Emotion Analytics with Face Recognition and Twitter

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Abstract

As social media is getting more and more popular, humans express their emotions, thoughts, and feelings via text, emojis, like/dislikes, and selfie on social media. It is important to understand the true meaning behind these data populated by social media users. For our group project, we want to create an IoT hardware-based system which will have the ability to the emotion of a person from their face image and emotion of that person from their social media account (e.g. analysis the semantics of the tweets sent by that person). Also, we want to identify a person from the face image.

Introduction

In this project we This project can be divided into three parts: emotion analytics from face image, face recognition with name mapping, and sentiment analysis from tweets.

Literature Review / Background Study

Emotion Analytics From Face Image

For emotion analytics from a face image, the issue we will need to solve here is how to teach a computer to recognize a person's mood form their face image. Humans have the ability to taking in non-verbal cues from others' facial emotions, in order to do the same thing with a computer instead of having a human to interpret the facial emotions, we will need to train a machine learning model to do so. During the model training, several facial parameters will be extracted from a facial image and will be used to train several generalized and specialized neural networks. Based on the initial testing, the best performing generalized/specialized neural networks will be recruit into decision-making committees which will then form an integrated committee neural network system. After this step, the integrated committee neural network will then be evaluated use training data.

Face recognition with name mapping

For face recognition with name mapping, the issue we will need to solve here is how to teach a computer to identify the image A belongs to user A instead of user B. In order to identify a person, one generally looks at faces, which differentiate one person from others. In order to accomplish this task without having a human being to check manually, face recognition is used to search for other images with matching features extracted from face images. Originally, this technique is used to help law enforcement to identify terrorists, criminals, and other types of persons that are wanted. As smartphones are getting more powerful and having higher resolution of the camera, this technique also got adopts in several smartphones as a way to perform authentication. The accuracy of face recognition can be affected by a change in lighting, the person's hairstyle, age, facial expression, and facial details (glasses/no glasses), and low resolution of the image. Therefore, when training a face recognition system, it is important to train the model with different combines of features among various subjects.

As features extracted from face images can contain high dimensionality, it will take a longer time and more space needed for the face recognition model to be trained with the raw data. Therefore, a

common practice is to perform dimensionality reduction with the raw data then perform modeling on the reduced dimension data. PCA and LDA are two popular approaches to perform this task.

PCA is an unsupervised method and the criterion of PCA is to maximize the variance. PCA approach includes two phases: training and classification. During the training phase, an eigenspace is established from the training dataset using the principal component analysis method. Then the training dataset is mapped onto the eigenspace. During the classification phase, the input dataset is projected onto the same eigenspace and classified by an appropriate process.

Unlike the PCA which encodes the information in an orthogonal linear space, the LDA encode discriminatory information in a linear separable space of which bases are not necessarily orthogonal. LDA is a supervised method the criterion of LDA is to maximize the separation between different classes.

When only using one dimensionality reduction technique, the face recognition system may not produce the best accuracy. According to the No Free Lunch Theorem, there is no algorithm that is always the most accurate. Therefore, researches are continuously trying out different

approaches for dimensionality reduction in order to improve the accuracy of the face recognition system. One of the popular methods is using a multi-classifier system by combining the PCA and LDA at score or decision level. The idea behind the multi-classifier system to generate a group of base-learners which when combined has higher accuracy compared to individual base-learners.

Sentiment analysis from tweets

For sentiment analysis from tweets, the issue we will need to solve here is how to teach a computer to interpret the mood behind a piece of writing. Sentiment analysis is the process of computationally to determine whether a piece of writing is positive, negative, or neutral. It is also commonly known as opinion mining where the system will derive the opinion or attitude of a speaker from their script. This technology has important roles in business, politics, and public actions.

For business purpose, the marking field companies use this technology to develop their strategies in order to understand customers' feeling and thoughts towards a particular product. Also, they used it to understand how people respond to their campaigns and why customers are buying and not buying the products.

For politics purpose, the political field uses this technology to keep track of the political views and detect consistency/inconsistency between statements and corresponding actions at government level. Also, this technology can be used to predict the election results by analyzing all of the messages sent from citizens.

For public actions purpose, this technology is used to monitor and analyze social phenomena such as finding out the potentially dangerous situation and determine the general mood of the blogosphere.

Methodology

Emotion Analytics From Face Image

First we are using python and opencv library for identifying the face, emotion, gender and location of the face in the image. For emotion analytics for face image, we created a CNN model. In order, for a model to take input of image, so we will need to read the image into numpy array via method load_image_file. The the program will get the input image to run it through the model to detect the emotions, gender and location of the face. For emotion analytics for face image, we created a CNN model. The test accuracy for gender classification is 96%, and for emotion classification accuracy is 66%. We are using a pre-trained model which is trained on data set fer2013/IMDB.

Face recognition with name mapping

For face recognition with name mapping, we are using python package face_recognition to perform this task. This package is created with deep learning and the model it uses contains an accuracy of 99.38% on the

Labeled Faces in the Wild benchmark. For simplicity, we are going to write a program to detect the face of Obama. In order to do so, we will need to load a couple of images of Obama for training the model. As there is no way for a model to take input of image, so I will need to read the image into numpy array via method load_image_file. To make the training fast, then we will need to encode the input that we just read from the raw image which then got stored in numpy array. With encoding completed, then we group the training data all into an array for labeling. At this moment, the training is completed. Then the program will get an input path from the user for an input image. The program will then check if the content of the image is Obama. This is done with method compare_faces.

Sentiment analysis from tweets

For sentiment analysis from tweets, we had to create a Twitter account first then request a developer account from Twitter. With developer account created, we can then use python package tweepy to connect to Twitter via OAuth. For using OAuth with Twitter, we will need to provide consumer key, consumer secret, access key, and access secret. Once we established a connection with Twitter via OAuth, we then ask a twitter screen name from input prompt for the user then call the method

user_timeline with the input value. This method has a limit of using a max of 200 most recent tweets from the user. Then we wrote a loop to extract the tweet message from the 200 tweets. At this moment, we have 200 tweets' text stored in an array. Before wel run sentiment analysis, we will need to remove the noise characters from the tweet message. Once we got the cleaned tweet messages back to the array, we then use python package TextBlob to compute the polarity for the sentiment. Then we use collections package in python to show the distribution of positive, negative, and neutral tweets for the given screen name that the user provided.

Circuit Diagram

We are not building any circuit diagram for this project. We will use Raspberry Pi for all three parts of the project. All of the three parts are more software based instead of hardware based. The only hardware we used in this project is Raspberry Pi. For image input, we will use images captured from other computers' webcams. By doing so, we don't need to buy a webcam for Raspberry Pi. This programs should also be able to run on other machines/platforms as well.

Results and Evaluation

Emotion Analytics From Face Image

So, for Emotion analysis from a Image, the model is able to predict the location of face in the image and distinguish the emotions and gender almost all of the time. The accuracy of gender identification is 97% and of emotion identification is 66%.

Face recognition with name mapping

We think we got all of the required features working. It will be nice if we have more images for input with different environments. The model is able to predict the right name from the trained model and reject the imposter image as they are faces from two different person.

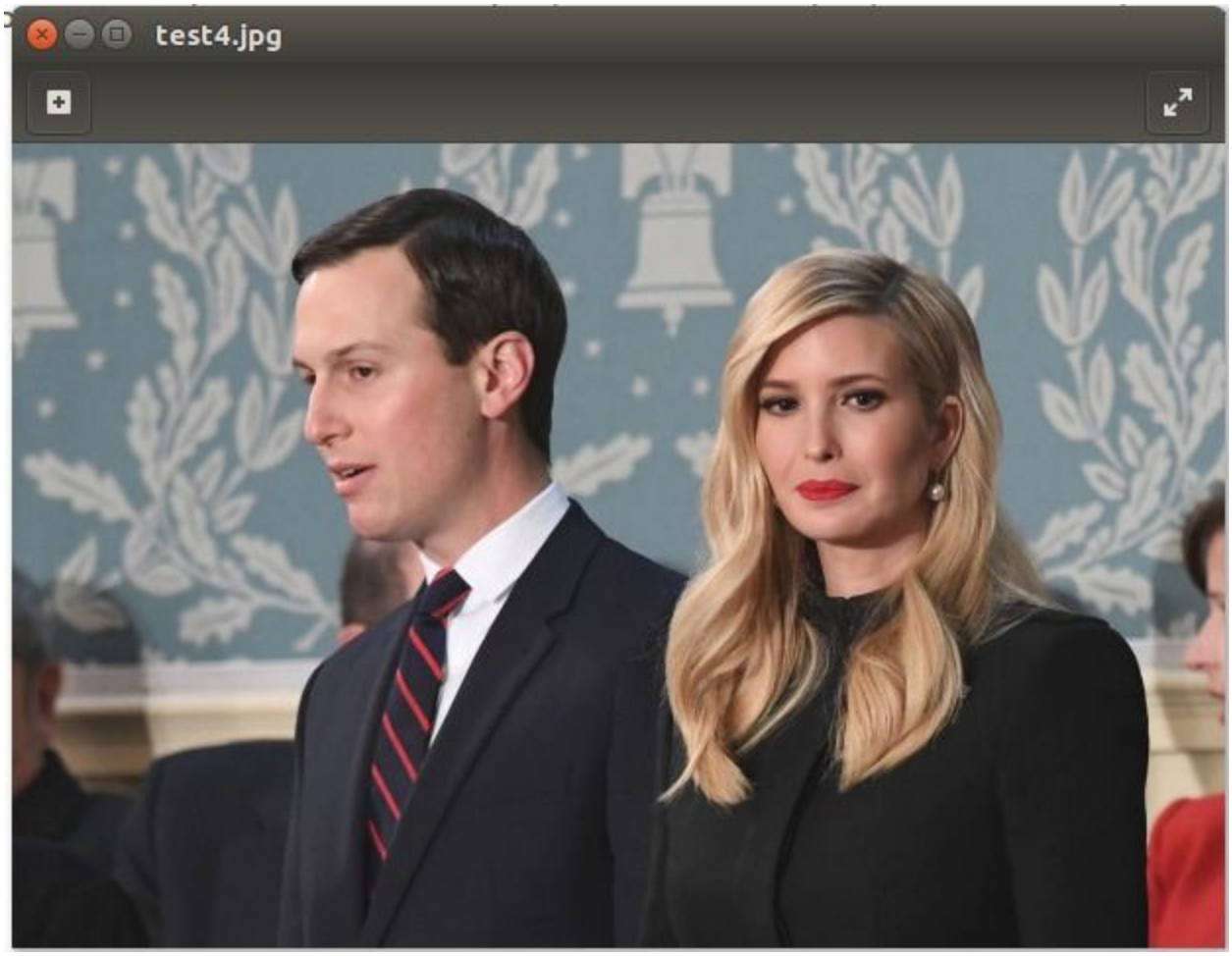
Sentiment analysis from tweets

We think we got all of the required features working for this one as well. However, Twitter API does have a limit on how many data we can pull back each time and how many times we can make the API call within 5 minutes. With this disadvantage, we will not be able to run our program over and over within the API's limited rate/time interval.

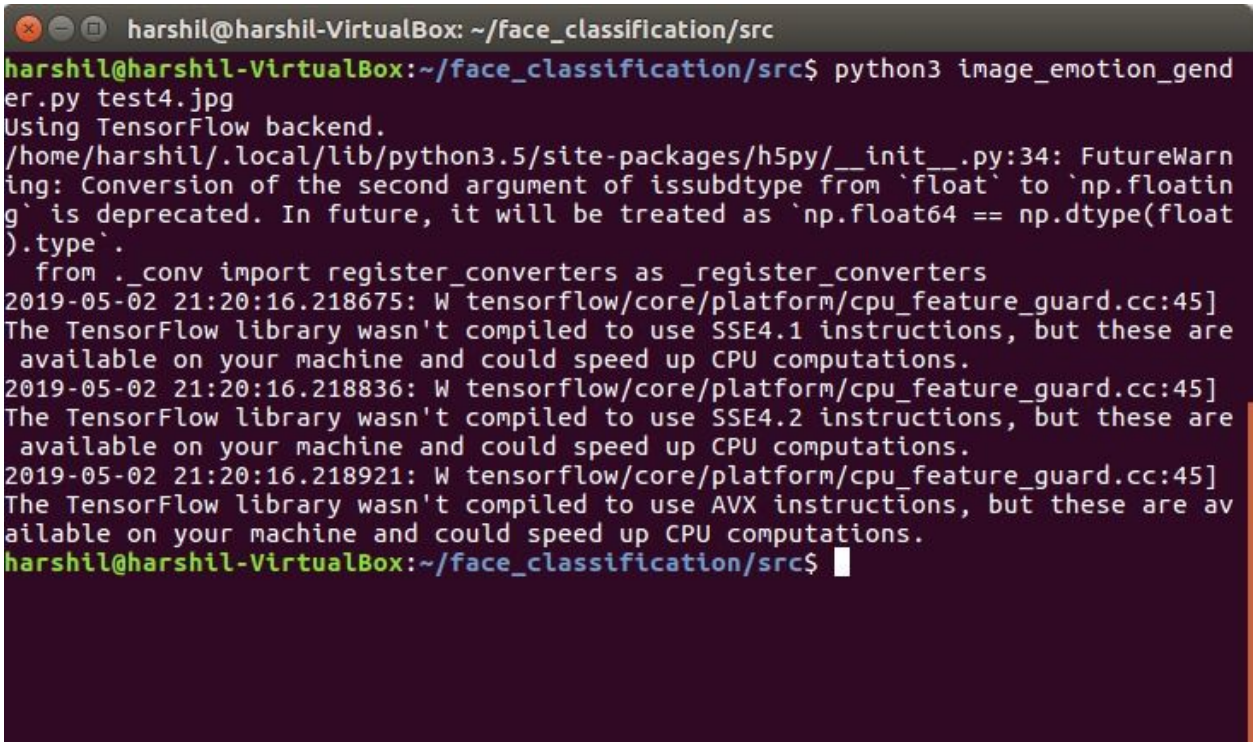
Project Review and Screens

Emotion Analytics From Face Image

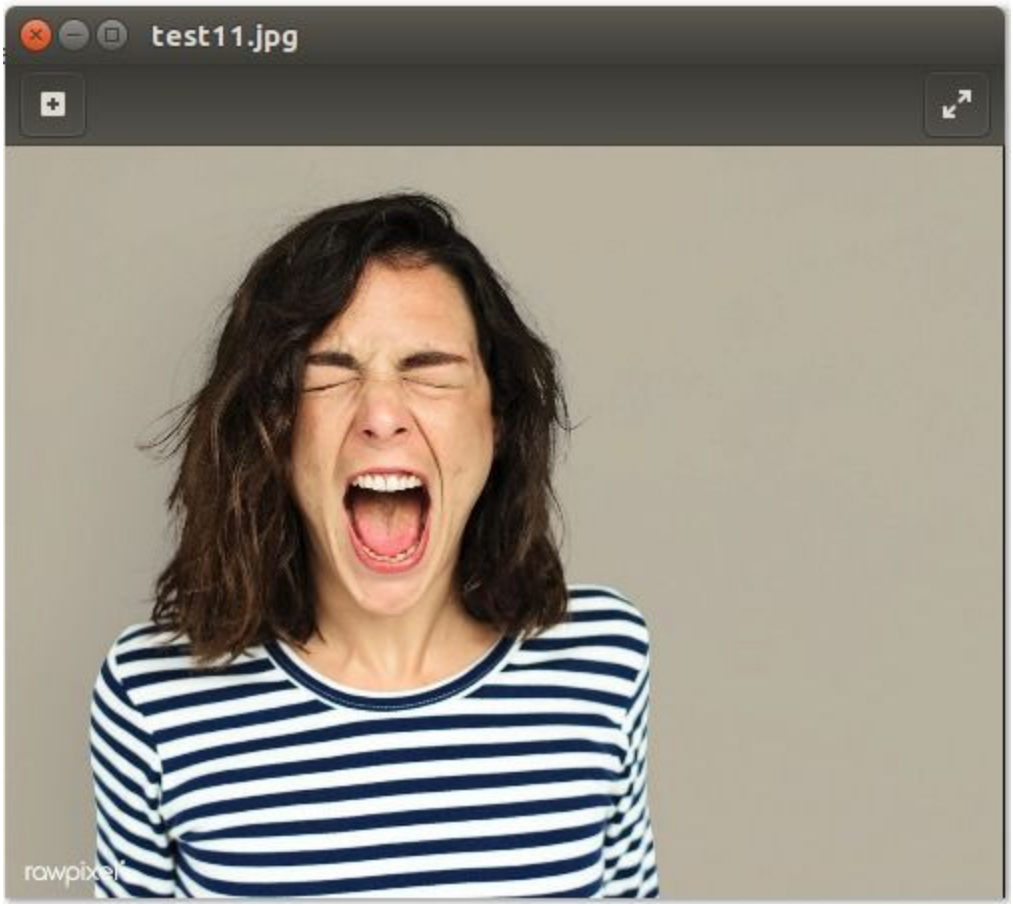
First we are using below image to run through the model. So in the image we can see two face; a man and a woman. The expressions on the man's face are neutral and on the woman are of sadness(Kind of). So, we expect the model to give the same result.



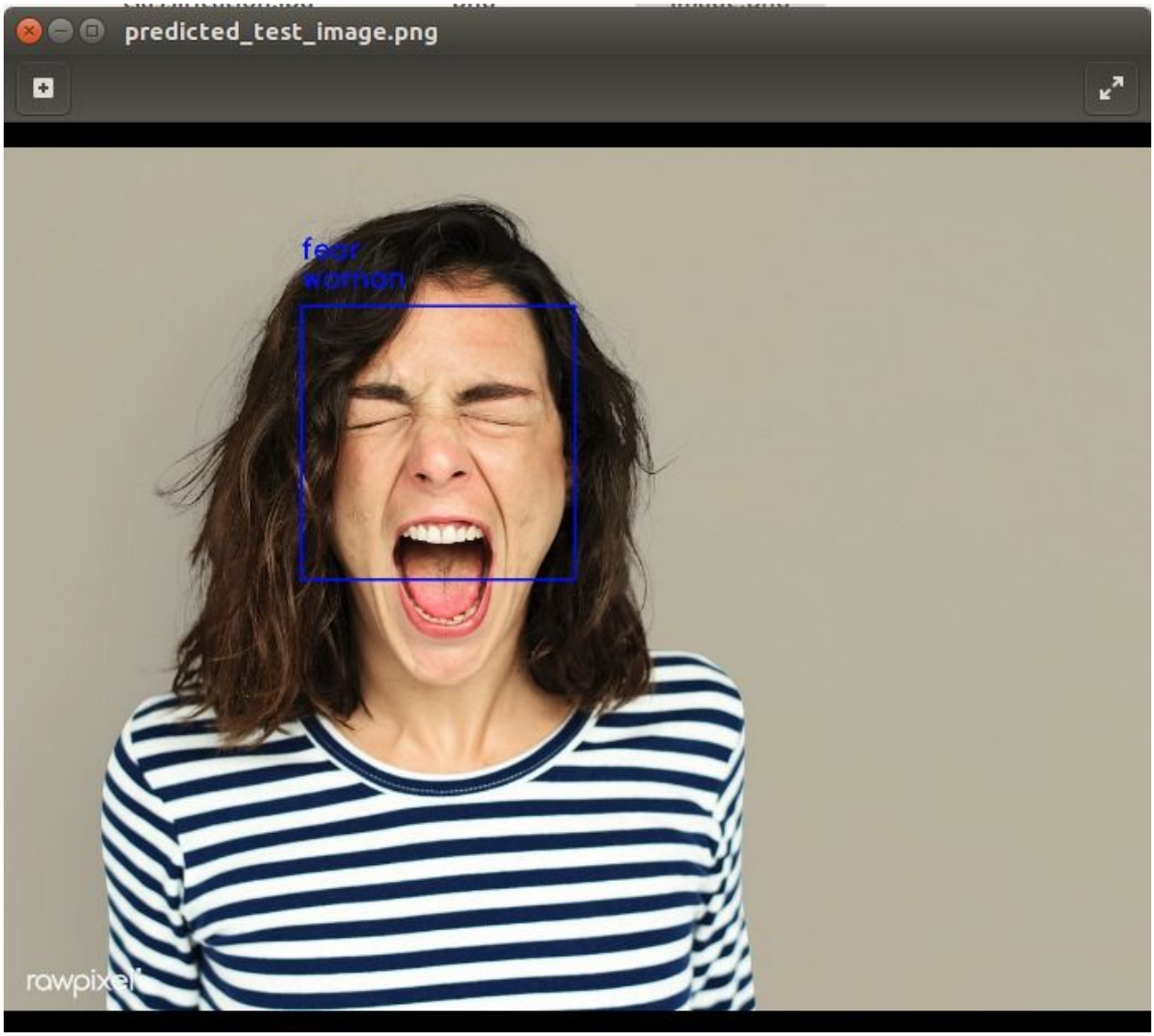
This is the code to input the images to the model for emotional analysis of the faces in the image.



So, we can see that model gives the exact result of the expressions of emotions in the image; of man a neutral emotion and of woman sad. But the model makes errors in identifying the gender of the man in this image. This is another example of the analysis. In this image we can see that a woman is furious or in fear so we can expect the same result.


test11.jpg
rawpixel

Result:

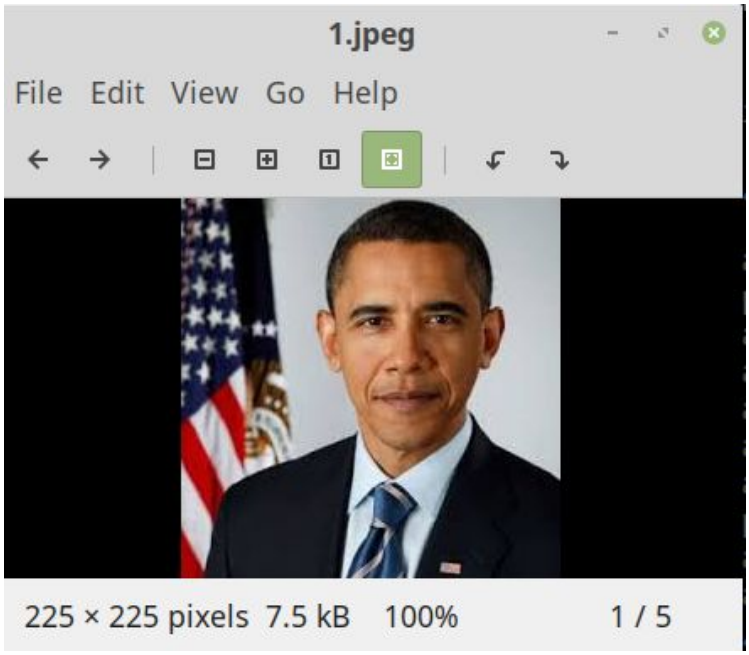


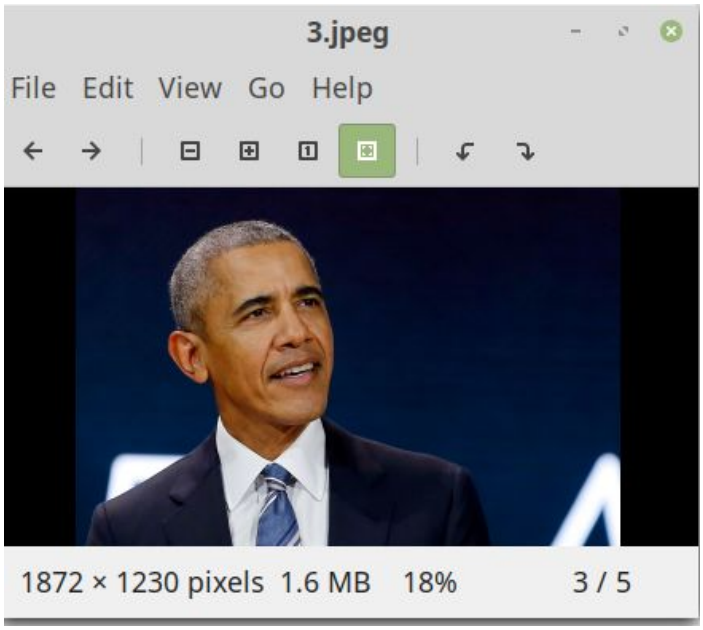
So, we can see the expected results; a woman who is in fear or furious.

For the Gender model we are getting an accuracy of 96%, and for emotion model we are getting an accuracy of 66%.

Face recognition with name mapping

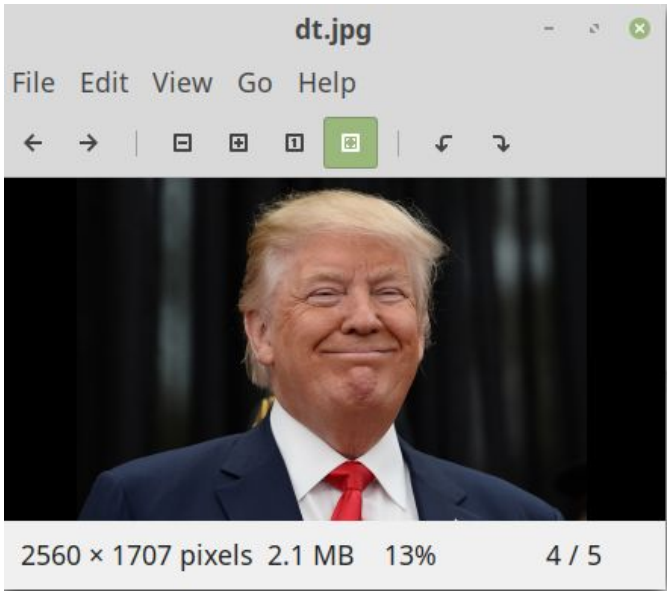
In order to recognize a person's face a machine learning model, we will need some input images for training purpose. For simplicity, we will use the following three images for training purpose:





The model for performing face recognition will be done with only these three images. In reality, it is better to have a variety of images of a same person under different environments.

To show this model is working, we will then using the following two images as testing set in order to verify the model is working:



obama.jpg is one of two inputs we will be using for testing the model. The model should be able to detect that is a face of Obama:

```
(iot_project) yong@workstation:~/Desktop/GitHome/IOT/Project$ python fr.py obama.jpg
Is the input face a picture of Obama? True
```

dt.jpg is another input that we will be using for testing the model. As the model is trained with only images of Obama, so the model will be able to determine this image is not Obama as they have different face parameters extracted from the images:

```
(iot_project) yong@workstation:~/Desktop/GitHome/IOT/Project$ python fr.py dt.jpg
Is the input face a picture of Obama? False
```

Sentiment analysis from tweets

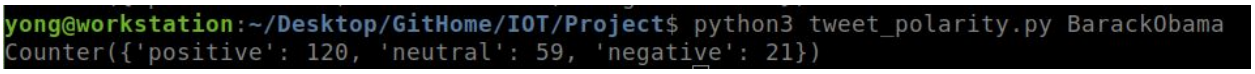
This is the polarity distribution for Twitter user with screen name brycesub for the most recent 200 tweets. As you can see, 106 of the tweets are neutral, 59 of the tweets are positive, and 34 of the tweets are negative.

```
yong@workstation:~/Desktop/GitHome/IOT/Project$ python3 tweet_polarity.py brycesub
Counter({'neutral': 106, 'positive': 59, 'negative': 34})
```

This is the polarity distribution for Twitter user with screen name realDonaldTrump for the most recent 200 tweets. As you can see, 76 of the tweets are neutral, 77 of the tweets are positive, and 46 of the tweets are negative.

```
yong@workstation:~/Desktop/GitHome/IOT/Project$ python3 tweet_polarity.py realDonaldTrump
Counter({'positive': 77, 'neutral': 76, 'negative': 46})
```

This is the polarity distribution for Twitter user with screen name DarackObama for the most recent 200 tweets. As you can see, 59 of the tweets are neutral, 120 of the tweets are positive, and 21 of the tweets are negative.



Conclusion and Future Work

We finished all of the required features given by Sayed. It is a pretty interesting project and we would like to continue work on this project during our spare time. For future work, we want to integrate all three parts together into one system and provide a more user-friendly interface for users to use. Also, we will need to improve the accuracy of the model for determining the mood of a person from images.

Project Repository

https://github.com/MonkeyCanCode/IOT_Project

References

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2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
3. Yang, J., Yu, H., & Kunz, W. (2000, December). An efficient LDA algorithm for face recognition. In Proceedings of the International Conference on Automation, Robotics, and Computer Vision (ICARCV 2000) (pp. 34-47).