both.

Complete the machine learning exercises (Part 1 &2) on your own or with your lab partner(s), and the interface solution (Part 3) with your whole team.

Part 1 – Tool Installation

You can either do these exercises on your RPi or your own computer. The SBCs are certainly capable, but I think it's simplest to just do it on a laptop, so as to not clutter up your OpenCV installation/ SD card. A good starting point is to install Anaconda on your device – you can use Windows, Mac or Linux. For students, it is free for an individual license. You could use other environments, too, if you have a favorite. Anaconda is nice because it includes all the libraries we'll need, including pandas, numpy, seaborn and sklearn. If you go another route, you'll need to install these.

Part 2 – Machine Learning Exercises

You can do as many of these as you choose. I recommend doing them all to get a better understanding of what is going on behind the scenes with the tools that we will use for facial and voice recognition. On canvas you will find instructions on running scripts with Anaconda, and four chapters (from Python Machine Learning for Beginners. Copyright 2020 by AI Publishing) of instructions and exercises with specific command scripts (that you can copy and paste if you don't want to type). Fwiw, I'm claiming educational "fair use" here.
Other resources:
https://scikit-learn.org/stable/supervised_learning.html#supervised-learning
https://towardsdatascience.com/step-by-step-tutorial-of-sci-kit-learn-pipeline-62402d5629b6/
https://www.tutorialspoint.com/scikit_learn/index.htm

Part 3 – Facial or Speech Recognition

Once you feel that you have some foundational knowledge of how machine learning works, move on to creating your main interface tool – facial recognition or speech recognition. Fortunately these are both well-established technologies with lots of libraries, code and tutorials. I've included some below, but you can use others. If you find good ones, please post them to canvas.

Your final task is to get the user interface solution (facial or speech recognition) of your choice up and running on your RPi. You'll need OpenCV running for facial recognition, and you'll need a microphone for speech recognition.

For facial recognition, your goal is to have your system recognize the face of everyone on your team. It should display the team member's name when it identifies them.

Resources and tutorials:
5 Easy & Effective Face Detection Algorithms in Python
How to Train your Raspberry Pi for Facial Recognition - Tom's Hardware
Raspberry Pi Face Recognition - PyImageSearch
Face Recognition With Raspberry Pi and OpenCV – Core Electronics
Real-time Face Detection using Raspberry Pi – Connections and Code
And if you got MediaPipe running in Lab 1, there's a Face Detection solution there too.

For speech recognition, your goal is to have your system understand and be able to respond to key words and phrases relevant to your drink delivery system, e.g., "sit", "roll over", "come", "fetch".
Offline Speech Recognition on Raspberry Pi 4 with Respeaker
Python Edge Speech Recognition with Voice2JSON
Speech Recognition on Raspberry Pi for Voice Controlled Home Automation

Once your facial recognition system can identify everyone on your team, or your speech recognition can respond to pet commands, obtain a signature below.
3)

Signoff

I have witnessed Dom's Team 's facial recognition or speech recognition system.

Witness _____ Date 1/23/2026