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ECE 4580

Digital Image Processing

Final Project Proposal

Hand Gesture Recognition using Convolutional Neural Network

Problem

It is a sad reality that some people have the misfortune of experiencing disabilities that inhibit basic functions such as communication and expression. These issues have been amplified greatly this year with the pandemic lockdowns forcing remote work. While doctors are busy finding medical solutions, we as engineers are responsible for using modern technologies to facilitate overcoming these problems.

Hand gestures have been used as a method of communicating for generations, enabling the transfer of information without the need for voice. Given how technology has integrated itself in our lifestyle, it could prove to be useful that our machines can also interpret these hand signals as a person would. By creating methods and strategies that allow everyone to communicate efficiently, the spread of ideas will increase, ultimately benefiting humanity as a whole.

Approach

For my final project, I plan on creating a program that will take input images of hand gestures and extract the appropriate meaning. For the scope of the project, I will be using the fingers to count digits along with 'Yes' and 'No' expressions with the thumbs. More gestures can be added in the future, with the hopes of creating a full sign language interpreter, however this will not be part of the project at this time.

Using image processing techniques discussed throughout the semester, I will take the input images and apply the necessary filters to efficiently extract a binary image of only the hand. Blurring, background deletion, edge detection, and other fine-tuning strategies will be used to accomplish a clean dataset.

The images will then be used in a convolutional neural network and the model will be trained appropriately. Although there almost certainly are datasets of images already available, I plan on creating my own image dataset for the training. Once trained, I will test my model with the public datasets to verify the validity.

Expected Outcome

At the end of the project I will have a trained model that can accurately detect different hand signals and display the intended result. The program will allow you to input test images or take a picture with a webcam to test different images. If my computer allows it, I will attempt live hand detection with a webcam feed, but it depends on how resource intensive it would be (my laptop is not the newest). The

program will be modularly structured allowing different gestures to be added and trained efficiently. The trained model will be able to be used in many different applications requiring specific hand gestures.

References:

Robust Hand Detection and Classification

https://ieeexplore.ieee.org/abstract/document/8014893

Real-Time Gesture Recognition

https://www.hindawi.com/journals/tswj/2014/267872/

Convolutional Neural Networks in MATLAB

https://www.mathworks.com/help/deeplearning/ug/setting-up-parameters-and-training-of-a-convnet.html

Fast Hand and Finger Detection Algorithm

https://www.sciencedirect.com/science/article/abs/pii/S0141938217301622