Asynchronous Facial Emotion Recognition (FER) of the Faculty Members of College of Engineering and Computer

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Abstract

Nowadays, more and more people are highly dependent on technology, most especially with the proliferation of smart phones. Hence, more and more data are being produced and stored like images and videos. Hence, in the advent of these data, the challenges to utilize these images are an interesting research topic with the aid of deep learning algorithms and frameworks. The objective of the study is to identify emotion thru facial images using CNN (Convolutional Neural Network) and Haar using Spyder-Phython an openCV platform. By implementing deep learning algorithm the proponents had asynchronously classified the emotion of the faculty of the College of Engineering and Computer Studies, using the six types of emotions, namely; happy, sad, angry, surprise, fear and the neutral emotions that can be used to link on the behavioral pattern of an instructor that is an essential endeavor that can be used in continuous studies on the effect of emotions emulated by teachers while teaching on the ability of the students to learn more.

Keywords: emotion, Facial image , Spyder-Phython, openCV,Deep learning Algorithms,frameworks

I. INTRODUCTION

In today's advent of technology, humans use a lot of non-verbal cues, such as facial expressions, gesture, body language and tone of voice, to communicate their emotions. Hence, the study of Jeong et al. (2018), suggests that the recognition of human emotion from images is one of the many important topics in research towards affective computing. Deep learning algorithms are commonly used to measure unfiltered and unbiased facial expressions of emotion, in images using just a standard webcam. Face emotion recognition technology first identifies a human face in real time in an image. Furthermore, computer vision algorithms identify key landmarks on the face – for example, the corners of eyebrows, the tip of the nose, or the corners of the mouth. Also, deep learning algorithms in much research analyze pixels in the face image regions to classify facial expressions and combine these facial expressions and then mapped to emotions. Facial Emotion Recognition (FER) is an incredibly important aspect of deep learning and computer vision and essentially part as a tool to identify the emotions of the human behaviors if they were happy, sad, mad, confused etc. Moreover, FER can involve in analysis the human expression in Video, Audio, and Biosensor like human heart rate. In fact, according to Gao, et al. (2017), face recognition is a method of identifying or verifying the identity of an individual using their face. Face recognition systems can be used to identify people in photos, video, or in real-time. Moreover, face recognition systems use computer algorithms to choose specific, distinguishable details about a person's face. These details, such as distance between the eyes or shape of the chin, are then converted into a mathematical representation and compared to data on other faces collected in a face recognition database (Prospero et.al, 2018). The data about a particular face is often called a face template and is distinct from a photograph because it is designed to only include certain details that can be used to distinguish one face from another.

Related Works

Machine learning used in various classification and prediction application helps in the utilization of data for computing purposes. For example, traffic prediction relies to estimate the regions where congestion can be found based on daily experience. Also, machine learning in video surveillance system nowadays makes it possible to detect crime before they happen. They track unusual behavior of people like standing

motionless for a long time, stumbling, or napping on benches etc. The system can thus give an alert to human attendants, which can ultimately help to avoid mishaps. And when such activities are reported and counted to be true, they help to improve the surveillance services. This happens with machine learning doing its job at the backend. Machine learning in spam and malware filtering powered them to ascertain that these spam filters are continuously updated. When rule-based spam filtering is done, it fails to track the latest tricks adopted by spammers. Multi-Layer perceptron and decision tree induction are some of the spam filtering techniques that are powered by deep learning algorithms.

In online fraud detection, machine learning is proving its potential to make cyberspace a secure place by tracking monetary frauds online. For example: Paypal is using ML for protection against money laundering. The company uses a set of tools that helps them to compare millions of transactions taking place and distinguish between legitimate or illegitimate transactions taking place between the buyers and sellers.

Moreover, one of the most famous of application of machine learning is that on the social media platforms. One will later realize that the following are using machine learning. The following are examples in which machine learning is applied, People You May Know: Machine learning works on a simple concept of understanding with experiences. Facebook continuously notices the friends that you connect with, the profiles that you visit very often, your interests, workplace, or a group that you share with someone etc. Based on continuous learning, a list of Facebook users is suggested that you can become friends with. Face Recognition: You upload a picture of you with a friend and Facebook instantly recognizes that friend. Facebook checks the poses and projections in the picture, notice the unique features, and then match them with the people in your friend list. The entire process at the backend is complicated and takes care of the precision factor but seems to be a simple application of ML at the front end. Similar Pins: Machine learning is the core element of Computer Vision, which is a technique to extract useful information from images and videos. Pinterest uses computer vision to identify the objects (or pins) in the images and recommend similar pins accordingly.

Eventually, you will realize that there are lot numerous machine learning applications available for us in the future. You should just explore different techniques already given to us by experts and develop more from them.

Objectives of the Study

The general objective of the project is to design and develop a Facial Emotion Recogtion (FER) asynchronously to detect the facial emotion of the College of Engineering and Computer Studies faculty using deep learning algorithm. The specific objectives of the project, are to design a Facial Emotion Recognition to the facial images captured in real-time using Spyder CNN in Opencv to detect the emotion classify the emotion of the faculty of the College of Engineering and Computer Studies, using the six emotions, such as; happy, sad, angry, fear, surprise and neutral; To test the accuracy of the system by using the manual testing method.

II. METHODOLOGY

Agile method generally promotes a well-ordered project management process the encourages common review and modification.

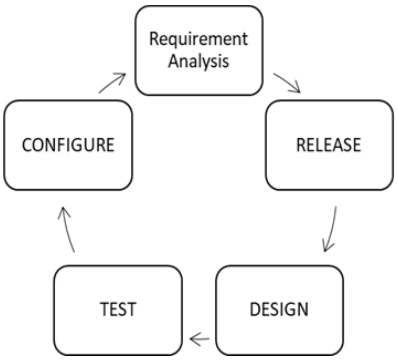

Figure 1. Software Methodology

Using agile methodology for computer application development, the application development process becomes quicker, easier, and more efficient. The requirements analysis began during the inception of the project topic

and client deliberation to gauge and measure the required components of the system based on the needs of the client. After the goals of the proposed system were clear with the guidance of the client, the researchers moved on to the next stage of development. After identifying the requirements for the system, the planning phase occurred to determine how best to tackle the needs of the client. The planning stage included analysis and assumption of time, financial, and personnel costs. This is critical to assess the feasibility and measure the success of the system. Apart from designing the application's parameters, the researchers also underwent the actual design of the application. The project's components, including user interface and features are meant to fulfill the requirements planned during the requirements analysis stage. The design of the system should adapt to the computer platform that the researchers propose to be used. Development is the actual creation of the system, in this instance, in the form of programming. The researchers utilized Android Studio to build the system with the Java programming language. Currently, the researchers are in the developmental stages. The system currently features only a log-in module, with the other modules soon to follow.

The testing of the application would be the final phase of the study and it would be the measuring stick for the success of the system. Additionally, the researchers would employ a post-development survey for users and administrators of the application to gauge how effective the system is in terms of functionality, ease-of-use, and maintainability.

System architecture

This is the system architecture of the capstone project which is the foundation of the layout of its hardware and networking topology that are used in the development of the system.

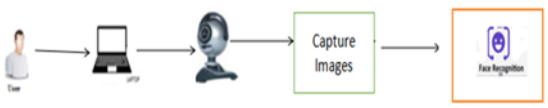

Figure 2. System Architecture

The network topology defines the physical and logical layout of the network that the application uses. Figure 2 depicts an example wherein the user needs the webcam to detect the captured image to facial emotion. The administration, which is the professor of the COECS faculty member, can access the data of the emotion, system flowchart.

Code Appendices

Numpy Array

A Numpy Array is a library of python to support the large multidimensional array and matrices, it also has big collection of high-level function to operation of the arrays.

```
import numpy as np
import matplotlib.pyplot as plt


# Load a small section of the image.
image = data.coins()[0:95, 70:370]


fig, axes = plt.subplots(ncols=2, nrows=3,
                         figsize=(8, 4))
ax0, ax1, ax2, ax3, ax4, ax5  = axes.flat
ax0.imshow(image, cmap=plt.cm.gray)
ax0.set_title('Original', fontsize=24)
ax0.axis('off')
```

Figure 3. First Code

```
import numpy as np

from keras.models import Sequential
from keras.layers import Dense, Dropout, Flatten
from keras.layers import Conv2D, MaxPooling2D
from keras.losses import categorical_crossentropy
from keras.optimizers import Adam
from keras.utils import np_utils


df=pd.read_csv('train.csv')
```

Figure 4. Emotion_Recognition.py

Emotion_Recognition.py is used member the different facial expression based on kaggle. Kaggle is have 28,000 training set to recognition the emotion. In this one We used import pandas to read the train.csv.

```
from keras.models import Sequential
from keras.layers import Dense, Dropout, Flatten
from keras.layers import Conv2D, MaxPooling2D
from keras.losses import categorical_crossentropy
from keras.optimizers import Adam
from keras.utils import np_utils
```

Figure 5. Emotion_Recognition.py

Keras model is an image processing kernel of a convolution matrix or masks which can be used for blurring, sharpening, embossing, edge detection and more doing convolution between a kernel and images.

```
df=pd.read_csv('train.csv')

X_train,train_y,X_test,test_y=[],[],[],[]

for index, row in df.iterrows():
    val=row['pixels'].split(" ")
    try:
        if 'Training' in row['Usage']:
            X_train.append(np.array(val,'float32'))
            train_y.append(row['emotion'])
        elif 'PublicTest' in row['Usage']:
            X_test.append(np.array(val,'float32'))
            test_y.append(row['emotion'])
    except:
        print(f"error occured at index :{index} and row:{row}")


num_features = 64
num_labels = 7
batch_size = 64
epochs = 30
width, height = 48, 48
```

Train.csv is a have two column emotion and pixel. The emotion columns contain numeric code ranging zero to six emotions in the image. Pixel is a column contains string surrounded images.

```
#Training the model
model.fit(X_train, train_y,
          batch_size=batch_size,
          epochs=epochs,
          verbose=1,
          validation_data=(X_test, test_y
          shuffle=True)


#Saving the  model to  use it later on
fer_json = model.to_json()
with open("fer.json", "w") as json_file:
    json_file.write(fer_json)
model.save_weights("fer.h5")
```

Figure 7. Emotion_Recognition.py

Fer_json is the train model. Video_test.py Video_test.py is a used to recognize the facial pattern of the face, based on the emotion_recogntion.py to match the same emotion. Then match is to display the facial expression to recognized.

```
import cv2
import numpy as np
from keras.models import model_from_json
from keras.preprocessing import image

#Load model
model = model_from_json(open("fer.json", "r").read())
#Load weights
model.load_weights('fer.h5')


face_haar_cascade = cv2.CascadeClassifier('haarcascade_frontalface_default.xml')


cap=cv2.VideoCapture(0)

while True:
    ret,test_img=cap.read()# captures frame and returns boolean value and captured image
    if not ret:
        continue
    gray_img= cv2.cvtColor(test_img, cv2.COLOR_BGR2GRAY)

    faces_detected = face_haar_cascade.detectMultiScale(gray_img, 1.32, 5)


    for (x,y,w,h) in faces_detected:
        cv2.rectangle(test_img,(x,y),(x+w,y+h),(255,0,0),thickness=7)
        roi_gray=gray_img[y:y+w,x:x+h]#cropping region of interest i.e. face area from  image
        roi_gray=cv2.resize(roi_gray,(48,48))
        img_pixels = image.img_to_array(roi_gray)
        img_pixels = np.expand_dims(img_pixels, axis = 0)
        img_pixels /= 255

        predictions = model.predict(img_pixels)
```

Figure 7. Video_test.py

This Figure shows from NumPy to import all the required libraries work of the function, it also shows fer,jerson is reading the training set.

```
        max_index = np.argmax(predictions[0])

        emotions = ('angry', 'disgust', 'fear', 'happy', 'sad', 'surprise', 'neutral')
        predicted_emotion = emotions[max_index]

        cv2.putText(test_img, predicted_emotion, (int(x), int(y)), cv2.FONT_HERSHEY_SIMPLEX,

    resized_img = cv2.resize(test_img, (1000, 700))
    cv2.imshow('Facial emotion analysis ',resized_img)


    if cv2.waitKey(10) == ord('q'):#wait until 'q' key is pressed
        break

cap.release()
cv2.destroyAllWindows
```

Figure 8. Video_test.py

Dataset

Epoch is a training set to ge the accuracy of the system and recorder the emotion.

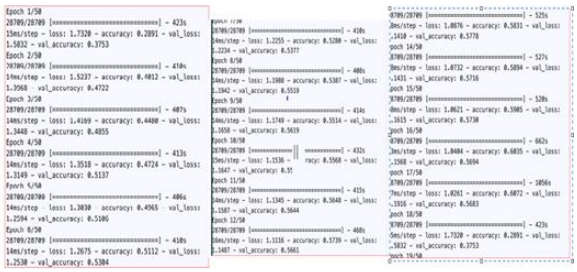

Figure 9. Dataset

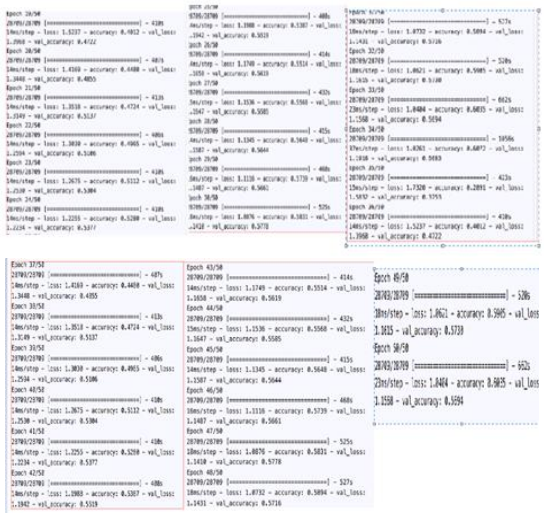

Figure 10. Dataset

Emotion Result

The researchers first captured an image of a COECS Faculty member to detect the emotion using Ananconda Spyder (Python). The emotion needs the light to get the accuracy of COECS Faculty member face.

The Anaconda Spyder (Python) is a system used to implemented and run the python file have data and training sets. The research said the Training set is an important in our system to identify the expressions detected on the face of the COECS Faculty members.

Figure 12. Emotion Result

The data consist of 48x49 pixel grayscale images of faces. The faces have been automatically registered so that the face is centered and occupies about same amount of in each image. The task is to categorize each face based on the facial emotion on six categories (angry, sad, fear, happy, surprise, neutral).

Training set is a data set of two columns, 'emotion' and "pixel". The "emotion" column contains a numeric code ranging from 0 to 6, inclusive, for the emotion that is present in the image. The "pixels" column contains a string surrounded in quotes for each image

III. RESULTS AND DISCUSSIONS

The Table Result is summarizing the facial emotion of recorded of 1 COECS Faculty Members, the researchers recorded system is based on accuracy of the Facial emotion of the system.

Facial Emotion	Read Correctly The emotion	Did not Read Correctly the emotion	Total # of Test	Accuracy
Happy	3	7	10	30%
Sad	3	7	10	30%
Angry	4	6	10	40%
Neutral	7	3	10	70%
Suprised	4	6	10	40%
Fear	5	5	10	50%
TOTAL	**26**	**34**	**60**	**40%**

Based on the table, The total of the test summarized the facial emotion of 1 COECS Faculty Member. Total of the number of tests is 60. Of the 60, The 26 were facial emotions detected and 34 did not match the emotions of the faculty member. In all the emotion stated, Happy and Sad is the only emotion that read less correctly with total accuracy of 30%, Angry and Surprise the emotion that read correctly with the total accuracy of 40%, Fear is the emotion second that most read correctly with total accuracy of 50%, lastly the Neutral is the most read emotion correctly the total with 70%.

Neutral is higher than happy, sad, surprise, fear and angry. It because of the Epoch When the training set accuracy of his epoch is most of his emotions will come out even if the emotions of one professor, he needs light so he can sharpen the face of the system.

IV. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The proponents applied facial emotion recognition (FER) asynchronously that detect the facial emotion of the faculty of COECS using deep learning algorithm. Implementing CNN, Haar in OpenCV with tensor flow the model recognized the facial emotion of the faculty that can be used in analyzing behaviors of humans to be used in future studies. FER framework identifies or verifies a person from facial images. Although the concept of recognizing someone facial feature is institutive, FER makes human recognition a computerized process, that can be concluded that the specific objectives are met as the outcomes of the study.

The researchers were able to classify the six facial emotions namely: sad, happy, surprised, fear, angry and neutral; and use deep learning algorithms to develop the FER asynchronously. They were also able to test the System by using the manual testing method.

In general, the study is applying a deep learning algorithm emotion of that can identify the facial images of the Faculty of the College of Engineering and Computer Studies real time.

Recommendations

In the light of the findings and conclusions, the following are presented as recommendations for possible improvement for asynchronously Facial Emotion Recognition.

The researcher would like to improve the system through putting more effort on the emotions like putting more emotion on the system and putting effort on the study of the emotions can be great help for the system

The researcher was able to create the Asynchronous Facial Emotion Recognition (FER) using the deep learning algorithm, but the system need improvement to its design and limitation more study and research of the topic can help the future development of the system

"The epoch are needed to have higher 150 or 200 training set for it to get the accuracy of the 6 basic emotion" for it. However, our laptop cannot support the 150/200 for that it needs a powerful laptop to have epoch of 150 or 200 set.

REFERENCES

[1] Ahmad J.(2019) Recognition of Emotion Intensities Using Machine Learning Algorithms: A Comparative Study retrieved from https://www.mdpi.com/1424-8220/19/8/1897

[2] Barsoum, E., Zhang, C., Ferrer, C. C., & Zhang, Z. (2016, October). Training deep networks for facial expression recognition with crowd-sourced label distribution. In Proceedings of the 18th ACM International Conference on Multimodal Interaction (pp. 279-283). ACM.

[3] Brownlee, J. (2019). Deep Learning for Computer Vision. Machine Learning Mastery.

[4] Burgoon, J. K., & Hoobler, G. (2002). Nonverbal signals. In M. L. Knapp & J. A. Daly (Eds.), Handbook of interpersonal communication (3rd ed., pp. 240–299). Thousand Oaks, CA: Sage.

[5] Chang, C. F., Gröschner, A., Hall, N. C., Alles, M., & Seidel, T. (2018). Exploring Teachers' (6)Emotions via Nonverbal Behavior During Video-Based Teacher Professional Development. AERA Open, 4(4), 2332858418819851.

[6] Cox, L. (2017). Applications of Facial recognition Technology. Retrieved from

[7] Cruz A.C (2015) Vision and Attention Theory Based Sampling for Continuous FacialEmotion Recognition retrieved from https://ieeexplore.ieee.org/abstract/document/6784434

[8] Dr Priya (2018) Deep Neutral Network for Human Face Recognition Retrieved from https://mail.google.com/mail/u/1/#inbox/FMfcgxwBWSvRWkLkZZCNmTgXNTGTsDWW?proje ctor=1&messagePartId=0.1

[9] Gao Y. (2003) Facial Expession recognition from line-based caricatures Retrieved from https://ieeexplore.ieee.org/abstract/document/1227586

[10] Iglesias J.(2017) scikit-image: image processing in Python retrieved from

https://peerj.com/articles/453/?fbclid=IwAR1u7H6

[11] Jeong, M., & Ko, B. C. (2018). Driver's Facial Expression Recognition in Real-Time for Safe Driving. Sensors, 18(12), 4270.

[12] Krithika L.B (2016) Student Emotion Recognition System (SERS) for e-learning improvement based on learner concentration metric retrieved from https://mail.google.com/mail/u/0/#sent?projector=1

[13] Maini, R. (2017). Applications of Machine Learning. Retrieved from https://medium.com/appaffairs/9-applications-of-machine-learning-from-day-to-day-life-112a47a429d0

[14] Phillip Ian Wilson, John Fernandez (2006) Facial feature detection using Haar classifier https://dl.acm.org/citation.cfm?id=1127416

[15] Prosprero M. (2019) Skybiometry and AffectNet on Facial Emotion Recognition Using Supervised Machine Learning Algorithms

[16] Shangfei W. & Lihua Y. (2015) Emotion recognition with the help of privileged information retrieved from https://mail.google.com/mail/u/0/#inbox/QgrcJHsHqgLszKKzRkDsZfxjGMQQTpzbQPg

[17] Suja P. (2016) Real-Time Emotion Recognition from Facial Image from Rasphery retrieved from https://www.researchgate.net/publication/308189789_Real

[18] Takeo K.(2015) Comprehensive Database for Facial Expression Analysis retrived from https://www.ri.cmu.edu/pub_files/pub2/kanade_takeo_2000_1/kanade_takeo_2000_1.pdf

[19] Tao, J., & Tan, T. (2005, October). Affective computing: A review. In International Conference on Affective computing and intelligent interaction (pp. 981-995). Springer, Berlin, Heidelberg.