Ira A. Fulton Schools of Engineering
Arizona State University

CSE 535: Mobile Computing

SmartHome Gesture Control Application: Part 2

Purpose

Gesture-based SmartHome devices have the ability to increase convenience, but also create more accessible SmartHome devices for the elderly and those with disabilities. In this project, you will develop an application service that will control SmartHome devices with gestures, and then develop a RESTful application service for classifying the SmartHome gestures. This project provides hands-on experience developing a mobile application and provides an excellent opportunity to gain further exposure to topics and applications in the areas of mobile computing and machine learning.

Description

You will work to develop a python application for classifying SmartHome gestures. You will gain hands-on experience in training and testing a CNN model for hand gestures, and applying pre-trained machine learning model usage for classification.
To complete Part 2 of this project, you will use the practice gesture videos generated in project Part 1 and test gesture videos provided in the test.zip in the instructions and the source code provided. This part of the project is auto-graded. The overall project accounts for 40% of your grade.

Objectives

At the completion of this individual project, learners should be able to:

- Develop a python application that classifies specific gestures
- Apply pre-trained machine learning model usage for classification
- Train and test a CNN model

Technology Requirements

- TensorFlow
- Python 3.6.9
- OpenCV for Python
- Keras

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Directions

Functionality of the application

Task 1: Generate the penultimate layer for the training videos.

Steps to generate the penultimate layer for the training set:

1. Extract the middle frames of all the training gesture videos.
2. For each gesture video, you will have one frame extract the hand shape feature by calling the get_Intsance() method of the HandShapeFeatureExtractor class. (HandShapeFeatureExtractor class uses CNN model that is trained for alphabet gestures)
3. For each gesture, extract the feature vector.
4. Feature vectors of all the gestures is the penultimate layer of the training set.

Task 2: Generate the penultimate layer for the test videos

Follow the steps for Task 1 to get the penultimate layer of the test dataset.

Task 3: Gesture recognition of the test dataset.

Steps:

1. Apply cosine similarity between the vector of the gesture video and the penultimate layer of the training set. Corresponding gesture of the training set vector with minimum cosine difference is the recognition of the gesture.
2. Save the gesture number to the results.csv
3. Recognize the gestures for all the test dataset videos and save the results to the results.csv file.

Gesture Name	Output Label
0	0
1	1
2	2
3	3
4	4
5	5
6	6

7	7
8	8
9	9
Decrease Fan Speed	10
FanOn	11
FanOff	12
Increase Fan Speed	13
LightOff	14
LightOn	15
SetThermo	16

Submission Directions

You will need to submit the following project deliverables:

1. Save the python application as main.py
2. Save the training gesture videos under “traindata” folder.
3. README file
4. Save the results (recognized gestures) to results.csv file.
5. A report evaluating your application that discusses the following points:
    a. An explanation of how you approached the given problem
    b. Solution for the problem

The five deliverables above are to be submitted in a single zip file. Please note that the zip file should only contain these deliverables and nothing else within a separate folder. The Python file that contains the Flask server code should be outside all of the other folders. Please follow the folder hierarchy listed below for your submission:

Submission Project Folder

|---- traindata

|--- main.py

|-- cnn.h5

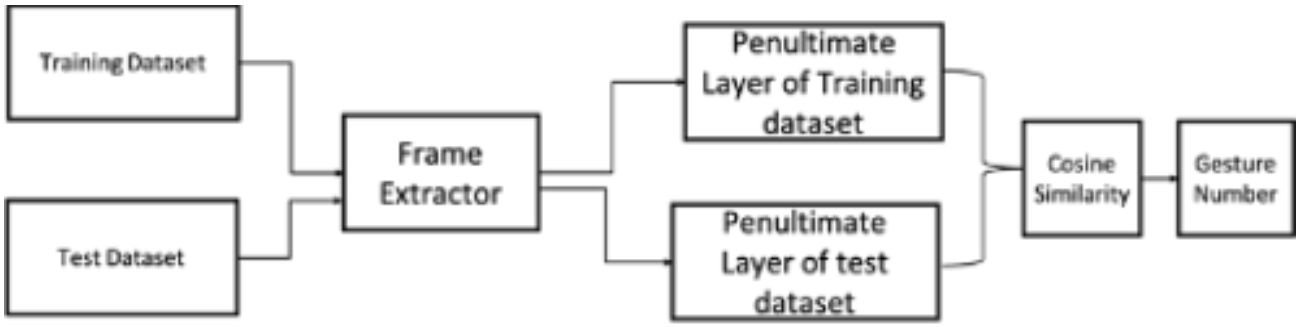
|-- handshape_feature_extractor.py

|-- any additional files you may create

|---- README.md

|---- Report.pdf

The name of the zip file that is submitted should be “CSE535Project2_(full name).zip”. Workflow for the project:



Evaluation

Learners will be evaluated based on the following criteria:

- Compilation errors: 0
- Application Compiles: 85
- Total score: 85+ Accuracy Score
- Accuracy score is computed by comparing Gesture true labels and user output labels.