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# Facial Expression Recognition using OpenCV

**Deshmukh Puja Subhash, Makhija Ronit Harishkumar, Dhamane Divya Sunil, Prof. Suresh Shinde**
Department of Computer Engineering,
Smt. Kashibai Navale College of Engineering, Pune, India

***Abstract:*** *These Human facial expressions carry several records visually in desire to articulately. Facial expression popularity plays an important characteristic inside facet the area of human-machine interaction. Automatic facial functions reputation device has many programs including, but now no longer limited to, human behaviour understanding, detection of highbrow disorders, and synthetic human expressions. Recognition of facial functions via computer with immoderate recognition fee remains a hard task.Two well-known strategies implemented regularly inside facet the literature for the automatic FER systems are based totally mostly on geometry and appearance. Facial Expression Recognition typically completed in four-ranges which includes pre-processing, face detection, characteristic extraction, and expression classification. In this mission we carried out diverse deep getting to know methods (convolutional neural networks) to identify the important thing seven human emotions: anger, disgust, fear, happiness, sadness, marvel and neutrality.*

**Keywords:** Face detection, Feature extraction, Image Processing, Machine Learning, Convolutional Neural Network

## I. INTRODUCTION

"2018 is the 12 months while machines learn how to draw close human emotions" --Andrew Moore, the dean of pc generation at Carnegie Mellon. With the advent of contemporary-day era our dreams went immoderate and it binds no bounds. In the existing technology a massive studies paintings goes on withinside the subject of virtual photo and photo processing. The manner of development has been exponential and it's far ever increasing. Image Processing is a enormous region of research in contemporary international and its applications are very widespread. Image processing is the sector of sign processing in which each enter and output alerts are images. One of the most important software of Image processing is Facial expression recognition. Our emotion is found out through the expressions in our face. Facial Expressions plays a essential role in interpersonal communication. Facial expression is a non-verbal scientific gesture which gets expressed in our face as in step with our emotions. Automatic reputation of facial functions plays an important function in artificial intelligence and robotics and therefore its miles a need of the generation. Some utility associated with this encompass Personal identity and Access control, Videophone and Teleconferencing, Forensic utility, Human-Computer Interaction, Automated Surveillance, Cosmetology and so on. The goal of this challenge is to increase Automatic Facial Expression Recognition System that may take human facial images containing some expression as input and recognize and classify it into seven different expression class such as:

- Neutral
- Angry
- Disgust
- Happy
- Sadness
- Surprise
- Fear

## II. RELATED WORK

**SMarek Kowalski, JacekNaruniec, Tomasz Trzcinski**, The authors have proven a Deep Learning alignment work, that's a energetic face calibration manner this is primarily based totally on Convolutional NN. They have proposed Deep Alignment Network performs the face calibrations mostly depends on the whole face images in contrast to what

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recently face alignments techniques perform, which make it very accurate to immense fluctuations in both initializations and forehead poses. Using heat maps which has landmark, and which transmits the detail of the locations of landmarks among DAN Phases, it helped them to apply face pixel in place of regionally to be had marks that's extracted round landmarks. Extensive performance evaluation improves the ultra-modern failure rate by a relatable limit more than 70% which were performed on two different challenges.

**Ali Mollahosseini, BehzadHasani, and Mohammad H Mahoor**, The authors have described the system "Affective Computing" as to expand systems, gadgets and mechanisms the ones of which can be recognizable, interpretable, and which imitates person affects through various attributes such as how he/she looks, the depth and modulation in his/her voice, and biological signals he/she may have. They have discussed about several network architecture driven models in their literature to shed lights on emotive facial expressions: 1) explicit, wherein the emotion is fetched from an emotive-associated class inclusive of FER datasets that have six primary human feelings in it. 2) Extent, where a numerical value is taken from a simultaneous face expression scale in images which are valence and arousal.

**Kai Wang, XiaojiangPeng, Jianfei Yang, DebinMeng**The authors have proven the facial features reputation gadget that's an actual international utility and solves the levels happened submit adjustments made. The authors have generated the numerous new assessments over FER datasets on those stages and proposed a new "Region Attention Network (RAN)" which itself depicts the importance of the facial landmarks. They similarly proven the implementation of a "Region Biased loss (RB-Loss)" characteristic that is used to bolster the excessive interest weight for areas which can be the maximum salient.The authors additionally evaluated their technique on the gathering in their datasets and made the good sized research on FER Plus and Affect-Net. The paintings proposed the approach which achieves the ultra-cutting-edge outcomes on distinct datasets which incorporates FER+, RAF-DB, SFEW, and Affect-Net.

**IvonaTautke, Tomasz Trzcinski, Adam Bielski**, The authors have made their outlook on an attempt in development approach for the facial features popularity which permits the gadget to get a great deal from the facial landmarks. The findings which can be figured at the JAFFE-dataset which advised a few symptoms and symptoms for an area for the improvement and extra precision. The authors have made their evaluate announcing that the proposed technique has sturdy potentials that may outperform the presently proposed methods.

**B. Hasani and M. H. Mahoor**, The authors advocate a Convolutional Neural Network approach that is a 3-Dimensional for FER in frames of videos. This model develops a 3-d Inception-ResNetlayers discovered through manner of manner of a unit called LSTM that concurrently Facial curve dots also are used as samples to their community layout which consciousness at the times of facial Landmarks as opposed to a few cited facial patches that won't be useful and won't be capable of generate facial expressions significantly.

**Daniel Llatas Spiers**, There is a studies performed through the writer to classify the Facial emotions over the static facial snap shots with the help of deep learning techniques. The consequences that have been accomplished have been non-futuristic, and barely higher than different techniques along with the traits engineering. It manner that finally Deep Learning structures can be capable of dispose of this trouble given a sufficient quantity of the labelled tuples. Characteristics engineering isn't always that essential, picture pre-processing reduces the inconsistencies of the classification.That's why it will increase the visibility and the exceptional at the enter image. In nowadays facial emotion detection software program software includes the use tendencies engineering. A locating this is completely depending on the function getting to know that doesn't appear close to yetdue to the principal restraint and that suggests the absence of a wide-ranging dataset of reactions.With the presence of a larger dataset, structures which have a bigger cap potential that is used to research systems that would be applied.Thus, emotion class may be attained with the assist of deep gaining knowledge of approaches.

**Sivo Prasad Raju, Saumya A and Dr.Romi Murthy**, the authors have proposed an architecture where convolutional neural network (CNN) are trained to classify facial emotions/expressions. The authors have used Japanese Female Facial Expression (JAFFE) dataset of facial emotion images for training CNN in order to achieve good accuracy during training phase. Concept of Hybrid Vehicle Employing of CNN has been used for detecting drowsiness or alertness of the drivers in real time.

**Deepesh Lekhak,** the writer has proposed a gadget of programmed facial Expression Recognition to carry out detection and locationof faces landmarks in a muddled scene, set of facial movements' extraction and facial emotions classification. This model is developed using Convolutional NN which is totally dependent based on a network design

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called “Le-Net”, Kaggle facial expression (FER2013) dataset with seven facial expression class labels which includes happy, sad, surprise, disgust, fear, anger & neutral.

**Jie Hu, Li Shen, and Gang Sun**, the authors have worked on the channel link and in which have proposed a fresh design unit, termed as “Squeeze and Excitation (SE)” block which tries to set right features channel wise by manipulating channel since they are independent. This paper has showed that chunks of patches can be loaded together to form SE-Net architecture to generalize extremely effectively across different datasets. “Squeeze and Excitation” Networks has formed the foundation of ILSRVC classification submission.

**han Li and Weilong Deng**, The authors have supplied an entire survey on a layout that's deep “Facial Expression Recognition (FER)” whichconsists of databases and algorithms that capabilities choice of statistics attractiveness and evolution designs for those units of statistics.The authors have reviewed a few already built Deep Neural Network Models and associated schooling modules.

## III. PROPOSED SYSTEM

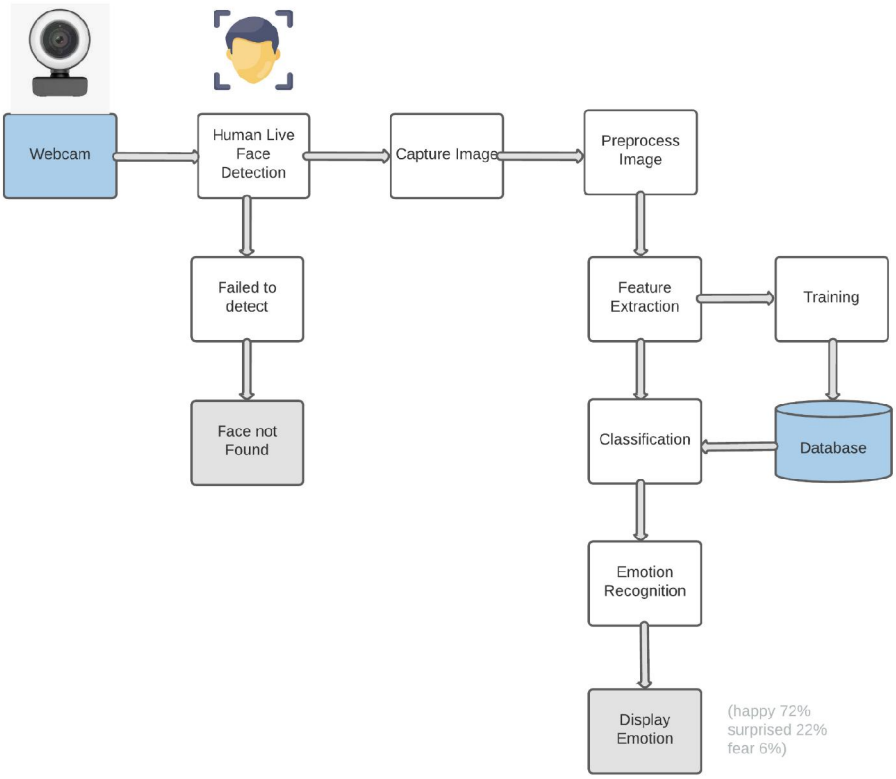


Fig. 3.1 System Architecture

**ALGORITHM**

Step 1:Collection of a data set of images. (In this case we are using FER2013 database of 35887 pre-cropped, 48-by-48-pixel grayscale images of faces each labeled with one of the 7 emotion classes: anger, disgust, fear, happiness, sadness, surprise, and neutral.

Step 2:Pre-processing of images.

Step 3:Detection of a face from each image.

Step 4:The cropped face is converted into grayscale images.

Step 5: The pipeline ensures every image can be fed into the input layer as a (1, 48, 48) numpy array.

Step 5:The numpy array gets passed into the Convolution2D layer.

Step 6:Convolution generates feature maps.

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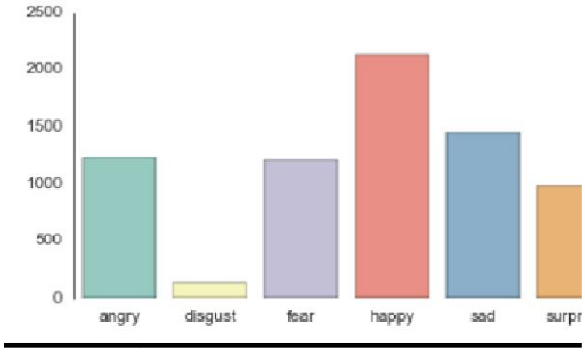
Step 7:Pooling method called MaxPooling2D that uses (2, 2) windows across the feature map only keeping the maximum pixel value.
Step 8:During training, Neural network Forward propagation and backward propagation performed on the pixel values.
Step 9:The Softmax characteristic provides itself as a opportunity for every emotion class.The version is ready to expose the element possibility composition of the feelings withinside the face.

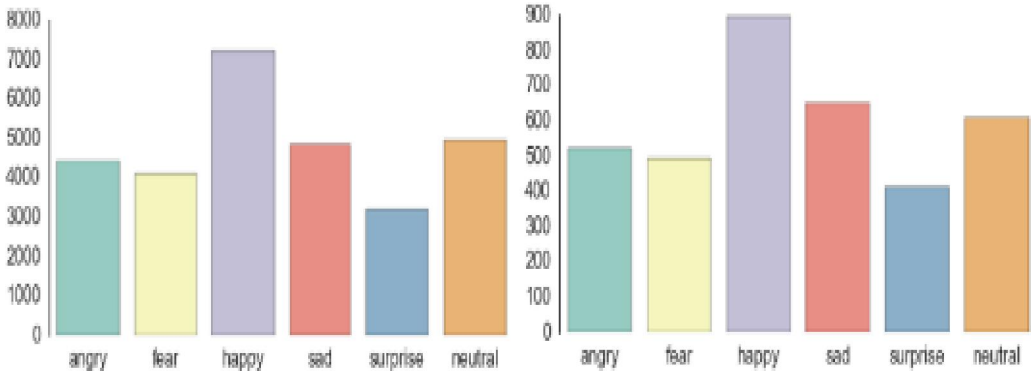
**THE DATABASE**

The dataset we used for training the model is from a Kaggle Facial Expression Recognition Challenge a few years back (FER2013). It comprises a total of 35887 pre-cropped, 48-by-48-pixel grayscale images of faces each labeled with one of the 7 emotion classes: anger, disgust, fear, happiness, sadness, surprise, and neutral.




As we have been exploring the dataset, we found an imbalance of the "disgust" magnificence in comparison to many samples of different classes. We decided to merge disgust into anger given that they both represent similar sentiment. To prevent data leakage, we built a data generator fer2013datagen.Py that may effortlessly separate schooling and hold-out set to special files. We used 28709 labeled faces as the training set and held out the remaining two test sets (3589/set) for after-training validation. The resulting is a 6-class, balanced dataset that contains angry, fear, happy, sad, surprise, and neutral. Now we're ready to train.

**The Model:**




Deep mastering is a famous method utilized in pc vision. We selected Convolutional Neural Network (CNN) layers as constructing blocks to create our version architecture.CNNs are recognized to mimic how the human mind works whilst reading visuals.
A typical architecture of a convolutional neural network contain an input layer, some convolutional layers, some dense layers (aka.Fully-linked layers), and an output layer. These are linearly stacked layers ordered in sequence. In Keras, the version is created as Sequential () and greater layers are delivered to construct architecture.

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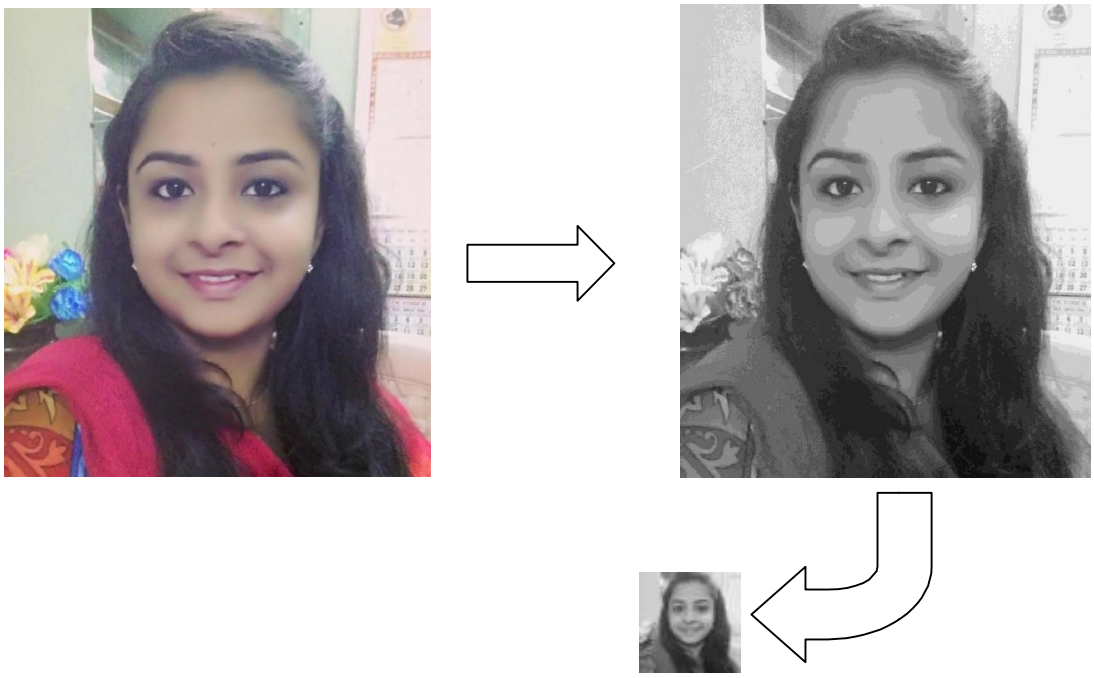
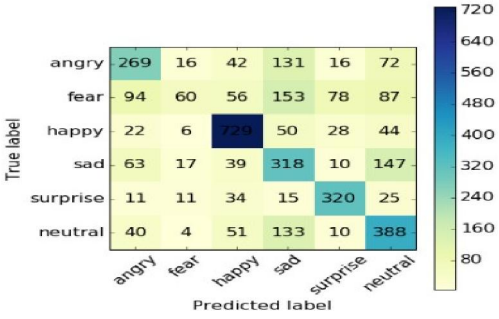
## IV. RESULTS AND DISCUSSION



```
from PIL import Image
from resizeimage import resizeimage

img11 = Image.open('ang2.jpg').convert('L')

img11.save('gimage10.jpg')


with open('gimage10.jpg', 'r+b') as f:
    with Image.open(f) as image:
        cover = resizeimage.resize_cover(image, [48, 48])
        cover.save('test-image-cover10.jpeg', image.format)

img11.save('resized_image12.jpg')

image = misc.imread('test-image-cover10.jpeg')
image=image.reshape(1,1,48,48)
score=model.predict(image)
print(score)
```



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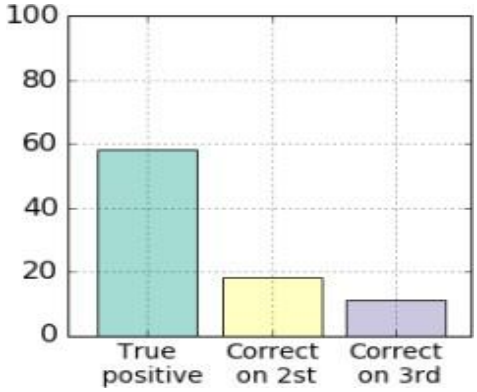
The confusion matrix gives the counts of emotion predictions and some insights to the performance of the multi-class classification model:

The version plays honestly properly on classifying nice feelings ensuing in exceedingly excessive precision ratings for glad and surprised. Happy has a precision of 76.7% which may be defined with the aid of using having the maximum examples (~7000) withinside the schooling set.Interestingly, marvel has a precision of 69.3% having the least examples withinside the education set.There ought to be very robust alerts withinside the marvel expressions.

Model performance seems weaker across negative emotions on average.In particularly, the emotion unhappy has a low precision of most effective 39.7%.The version regularly misclassified angry, worry and impartial as sad.In addition, it's far maximum burdened whilst predicting unhappy and impartial faces due to the fact those feelings are probable the least expressive (except crying faces).

Frequency of prediction that misclassified by less than 3 ranks.




Computer Vision As a result, the characteristic maps turn out to be an increasing number of summary down the pipeline whilst extra pooling layers are added.This gives an idea of what the machine sees in feature maps after 2nd and 3rd max-pooling.

## V. FUTURE WORK

It is essential to observe that there may be no precise system to construct a neural community that could assure to paintings well.Different troubles might require special community structure and plenty of path and mistakes to supply proper validation accuracy.This is the cause why neural nets are frequently perceived as "black container algorithms.In this mission we were given an accuracy of virtually 70% which isn't always awful in any respect evaluating all of the preceding models.But we want to enhance in particular regions like-

- Number and configuration of convolutional layers
- Number and configuration of dense layers
- Dropout percentage in dense layers

But due to lack of exceptionally configured tool we could not move deeper into dense neural networks the gadget receives very sluggish and we can attempt to enhance in those regions in future.We might additionally want to teach greater databases into the gadget to make the version increasingly more correct however once more assets becomesA trouble withinside the route and we additionally want to enhance in numerous regions in destiny to remedy the mistakes and enhance the accuracy.Having tested strategies to deal with expression variation, in destiny it is able to be investigated inextra depth about the face kind problem and essential fusion of shadeaction and depth information.Further observe may be laid down withinside the path of allele of gene matching to the geometric elements of the facial expressions.The genetic assets evolution framework for facial expressional tool can be studied to suit. The requirement of various safety fashions along with crook detection, governmental private safety breaches etc.

## VI. CONCLUSION

In this case, at the same time as the model predicts incorrectly, an appropriate label is frequently the second most probably emotion. The facial capabilities reputation tool furnished in this research artwork contributes a resilient face reputation model based absolutely on the mapping of behavioural tendencies with the physiological biometric

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tendencies. The physiological developments of the human face with relevance to several expressions together with happiness, sadness, fear, anger, wonder and disgust are related to geometrical systems which restored as base matching template for the popularity system. The behavioural problem of this system relates the way of thinking in the back of one-of-a-type expressions as assets base. The property bases are alienated as exposed and hidden magnificence in genetic algorithmic genes .The gene training set evaluates the expressional region of information of individual facesand provide a resilient expressional reputation model inside facet the challenge of biometric security.The format of a unique choppy cryptosystem based totally mostly on biometrics having competencies like hierarchical groupprotection receives rid of using passwords and smart gambling playing cards in place of earlier cryptosystems.It requires a completely unique hardware help like numerous exceptional biometrics system.This research artwork ensures a present day course of research inside facet the vicinity of unevenBiometric Cryptosystems this is rather ideal on the way to remove passwords and smart gambling playing cards completely.Experimental assessment and feature a have a take a observe show that the hierarchical protection structures are effective in geometric shape identification for physiological traits.

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