BioGecko

Vol 12 Issue 03 2023
ISSN NO: 2230-5807

Facial Emotion Detection Using Deep Learning

Paras Sharma,Mohit, Surya Pratap Singh
Department of Computer Science and Engineering
Meerut Institute Of Engineering And Technology, Meerut,U.P. ,India
{ paras.sharma.cs.2019@miet.ac.in , mohit.manoj.cs.2019@miet.ac.in , surya.singh.cs.2019@miet.ac.in }

***Abstract*—**

Facial expressions are important in social communication because they convey a lot of information about people, including their moods, feelings, and other characteristics. These are generated by the movement of facial muscles attached to the jaw creases and folds in the skin and fascia, causing facial features. The lips, eyes, and eyebrows should all move to convey an emotion. Emotion recognition is critical for developing effective Human-Computer Interaction because of its multiple advantages, and applications in artificial intelligence, such as data-driven animation, human-computer interaction, and human-robot collaboration. Machine Learning (ML) and Neural Networks (NNs) have been utilized to recognize emotions in recent years. In this Thesis, Convolutional Neural Network (CNN) extracts information from images to detect emotions, and then with grayscale images from the FER 2013 dataset, a CNN-based ResNet9 model is trained to classify expressions into seven emotions: Disgust, Anger, Happy, Fear, Neutral, Surprise, and Sad. Batch Normalization and Dropout layers are used to improve model accuracy and reduce overfitting and residual layers were used to prevent the gradients from vanishing. The learning rate was scheduled using the One Cycle Policy and Adam optimization was used to help the algorithm converge towards the minima. Based on the training outcomes, the optimum model parameters are determined. The results of the testing data were used to evaluate the model which suggests that the ResNet9 Model is 63% accurate. Besides, I built a GUI desktop application that detects real-time emotions.

Keywords - Emotion detection, Deep learning, Pytorch, OpenCV, Artificial Intelligence Machine Learning, etc

Introduction

Emotion recognition is a technology that uses advanced image processing to read the emotions on a human face."

Facial recognition technology has come out one of the other technologies that has evolved and just increased over time. Currently, facial emotion detection applications or software are utilized to give access to a program to inspect and to process a person's expressions on face. This program which uses complex image dispensation to act as a brain of human being also has ability of emotion recognition.

A.I., or "Artificial Intelligence," detects and then examines various face's expressions to combine them with some more information. This can be used for various purposes, including interviews and investigation, and this way authorities can detect a person's emotions using only technology.

Every year, facial emotion recognition technology improves. The A.I. does identification and examines facial expressions to determine what emotion the individual is expressing based on a variety of parameters. Consider the following:

Eyebrow and eyeball placement
The mouth's position.
Facial characteristics change dramatically.

Emotion detection has already been trusted by various enterprises to evaluate customer temper towards their products or services, companies, promotion efforts, staff, or in-location experiences. Recognizing consumer feelings is important to determine company gains and improve encounters, but the solutions introduced from this innovation go furthermore than researching the market and advertising that is digital.

Emotion Recognition in Automobile Industry to avoid accidents.

There are lots of injuries and deaths daily brought on by distracted driving in the field. Using the implementation of automated programs and automated driving possibilities, car manufacturers face much more safety concerns and factors. They certainly need to fulfill security standards issued by the relevant organizations such as the European New Car Assessment Programme (Euro NCAP) and adapt to new protection criteria. To greatly enhance roadway protection, automobile manufacturers must see the driver's updates for example their particular feelings expressed by the emotions, fatigue attention, and level, and reflect it towards the drive programs and drive quality. Affective Automotive AI utilizes cams and microphones to determine intricate and delicate psychological and intellectual states making use of face and sound in real-time. Tailored deep learning frameworks, computer vision, message popularity, and vast amounts of real-world information fuel this next-generation software. It allows providers to identify and recognize motorist impairments and develop useful automobile applications that are motivated to boost protection and avoid any accidents caused by distractions, unusual psychological behaviour, etc.

Literature Review

Emotion detection using deep learning is a relatively recent development that has gained significant attention in the research community. The use of deep learning techniques, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs), has improved the accuracy and efficiency of emotion detection systems.

One of the early studies on emotion detection using deep learning was conducted by Dong Yu and co-workers in 2013. They proposed a deep belief network (DBN) based system for speech emotion recognition. The system was trained using a large dataset of emotional speech and achieved high accuracy in detecting emotions.

In 2015, researchers at the University of Waterloo developed a deep learning-based system for facial emotion recognition. They used a CNN to analyze facial expressions and achieved high accuracy in recognizing emotions such as happiness, sadness, and anger.

In recent years, there has been a growing interest in multimodal emotion detection systems that combine information from different modalities such as speech, text, and facial expressions. In 2018, researchers at the University of Texas at Austin proposed a multimodal deep learning-based system for emotion detection. They used a combination of CNNs and RNNs to analyze speech and facial expressions and achieved high accuracy in detecting emotions such as happiness, sadness, anger, and fear.

In 2019, a group of researchers at the University of California, Los Angeles proposed a deep learning-based system for emotion detection in text. They used a combination of CNNs and RNNs to analyze text and achieved high accuracy in detecting emotions such as happiness, sadness, anger, and fear.

In recent years, there has also been a growing interest in using transfer learning techniques to improve the performance of deep learning-based emotion detection systems. Transfer learning involves training a deep learning model on a large dataset and then using the pre-trained model to analyze a smaller dataset. This approach has been shown to improve the accuracy and efficiency of emotion detection systems.

In summary, emotion detection using deep learning is a rapidly evolving field that has shown significant improvements in accuracy and efficiency in recent years. Researchers are continuing to explore new techniques and approaches to improve the performance of deep learning-based emotion detection systems.

Existing System

There are several existing systems for emotional detection using deep learning that have been developed by researchers and companies in recent years. Here are a few examples:

Affect Net: Affect Net is a large-scale dataset of facial expressions that has been used to train deep learning models for facial emotion recognition. The dataset contains over 1 million images of facial expressions labeled

with seven basic emotions (anger, disgust, fear, happiness, sadness, surprise, and neutral). Researchers have used Affect Net to develop deep learning models such as CNNs and RNNs for facial emotion recognition with high accuracy.

EmoReact: EmoReact is a deep learning-based system developed by Microsoft that uses facial expressions, body language, and speech to detect emotions. The system uses a combination of CNNs and RNNs to analyze facial expressions, body language, and speech, and it can detect emotions such as happiness, sadness, anger, and surprise. EmoReact has been used in applications such as video game design and virtual reality.

Affective: Affective is a company that specializes in emotion detection using deep learning. They have developed a platform that can analyze facial expressions, speech, and physiological signals to detect emotions in real-time. The platform uses deep learning models such as CNNs and RNNs to analyze the data and can detect emotions such as happiness, sadness, anger, and surprise. Affective has been used in applications such as market research, advertising, and automotive safety.

Deep Emotion: Deep Emotion is a deep learning-based system developed by researchers at the Chinese Academy of Sciences for emotion detection in text. The system uses a combination of CNNs and RNNs to analyze text and can detect emotions such as happiness, sadness, anger, and fear. Deep Emotion has been used in applications such as sentiment analysis and opinion mining.

These are just a few examples of existing systems for emotional detection using deep learning. As research in this field continues, we can expect to see more sophisticated and accurate systems being developed for a variety of applications.

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

Purposed System

It is the core of Computer Vision. It treats all the images as 2D signals and applies different types of signal processing to it like Visualization, Recognition, Sharpening, restoration, etc. An image can be identified as arrays of pixels where each pixel ranges from (0 to 255) and represents the intensity of a color (RGB – Red, Green, Blue) or (A – Opacity), its dimensions can be represented as Width x Height, e.g., an image with dimension 800 x 600 has 240000 pixels. It has applications in various fields: Diagnosis of disease in the medical field, Object detection in automobile industries for self-driving cars, Face detection, emotion detection, etc.

In our case, we are going to use image processing for Facial emotion detection and to do that it involves changing a picture into a 2-Dimensional Matrix. It is done in 3 steps:
1) Image Scanning: A raw image must go through processing and does exist in pixels. The aim is to extract data that's appropriate to computing.
2) Process and Enhance: Image is transformed digitally by employing a digitiser that samples it and then input signals are quantised. The sample rate is ought to be high enough for better resolution and a high quantisation level for the human vision of various shades using a grayscale.
3) The acquired output explains the property of an image and then classifies that image.

There are 2ways to transform a colourful image into a grayscale image:
Average Method

Mean is acquiredfrom3 colors, Blue, Red and Green present in the color image. Hence, Grayscale is (R+G+B)/3, however, the black image is obtained sometimes instead of a grayscale image. It happens because of the converted image we receive 33% of Red, Blue and Green each. So, one method to tackle this problem is Luminosity Method

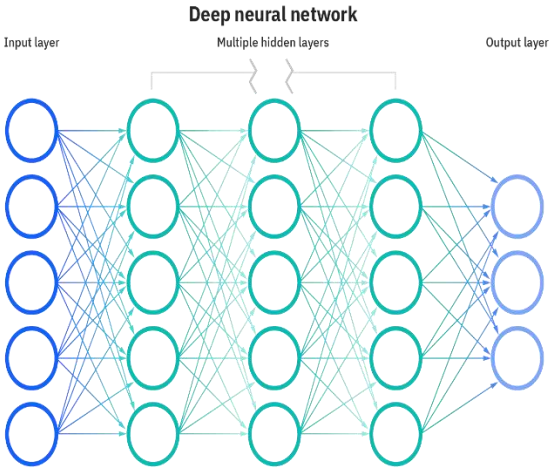


Figure 1.1

Methodlogy

In this section, I am going to talk about how and what methodologies take place in this project and what are their needs. First, I will go through some important steps which explain how our system is going to work and the things needed to meet our target of this emotion-detection system.

The steps are as follows:

Step 1: Beforehand we start working on our project, It is important to first import the Python libraries such as Numpy, Pandas, Matplotlibetc., and some important frameworks too like OpenCV and Pytorch. These libraries and frameworks are going to help us in working with our datasets.

Step 2: There are a lot of datasets available today such as JAFFE, COHN-KANADE, FER 2013, etc. for emotion recognition and each of them has its advantages and disadvantages. Some of them have good accuracy while some are not so good. In this step, the focus is on collecting datasets for training and checking if they are suitable to work with.

Step 3: After choosing a suitable dataset for the system we will move on further to train the model using the chosen dataset and when our model is trained it's easy to predict the accuracy.

Step 4: Here comes the application development, now we are going to use an open-source platform known as WxPython to develop a GUI for our emotion-detection system. We will concatenate our trained model with the application and check if it's working fine.

In Brief:

Importing Python libraries and frameworks

Choosing a suitable dataset

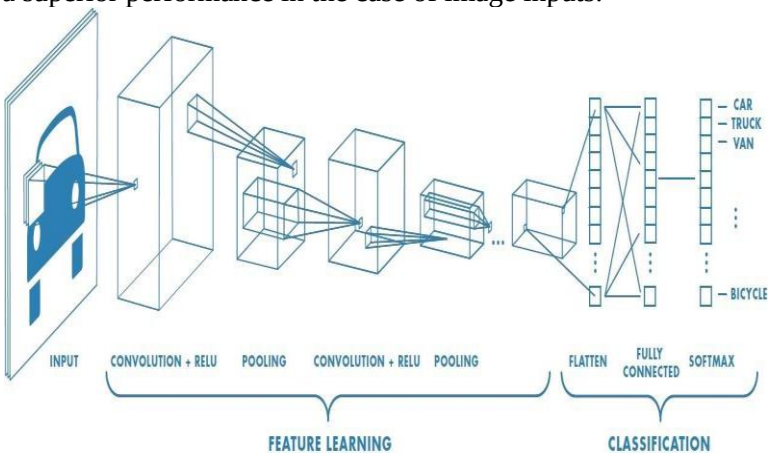
Training of Model with the dataset

GUI application development using Trained Model

Emotion Detection using CNN

Convolutional Neural Networks (ConvNet / CNN) can be defined as Deep Neural Learning Networks that can assign compliance (readable weight and bias) to the various objects/elements in the image., take an input

image,and differentiate between them. When compared to other classifications, it requires substantially less pre-processing, and also has a superior performance in the case of image inputs.

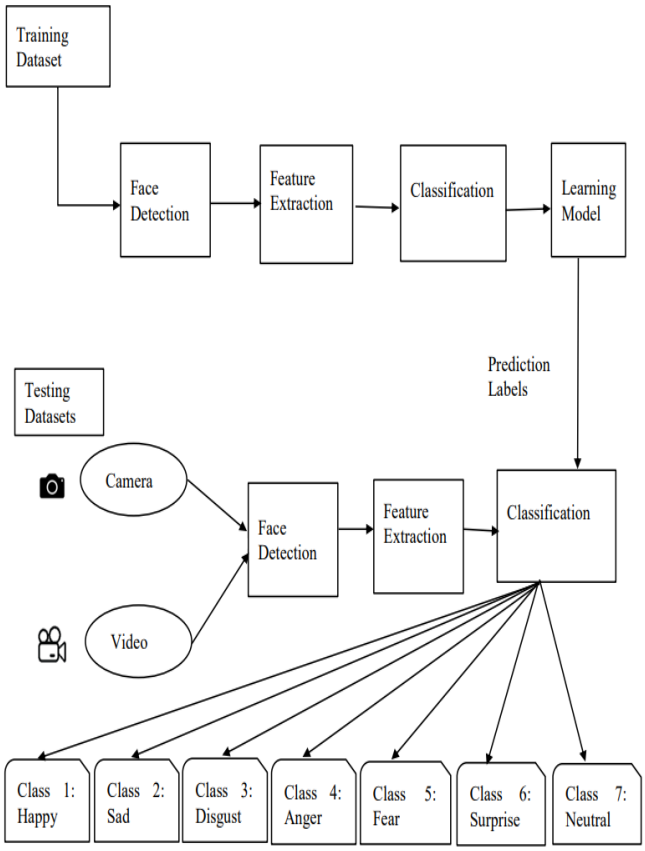


A traditional Convolutional Neural Network (CNN)

Flowchart of Emotion Detection System

A flowchart shows a computer algorithm, system, or process. They are widely used in many fields to read, write, develop, planning, and link complex processes to clear and simple diagrams.

Below is the flow chart diagram for the emotion detection system.



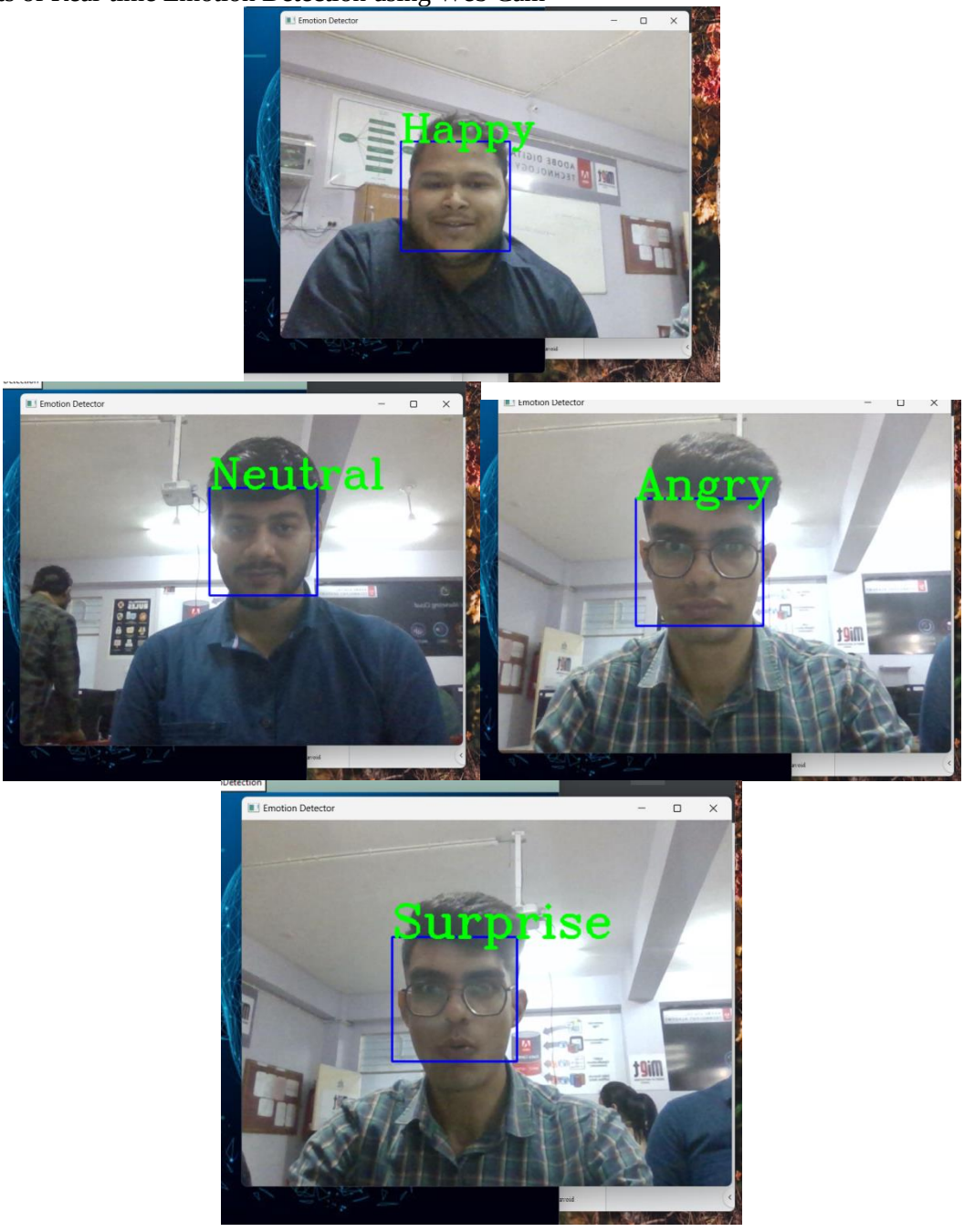
Conclusion

The ResNet9 architecture was able to classify the tested data with 63% accuracy, there were many misclassifications which might be a result of networks not being able to distinguish the features of some closely related classes. The model can be further improved using networks of more layers with appropriate residual blocks, learning, etc.

The technology for recognizing emotions is far from perfect. Despite their ability to recognize emotions, they nonetheless face and cause concerns and challenges. A system, for example, may regard delicate feelings and expressions to be more worrisome than they actually are. Furthermore, because it instinctively associates facial expressions with specific emotions, it is unable to discern between genuine and fake expressions and can be easily tricked.
AI also struggles to recognize cultural variances in emotional expression, making it difficult to draw accurate conclusions.

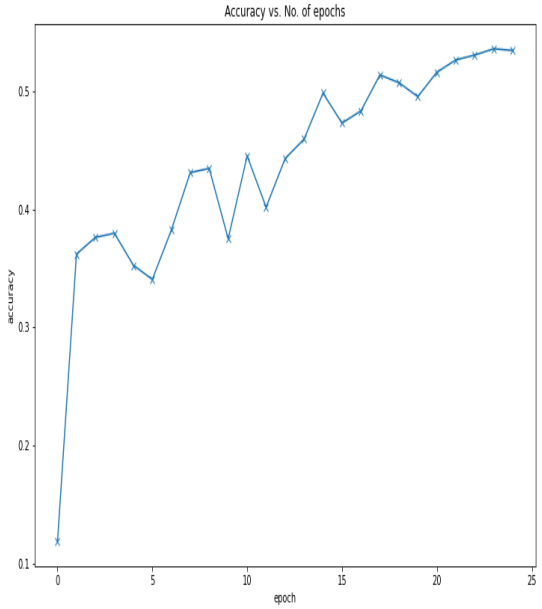
Results

Results of Real-time Emotion Detection using Web Cam

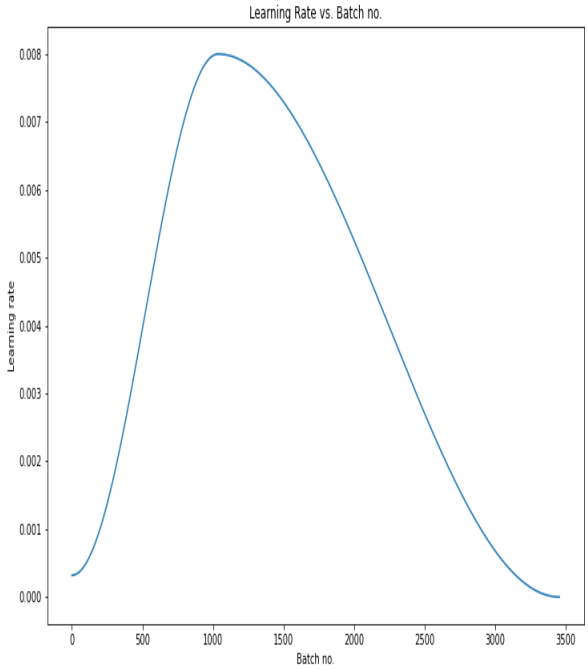


Result Analysis

Accuracy vs Epochs Plot



Learning Rate vs Batch No. Plot



REFERENCES

[1] Karen Simonyan, Andrew Zisserman. Very Deep Convolutional Networks for Large-Scale Image Recognition. 2014.

[2] Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun. Deep Residual Learning for Image Recognition. 2015.
[3] Kaiming He, Xiangyu Zhang, Shaoqing Ren, Jian Sun. Identity Mappings in Deep Residual Networks. 2016.
[4] Samira Ebrahimi, Vincent Michalski, Kishore Konda, Goethe Roland Memisevic, Christopher Pal—Recurrent Neural Networks for Emotion Recognition in Video‖,Kahou École Polytechnique de Montréal, Canada ; Universität Frankfurt, Germany; Université de Montréal, Montréal, Canada; 2015.
[5] Y. Fan, X. Lu, D. Li, and Y. Liu.Video-based Emotion Recognition Using CNN-RNN and C3D Hybrid Networks. Proceeding ICMI 2016 Proceedings of the 18th ACM International Conference on Multi- modal Interaction, Pages 445-450,Tokyo, Japan — November 12 - 16, 2016.
[6] Wei-Long Zheng1 and Bao-Liang Lu, Personalizing EEG-Based Affective Models with Transfer Learning, Center for Brain-like Computing and Machine Intelligence, Department of Computer Science and Engineering, Key Laboratory of Shanghai Education Commission for Intelligent Interaction and Cognitive Engineering, Brain Science and Technology Research Center, Shanghai Jiao Tong University, Shanghai, China. 2016
[7] Zixing Zhang, Fabien Ringeval, Fabien Ringeval, Eduardo Coutinho, Erik Marchi and Björn Schüller, Semi-Supervised Learning (SSL) technique
[8] Yelin Kim and Emily Mower Provos,Data driven framework to explore patterns (timings and durations) of emotion evidence, specific to individual emotion classes; University of Michigan