IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 10, Issue 5, May 2022

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.165

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.165 |

|| Volume 10, Issue 5, May 2022 ||

| DOI: 10.15680/IJIRCCE.2022.1005131|

Depression Analysis using Image Processing and Machine Learning

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ABSTRACT: At present, depression has become a main health burden in the world. Depression is a mental disorder that causes a persistent feeling of sadness and loss of interest. Also called major depressive disorder or clinical depression. It affects how you feel, think and behave and can lead to a variety of emotional and physical problems. You may have trouble doing normal day-to-day activities, and sometimes you may feel as if life isn't worth living. Depression is the common reason for increasing suicide cases worldwide. Globally it is estimated that 5.0% of adults suffers from depression. Now it seems to be a common type of problem in most of the person. Therefore, reliable and objective evaluation method is needed to achieve effective depression detection in human. This study describes different algorithms and methods which will help to detect the real time depression in human by face recognition. A great way of using deep learning to classify images is a Convolutional Neural Network (CNN). CNN can be used for feature extraction and training the model. By using these techniques and algorithm one can collect the data base for depression analysis. OpenCV can be used for real time image processing and performing computer vision task. This will help in early detection of depression. It will also provide researchers and doctors with valuable data. We can also find out some predictive results for the disease.[1].

KEYWORDS: Depression, OpenCV, CNN, Real-time, Prediction

I. INTRODUCTION

Depression is a severe mental disorder with characteristics symptoms like sadness, feeling of emptiness, anxiety, and sleep disturbance, as well as general loss of initiative and interest in activities. Additionally features like the feeling of guilt or worthlessness, reduced energy, concentration problems, suicidality and psychotic symptoms might be present. The severity of a depression is determined by the quantity of symptoms, their seriousness and duration, as well as the consequences on social and occupational function. Generally, the symptoms of depression are reflected in the behavior of the patient. Worldwide, almost 13% of the child population, 46% of adolescents, and 19% of the adult population struggle with mental illness each year. Given the harmful effects of depression on individuals and society, pattern recognition and computer vision communities have proposed methods that are based on verbal and nonverbal information for accurate estimation of a subject's depression level. For the visual information, face and body carry important cues, such as facial expressions, eye blinks, and head pose and movement. The diagnosis of depression in the early curable stages is crucial to prevent it from reaching a severe and irreversible state and to save the life of depressed individuals. This paper focuses on techniques for accurate detection of depression levels based on the images.
The main motivation of project is to detect whether the person is depressed or not based on the maximum percentage of emotion detected during real time face reorganization. [2-3]

II. RELATED WORK

For implementing this project following basic steps are required to be performed.

1. Preprocessing
2. Face registration
3. Facial feature extraction
4. Emotion classification
5. Predict whether person is depressed or not based on emotions classified.

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Description about all these processes are given below-

1.Preprocessing :

Preprocessing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. Most preprocessing steps that are implemented are –

a. Reduce the noise
b. Convert The Image To Binary/Grayscale.
c. Pixel Brightness Transformation.
d. Geometric Transformation.

2. Face Registration :

Face Registration is a computer technology being used in a variety of applications that identifies human faces in digital images. In this face registration step, faces are first located in the image using some set of landmark points called “face localization” or “face detection”. These detected faces are then geometrically normalized to match some template image in a process called “face registration”.

3. Facial Feature Extraction :

Facial Features extraction is an important step in face recognition and is defined as the process of locating specific regions, points, landmarks, or curves/contours in a given 2-D image or a 3D range image. In this feature extraction step, a numerical feature vector is generated from the resulting registered image. Common features that can be extracted area.

a. Lips
b. Eyes
c. Eyebrows
d. Nose tip

4. Emotion Classification :

In the third step, of classification, the algorithm attempts to classify the given faces portraying one of the seven basic emotions.

5. Predict whether person is depressed or not based on emotions classified:

We are predicting the results in two ways i.e., by using the already captured images and the other way is by real time face capturing. Based on the emotion detected andthe percentage of a particular emotion we classify the results as depressed or not. If the emotions are sad, disgust, fear or angry they are classified as depressed and the rest (happy, neutral, surprised) are classified as not depressed.[4]

SYSTEM ARCHITECTURE:

1. Firstly, the training dataset is imported in the system.
2. Using CNN algorithm the features are extracted and the model is trained.
3. This trained model is the loaded to SVM classifier.
4. On the other hand the real-time face is captured using OpenCV.
5. Facial features are extracted from each frame of video.
6. This will act as the testing material which will be passed to the SVM classifier.

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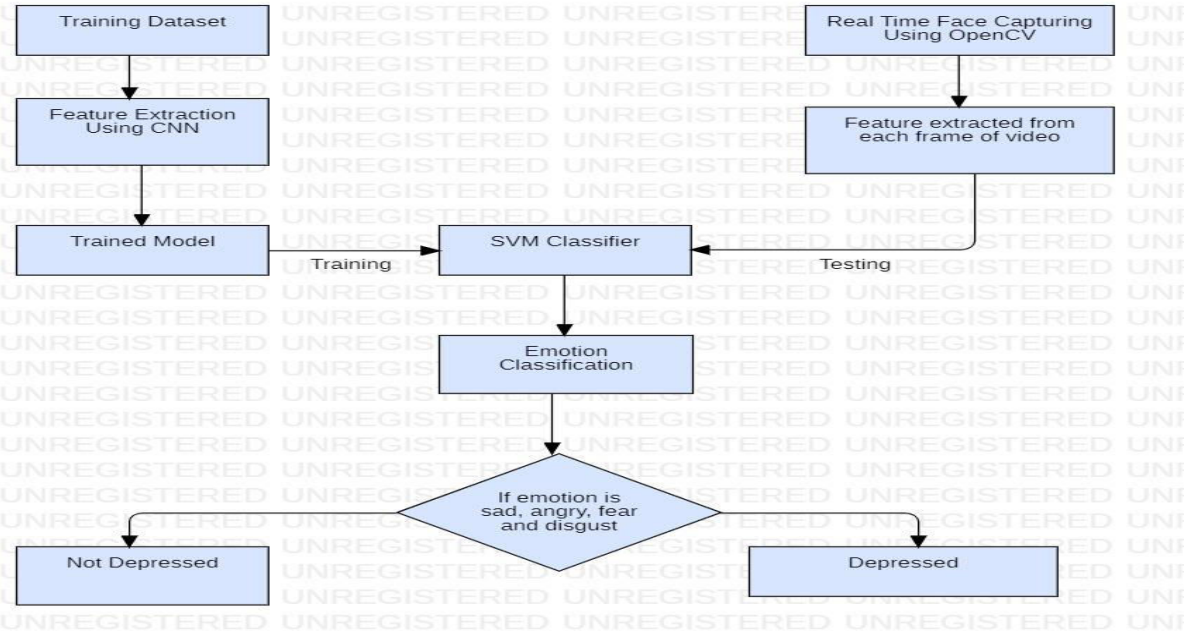
7. The emotion will be classified.

8. If the emotion is sad, fear, angry, disgust it will predict as depressed

Else (if emotion is happy, neutral, surprised) system will predict it as not depressed.



n

Architecture

III. PROPOSED ALGORITHM

Convolution Neural Networks(CNN):

CNN or the convolutional neural network (CNN) is a class of deeplearning neural networks. In short think of CNN as a machine learning algorithm that can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image, and be able to differentiate one from the other.

CNN works by extracting features from the images. Any CNN consists of the following:

I. The input layer which is a gray scale image

- The Output layer which is a binary or multi-class labels.
- Hidden layers consisting of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network

The role of CNN is to reduce the images into a form that is easier to process, without losing features critical towards a good prediction. This is important when we need to make the algorithm scalable to massive datasets.[5]

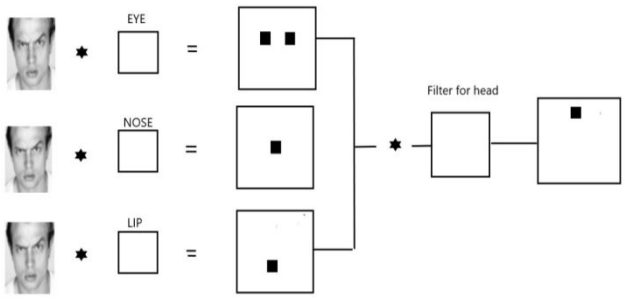


Fig2: CNN

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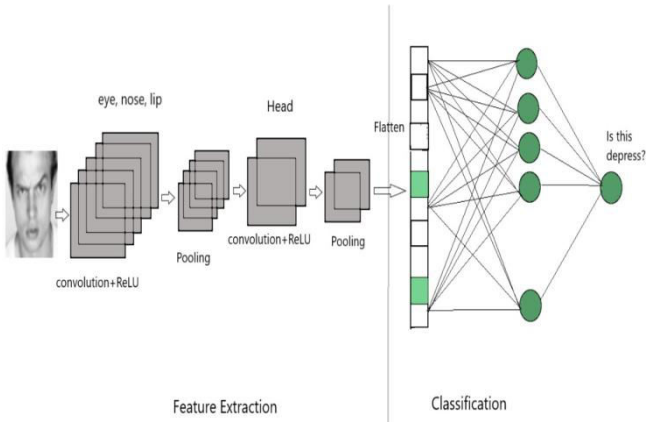

Fig3: Working of CNN

a. What are convolutions?

The convolution layer consists of one or more Kernels with different weights that are used to extract features from the input image. When we slide the Kernel over the input image (say the values in the input image are gray scale intensities) based on the weights of the Kernel we end up calculating features for different pixels based on their surrounding/neighboring pixel values. [6]

b. Why ReLU?

ReLU or rectified linear unit is a process of applying an activation function to increase the non-linearity of the network without affecting the receptive fields of convolution layers. ReLU allows faster training of the data, whereas Leaky ReLU can be used to handle the problem of vanishing gradient.[6]

C. Role of Pooling Layer

The pooling layer applies a non-linear down-sampling on the convolvedfeatureoften referred to as the activationmaps. This is mainly to reduce the computational complexity required to process the huge volume of data linked to an image. Pooling is not compulsory and is often avoided. Usually, there are two types of pooling, MaxPooling**,** that returns the maximum value from the portion of the image covered by the Pooling Kernel and the AveragePoolingthat averages the values covered by a Pooling Kernel. [6]

D. Image Flattening

Once the pooling is done the output needs to be converted to a tabular structure that can be used by an artificial neural network to perform the classification. Note the number of the dense layer as well as the number of neurons can vary depending on the problem statement. Also, often a drop out layer is added to prevent overfitting of the algorithm. Dropouts ignore few of the activation maps while training the data however use all activation maps during the testing phase. It prevents overfitting by reducing the correlation between neurons.[6]

IV. PSEUDO CODE

Step 1: Input the training dataset.
Step 2: The training dataset is preprocessed using CNN algorithm.
Step 3: Features are extracted
Step 4: Model is trained.
Step 5: Model is loaded
Step 6: Real time face is captured using openCV
Step 7: Emotion is classified
Step 8: If the emotion is sad, fear, angry, disgust it will predict as depressed
Else (if emotion is happy, neutral, surprised) system will predict it as not depressed.

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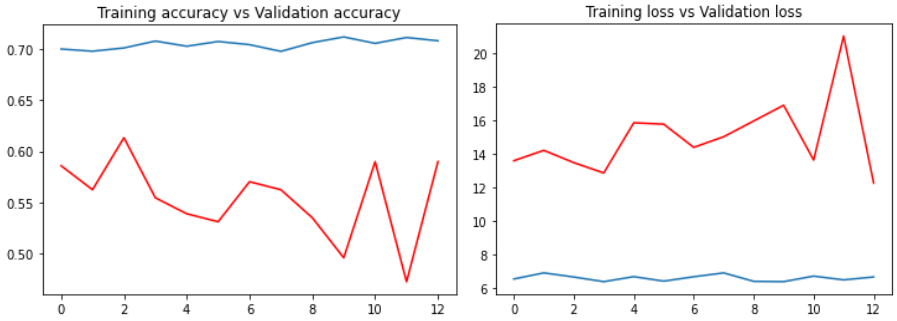
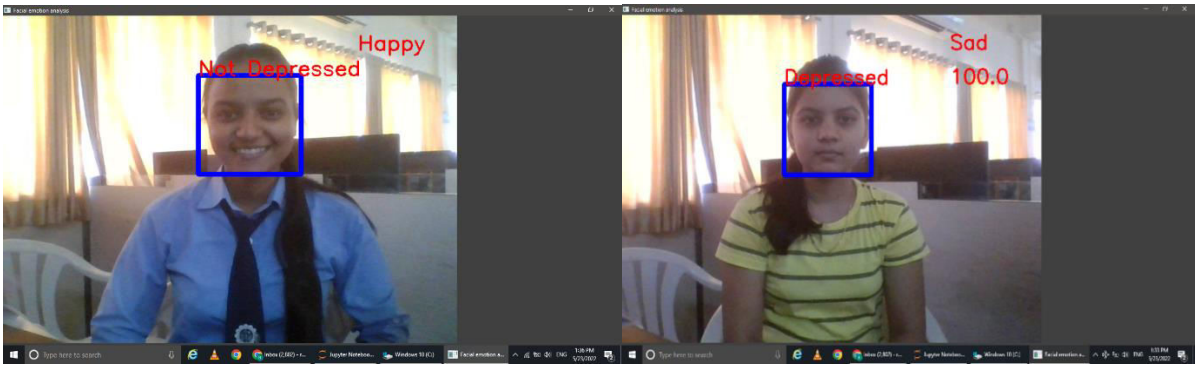
V. SIMULATION RESULTS

For Depression detection, we first detect the emotions using the different feature of images in the dataset downloaded from the Kaggle. There are approximately 35000 images in the dataset. After training the dataset for 449 steps per 50 epochs the training accuracy was found to be 70.07% and the validation accuracy is 60%. The graph of training accuracy vs validation and training loss vs validation loss is given below:



We analyze whether the person is depressed or not based on the percentage of his/her emotion detected. We can see the results below:



The result shows the emotion and percentage of emotion in the upper right corner and based on that emotion it predicts whether the person is depressed or not.

VI. CONCLUSION AND FUTURE WORK

Conclusions:

Through this study we conclude that depression being most important predominant mental issue it needs to be detected before it's too late. We have also discussed the methods of detecting depression with the help capturing different facial expressions. To everything up all, it is better to state that the responsibilities of advancement in depression database are highly promising and so is scope for research in the field of depression detection.

Future Scope:

It is important to note that there is no specific formula to build a neural network that would guarantee to work well. Different problems would require different network architecture and a lot of trail and errors to produce desirable validation accuracy. This is the reason why neural nets are often perceived as "black box algorithms.".

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In this project we got an accuracy of almost 70% which is not bad at all comparing all the previous models. But we need to improve in specific areas like-
1. number and configuration of convolutional layers
2. number and configuration of dense layers.
3. dropout percentage in dense layers

But due to lack of highly configured system we could not go deeper into dense neural network as the system gets very slow and we will try to improve in these areas in future. We would also like to train more databases into the system to make the model more and more accurate but again resources becomes a hindrance in the path and we also need to improve in several areas in future to resolve the errors and improve the accuracy. Having examined techniques to cope with expression variation, in future it may be investigated in more depth about the face classification problem and optimal fusion of color and depth information which will help in predicting the accurate reasults. Further study can be laid down in the direction of allele of gene matching to the geometric factors of the facial expressions. The genetic property evolution framework for facial expressional system can be studied to suit the requirement of different security models such as criminal detection, governmental confidential security breaches etc.

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INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 8.165

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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