Deep Learning-based Face Emotion Recognition

Parminder Singh
Department of Computer Science and Engineering
Lovely Professional University, Phagwara, India

Avinash Kaur
Department of Computer Science and Engineering
Lovely Professional University
Phagwara, India

Abstract: There is an increased demand for facial expression recognition in various sectors such as healthcare, education, business, etc. Artificial intelligence, machine learning, and image processing are used to extract emotions from the images of faces. In this work, we used deep learning and image classification to classify the expression by recognizing the expressions. The Inception of the Image Net dataset is used to implement the proposed model and investigate the effects of image recognition. The 80% data is used for training and 20% data is used for testing purposes. The model is tested in the classification of images concerning 7 classes: angry, disgust, happy, sad, surprise, fear and neutral. The proposed model gives the approximate 41% accuracy.

Keywords: Face emotion recognition, Deep Learning, Machine Learning, Classification of images,

1. Introduction

The humans have a few diverse facial feelings by which we can comprehend someone else's emotions and can speak with one another and his aim in accomplishing something. On the off chance that you need to locate somebody's passionate status or stance, at that point, the procedure of Facial Emotion Recognition comes into the image and is utilized anyplace [1]. For the most part, when a framework is characterized with a rundown of prepared pictures from the given dataset are recognized with the photograph that is caught lastly brings about finding the enthusiastic condition of the individual alongside his/her picture then it is called Facial Emotion Recognition System [2,3]. A one of a kind human facial acknowledgment is a framework where dependent on his/her feelings is arranged into significantly seven fundamental types they are characterized as:

- Happy(enjoy)
- Sad(cry)
- Surprise(shock)
- Fear(panic)
- Anger(temper)
- Disgust(revolting)
- Neutral(normal)

The human programmed outward appearance is the primary part of human interfaces normally, significantly in conduct sciences.

1.1. Types of Emotions are:

Outrage: It includes the principle three highlights going on the defensive, eyebrows in the descending course and inside the agreement, squinting eyes. The capacity would resemble an assault. The teeth resemble preparing to chomp and dreading the adversaries, eyes, and eyebrows are flickered to ensure the eyes, yet not shutting totally to see the aggressor.

Satisfaction: Includes bends along the two sides of the mouth, the eyes would resemble squinting and wrinkles show up at eye corners. The essential practical job of the grin, which tells bliss, that remaining parts a secret one. A few analysts accept that the grin was at first an indication of dread. Monkeys and different sorts of primates grasped teeth to show predators that they are innocuous. A grin is a thing that urges the cerebrum to discharge hormones considered endorphins that tell decreasing torment and take after a sentiment of prosperity. New or Just conceived children have seen to grin unwantedly, while they are resting. A child's grin helps his/her folks to associate with him and get appended to him. It bodes well that for developmental reasons, an automatic grin of an infant makes positive affections for the guardians, so they wouldn't surrender their posterity.

Contempt: The inclination that someone or something is useless or underneath thought and includes rise just on one side of the face in lip corner and furthermore just a single eyebrow rises. This articulation may be looking like and some astonishment, some satisfaction. This can apply to the individual who gets this look we are astounded by what he said or didn't (positively) and that we are delighted by it. This is a hostile articulation that leaves them feeling that an individual is better than someone else.

Sadness: The condition or nature of being pitiful and includes a slight pulling down of corners of lips, eyebrows internal side is rising. The general control in the upper lip is more noteworthy than the lower lip, thus the lower lip drops. Expecting when an individual shouts and cries, the eyes are shut to shield them from the circulatory strain that streams in the face. Along these lines, when we have the feeling to cry and we need to stop it, the eyebrows are raised to keep the eyes from shutting.

Anger

Disgust

Fear

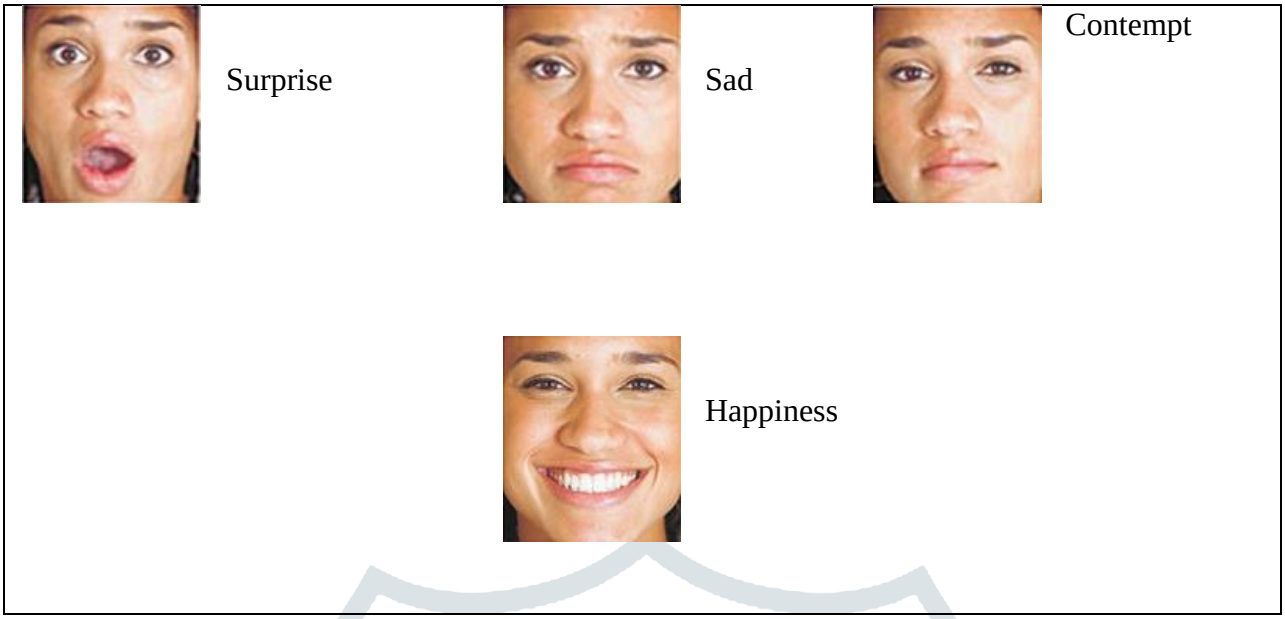

Figure 1: Different types of face emotions

The ideal explanation for this characteristic wonder is the motivations that actuate the explicit arrangements of muscles in specific districts on the face. Face appearance is characterized as that the obvious presentation of the enthusiastic state, mental movement of the highlights, expectation, forcefulness and psychopathology of people and assumes an open job in social and communicational relations. It is read for an all-inclusive time and getting progress as of late. The advancement has been made, perceiving face demeanor with a high precision stays to be so tricky due to the quality and styles of outward appearances. For the most part, characters will pass on perspectives on expectations and feelings through nonverbal ways that like signals, outward appearances, and socio-social dialects. This method is extensively useful, the nonverbal way for people/individuals to talk with each other. This factor is anyway fluidly in the framework recognition or concentrates the face from the picture. The framework is developing consideration because of this may be generally utilized in a few fields like falsehood recognition, human&pc, therapeutic interface [4]. On every day today rudiments people are having a recognize feelings by trademark choices, shown as an area or set of sets in the outward appearance. A model

1) Joy is without a doubt identified with a grin or an upward development of both the sides of the lips. similarly, elective feelings region unit portrayed by elective miss happenings commonplace to a particular articulation. Dissecting in the programmed acknowledgment of looks on faces gives the issues near the clarify and arrangement or grouping of static or dynamic attributes of those different types of facial pigmentation.
2) Outrage includes fundamental three highlights going on the defensive, eyebrows in a descending heading and inside the agreement, squinting eyes. The capacity would resemble an assault. The teeth resemble preparing to nibble and dreading the foes, eyes, and eyebrows are squinted to ensure the eyes, however not shutting totally to see the aggressor.
3) Hatred is the inclination that someone or something is useless or underneath thought and includes rise just on one side of the face in lip corner and furthermore just a single eyebrow rises. This articulation may be

looking like and some astonishment, some bliss. This can apply to the individual who gets this look we are amazed by what he said or didn't (positively) and that we are diverted by it. This is a hostile articulation that leaves them feeling that an individual is better than someone else.

4) Sadness is the condition or nature of being dismal and includes a slight pulling down of corners of lips, eyebrows inward side is rising. The general control in the upper lip is more noteworthy than the lower lip, thus the lower lip drops. Accepting when an individual shouts and cries, the eyes are shut to shield them from the circulatory strain that streams in the face. In this way, when we have the feeling to cry and we need to stop it, the eyebrows are raised to keep the eyes from shutting.
5) The amazement is a sudden or surprising occasion, a reality that is fundamentally the same as the statement of dread. Perhaps in light of the fact that a shocking circumstance can fear us for a brief and specific minute, and afterward it relies upon whether the astonishment is decent or a terrible.
6) Fear in General, an undesirable or abnormal feeling dropped by the risk of threat, agony, or hurt and includes eyes opening broadly and once in a while likewise opening the mouth. The capacity in opening the eyes so broadly should help increment the visual field and the quick development of the eye, which can create by discovering dangers. Opening the mouth it empowers us to inhale unobtrusively and by that not being uncovered by the foe.
7) Disgust implies a sentiment of objection like the inclination you get when you see or smell something strange or unheard of is a case of nauseating. It includes a nose and mouth in wrinkled and just as tongue turning out. This articulation copies an individual that when tastes any terrible nourishment and needs to let it out, or smelling the foul smell.

The framework orders the face demeanor of the special character into the fundamental feelings especially outrage, nauseate, dread, bliss, pity, and shock [5]. the most and first reason for this technique is socio-practical communication between people/people and machines in the eye stare, outward appearances, mental element displaying, and so on.

In this identification and grouping of facial or passionate articulations might be utilized as a characteristic strategy for the association among man and machine [6]. Notwithstanding that, the framework forces of lightning in the edges in various arrangements of shifts from individual to individual and furthermore differs in alongside age, sexual orientation, size, and type of the face, and any, even the demeanors of indistinguishable individual don't remain steady with time.

Notwithstanding, the detached fluctuation of facial or physiological pictures brought about by different components like varieties or contrasts in brightening, present, arrangement, impediments makes appearance acknowledgment a troublesome assignment [7].

In the present exceptionally arranged world, the has the prerequisite to keep up the security of information or property to not be taken and is changing into every increasingly imperative and increasingly problematic [8]. In nations like India, the speed of wrongdoing scenes in the square estimates expanding step by step.

No programmed discovery frameworks square measure there which will follow an individual's movement in that circumstance. On the off chance that we'll be prepared to follow Facial or enthusiastic articulations of people precisely then, we will understand the crook or guilty party just since outward appearances change doing changed exercises.

Subsequently, we will, in general, decide to shape a Recognition System. we will, in general, have an enthusiasm during this venture in regards to the procedure of the meeting as there will be a webcam by which the scout can see the individual and get his/her facial feelings acknowledgment. The papers were uncovered according to their framework creation and methods for making the framework for the right and dependable acknowledgment framework. Accordingly, we will in general square measure incredibly expected to build up a framework that recognizes the face and track one individual's movement.

Human feelings Associate in enticing goals unit communicated through outward appearance and deduction a modest and compelling element is that the basic a piece of the acknowledgment framework. Face acknowledgment is adequately utilized for the characterizing of outward appearances in applications like clever, man-made-machine interface and correspondence in the smart enhanced visualization researching and furthermore the meeting and measure of activity from live movement film.

2. Related Work

The intensive research on emotion of face has accomplished in classification to fetch the dataset properties [9]. Many classification techniques have been discussed to fetch the visual features of the image [10] and performed emotion recognition features. The image's reactions are examined based on different classes of emotion recognition [11]. In this article, the author used a random forest and K-Nearest Neighbor (KNN) algorithm for emotion recognition.

The data science is problems are resolved with the help of Neural Network and advanced features. In literature, the Bi-directional LSTM, LSTM and Deep RNN are used to extract the features of audio and visual properties [12]. The evaluation of emotion recognition is performed through CNN modeling and training on different ranges [13]. The research field of emotion recognition and have the application in the various field [14]. Deep CNN and filter banks are a creation from facial images after emotion identification [15]. This work helps to gain

higher accuracy in image identification, moreover, the author suggests to attain higher accuracy after incorporating Deep learning. The deep convocational network is performed for facial emotion recognition with image spectrograms [16].

The conventional techniques for image feature selection are used in the previously mentioned articles. Further, Pitch is used in wave parameter to increase the accuracy [6]. The emotions are classified for facial expression of images for feature selection and emotion recognition after studying various databases [17]. Long and Short Term Memory (LSTM) and bottlenecks are used for facial recognition for data array [18]. Along with face recognition, speech emotion recognition is also used which gives better results in real-time [19]. The unweighted average recall (UAR) with a belief network and hidden Markov model is done for emotion recognition for facial expressions [20].

3. Research Methodology

The outward appearance acknowledgment unit valuable for affordable association Most examination and framework in the acknowledgment unit confined to seven fundamental articulations (satisfaction, pity, outrage, appall, dread, shock, scorn). it's discovered that it's sent to clarify every outward appearance and these articulations unit and double grouped upheld facial activities. recognition face and perceiving the outward appearance is likewise a convoluted undertaking once it's crucial to consider essential segments like face arrangement, direction, the area where the face is readied. The extent of this technique is to help and safeguard the issues that may emerge in everyday life. some of the extensions are:

1. The framework can have the option to see and characterize a client's perspective.

2. The framework utilized in divider bazaars to take a gander at the client's emotions while giving criticism.

3. The framework will be worked in an overwhelming group of places like rail and street stations for human appearances and outward appearances of each individual. On the off chance that there is any proportion of countenances that seemed irate or frightful, the framework would perhaps set an alert.

4. The framework likewise can even be utilized for watching purposes like one can get input on anyway the questioner is responding all through the meeting procedure.

5. This technique will be utilized for a lie or phony location among the criminal suspects all through the cross-examination

6. Advancing the affirmation in the plausibility of flaw treatment passionate data of an individual/Individual which may be known by this strategy.

4. Result and Discussion

The list of software used for implementation is:

a) Programming in Python

b) IDE was the ANACONDA, Python IDLE

c) libraries from Python

d) TensorFlow with Keras light-weighted edge work

e) Opencv Library

Face feeling acknowledgment isn't a bad dream any longer now with the most recent advances like profound learning and open cv we can do it effectively. Presently face feeling acknowledgment is utilized in various enterprises how about we take a gander at a portion of the businesses how it's been utilized and furthermore we should perceive how we have improved the current thought which makes much simpler for imagining the yield.

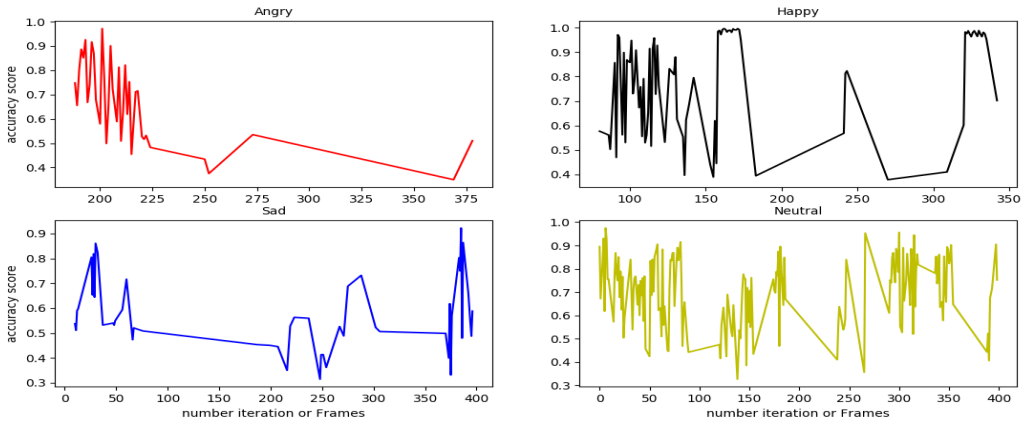

Figure 2: Live Graphs for facial emotion recognition with the proposed model.

The frameworks which are available currently can give you criticism dependent on the given information it is possible that it is a video or photograph however in our framework we have included a module or we call it more as an update which helps the client of the product to imagine everything in live which implies the product plots the diagrams as indicated by the feelings of the individual it is dissecting and toward the finish of the session it gives total information as pie outline which shows level of every feeling that an individual was conveying at time of analyzing and furthermore it gives the bar graph which shows how often he was conveying the every last one

of the seven feelings lastly the entire information is put away into the CSV document which contains the feeling of an individual as likelihood regarding every feeling.

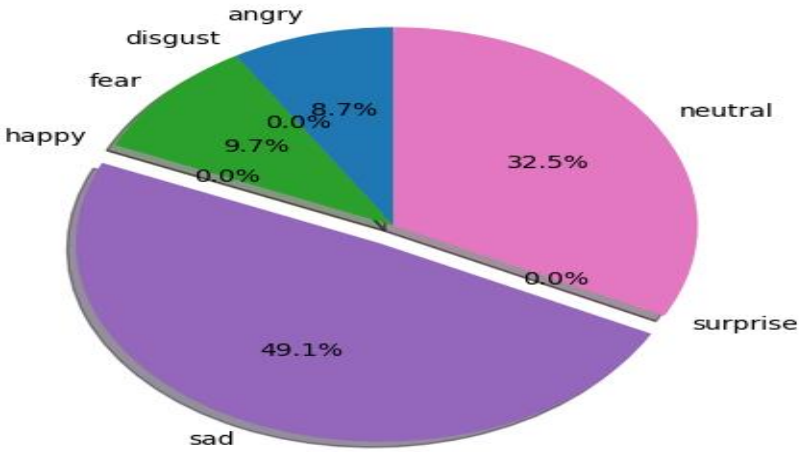

Figure 3: Pie Chart for various emotion recognition ratios with the proposed model.

This is the live visualization graph when we are testing our model. Here you can see that it is showing the probability of emotion on the y-axis and number of frames in the x-axis.

This is the pie chart generated after completing the session in front of the camera which helps to visualize and analyze the person very easily.

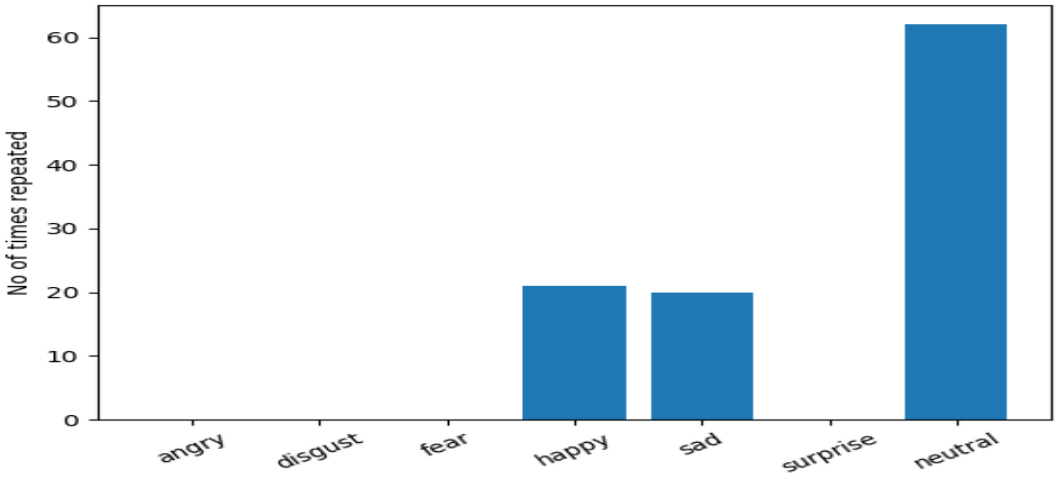

Figure 4: Bar graphs for the number of times recognition of the proposed system.

In the above piechart, most of the time the person is sad which is 49%. The above barplot is also generated after completing the session. In the above bar graph, you can see that on the y-axis it is showing how many times the emotion is repeated and on the x-axis, we have seven emotions.

According to the above bar graph, most of the time the person in front of the camera is carrying the neutral emotion, which is for 60 times approx.

6. Conclusion

The emotion recognition is studied by the various authors using machine learning, image recognition. In this article, Deep learning has been used to conduct facial emotion recognition. The seven types of emotions are recognized such as neutral, surprise, sad, happy, fear, disgust and angry. The emotion recognition has various applications in the industry 4.0. The dataset is used to test the model by dividing the dataset 80% for training and 20% for testing. The proposed model gave an accuracy of about 41%. In the future, the proposed model can be enhanced using speech recognition along with the image to increase the accuracy of real-time systems.

References

1. M. El Ayaadi, F. Karraeand M. S. Kamal "Survey on emotion recognitions: Features, classification scheme, and database," *Pattern Recognit.*, vol. 44, no. 3, pp. 572–587, 2011.
2. Y. Lecan, Y. Bengeo, and G. Hintin, "Deep learning," *Nature*, vol. 521, no. 7553, pp. 436–444, 2015.
3. J. Schmidhubar, "Deep Learning in neural networks: An overview," *Neural Networks*, vol. 61, pp. 85–117, 2015.
4. J. Ngiem, A. Khoslaa, M. Kam, J. Nim, H. Lei, and A. Y. Nig, "Multimodal Deep Learning," *Proc. 28th Int. Conf. Mach. Learn.*, pp. 689–696, 2011.
5. S. Lugivic M. Harva and I. Dander "Techniques and applications of emotion recognition," *2016 39th Int. Conv. Inf. Commun. Technol. Electron. Microelectron. MIPRO 2016 - Proc.*, no. November 2017, pp. 1278–1283, 2016.
6. B. Schaller, G. Rigull, and M. Ling, "Emotion recognition combining acoustic features and information in a neural network - belief network architecture," *Acoust. Speech, Signal Process.*, vol. 1, pp. 577–580, 2004.
7. J. Riang, G. Leie, and Y. P. P. Chen, "Acoustic feature selection for automatic emotion recognition from speech," *Inf. Process. Manag.*, vol. 45, no. 3, pp. 315–328, 2009.
8. F. Noruzi, G. Anbarjafaari and N. Akraami "Expression-based emotion recognition and next reaction prediction," *2017 25th Signal Process. Commun. Appl. Conf. SIU 2017*, no. 1, 2017.
9. G. Hintin ,Greves and A. Mohemed, "Emotion Recognition with Deep Recurrent Neural Networks," in *2013 IEEE International Conference on Acoustics, Speech and Signal Processing*, 2013, pp. 6645–6649.
10. K.Weint and C.-W. Huaang, "Characterizing Types of Convolution in Deep Convolutional Recurrent Neural Networks for Robust Speech Emotion Recognition," pp. 1–19, 2017.
11. A. M. Yusuf, M. B. Mustaafa, M. and M. Malekzedeh, "emotion recognition research: an analysis of research focus," *Int. J. Speech Technol.*, vol. 0, no. 0, pp. 1–20, 2018.
12. L. Cavidon ,H. M. Fayak, M. Lich,"Evaluating deep learning architectures for Emotion Recognition," *Neural Networks*, vol. 92, pp. 60–68, 2017.
13. A. M. Badshaah, J. Ahmed and S. W. Baek, "Emotion Recognition from Spectrograms with Deep Convolutional Neural Network," *2017 Int. Conf. Platf. Technol. Serv.*, pp. 1–5, 2017.
14. A. Routrey, M. Swaen and P Kabisetpathy, "Database, features and classifiers for emotion recognition: a review," *Int. J. Speech Technol.*, vol. 0, no. 0, p. 0, 2018.

15. K.-Y. Hueng, C.-H. Wiu, T.-H. Yieng, M.-H. Sha and J.-H. Chiu, "Emotion recognition using autoencoder bottleneck features and LSTM," in *2016 International Conference on Orange Technologies (ICOT)*, 2016, pp. 1–4.
16. M. N. Sttilar, M. Leich, R. S. Bolie, and M. Skinter, "Real time emotion recognition using RGB image classification and transfer learning," *2017 11th Int. Conf. Signal Process. Commun. Syst.*, pp. 1–8, 2017.
17. D. Lie and E. M. Provest, "EMOTION RECOGNITION USING HIDDEN MARKOV MODELS WITH DEEP BELIEF NETWORKS."
18. H. Jiaang *et al.*, "Investigation of emotions for identifying depression using various classifiers," *Expression Commun.*, vol. 90, pp. 39–46, 2017.
19. Q. Maio, M. Diong, Z. Huaeng, and Y. Zhaen, "Learning Salient Features for Emotion Recognition Using Neural Networks," *IEEE Trans. Multimed.*, vol. 16, no. 8, 2014.
20. P. Hairár, R. Burgeet, and M. K. Duitta, "Facial Emotion Recognition with Deep Learning," in *Signal Processing and Integrated Networks (SPIN)*, 2017, pp. 4–7.