FACIAL EMOTION DETECTION USING CONVOLUTIONAL NEURAL NETWORK AND OPENCV

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Abstract: Human Emotion detection from image is one of the most powerful and challenging research task in social communication. Deep learning (DL) based emotion detection gives performance better than traditional methods with image processing. This paper presents the design of an artificial intelligence (AI) system capable of emotion detection through facial expressions. It discusses about the procedure of emotion detection, which includes basically three main steps: face detection, features extraction, and emotion classification. This paper proposed Convolutional neural networks (CNN) based deep learning architecture for emotion detection from images. The performance of the proposed method is evaluated using live video and stored images. The accuracies achieved with proposed model are 70.14 and 98.65 percentage for dynamic data respectively.

1. INTRODUCTION

The rapid development of artificial intelligence (AI) (Ustun et al., 2021), big data (Wang J. et al., 2020), and Blockchain technology (Lv et al., 2021a) has changed the social structure, talent demand, as well as the form of social education. Through traditional data acquisition methods, people need a lot of time and energy to collect data, which hinders the convergence and synchronization of art developed to a certain extent. With the rapid development of information technology, in the internet era, art information and exhibition information around the world can be known by global users in a very short time. People can easily collect landscape materials from all over the world online without leaving home. Meanwhile, the computer gave birth to new art forms and ideas. Through the computer, the scope of traditional art expression has also expanded from oil painting, traditional Chinese painting, printmaking, sculpture, watercolor, etc. to animation art, image art, photoelectric art, etc. through the sketches drawn by artists. The change in technologies has caused the innovation of the learning environment, and the intelligent learning environment with the Internet of Things (IoT) technology as the core has begun to attract extensive attention from people. In the intelligent learning environment, teachers carry out teaching activities online through the Internet, and learners can easily acquire and learn knowledge through the network. However, psychological research has shown that various emotions generated in the learning process can affect the learning effect. For example, positive emotions such as happiness and satisfaction generated in the learning process are conducive to raising learning interest, while emotions such as boredom and anxiety can hinder the cognitive process. In traditional teaching activities, face-to-face communication between teachers and students enables learners to maintain a positive interest in learning at any time. In contrast, it is difficult for teachers and students to feel each other's emotional state in time due to the constraints of time and space in the intelligent learning environment. Correspondingly, it is urgent to seek out an effective way to combine knowledge transmission with emotional communication in the current intelligent learning environment. Human emotions are complex and simple. As a smart species currently in the dominant position on the earth, humans can express emotions through various methods, such as voice, text, and facial expressions (Jain et al., 2019; Khare and Bajaj, 2020; Guanghui and Xiaoping, 2021). In the intelligent learning environment, emotion recognition of learners' images in class hours through computers and deep learning algorithms can facilitate timely monitoring of psychological and emotional states of learners. The emotion recognition through facial expression images requires high-quality cameras to capture facial images, resulting in high implementation cost. Therefore, the speech-based human emotion recognition method has gradually become the principal method to study human-computer emotion recognition. In the process of communication and expression, speech of humans not only contains semantic information, but also implies rich information like the speaker's emotion. Therefore, the research on emotion recognition based on human speech and image through computer and intelligent algorithms of deep learning is of great significance.Speech-based emotion recognition (Liu and Fu, 2021) has been using the method of acoustic statistical features since it was proposed in the 1980s. Until the 21st century, the fast-growing computer multimedia technology and the continuous breakthrough in the field of AI technologies have made great progress in speech-based emotion recognition. The traditional machine learning algorithms based on Gaussian mixture model (Tian et al., 2020), support vector machine (SVM) (Chuan et al., 2020), and artificial neural networks (Shao et al., 2020) have achieved brilliant results in speech-based emotion recognition tasks. However, the traditional machine learning algorithms have some defects in the accuracy of emotion recognition by speech and images. Improving the accuracy of emotion recognition by speech

and images based on existing technologies is a critical goal of AI and deep learning algorithms.

2. LITERATURE SURVEY

Yadan Lv et al. [5] in this paper implemented facial recognition via a deep learning algorithm. The parsed components help to detect the various types of the feature recognition technique; therefore, we do not need to add the additional feature for removing noise or any adjusting feature. The parsed technique is one of the most important techniques and a unique technique. Mehmood et al. [6] in this paper implemented the optimal feature selection and deep learning ensemble methods for emotional recognition from human brain EEG sensors. This paper implements the EEG feature extraction and the feature selection methods based on the optimization of the face recognition technique. Four types of emotional classifications are involved, namely, happy, calm, sad, and scared. The feature extraction is based on the optimal selected feature like the balanced one way ANOVA technique, so it provides better accuracy in the emotional classification. Additional techniques like the arousal-valence space provide enhanced EEG recognition. Li et al. [7] in this paper implemented the Reliable Crowd-sourcing and deep locality-preserving learning for expression recognition in the wild, for reducing the crowd-sourcing and the new locality loss layer preservation using a deep learning algorithm that is based on the RAFDB face recognition algorithm. Thus, the RAFDB expressed that the five different techniques, such as the calculation of the aged rat and the gender, the second step helps to identify the dimensional space of the image, and the third step helps to identify the two subsets. The first one contains seven types of emotions, and the second subset contains twelve types of emotions. The fourth one is identifying the accuracy, and the fifth one is classifying the images based on the input. Chen et al. [8] in this paper implemented the Soft-max regression-based deep sparse auto-encoder network for facial emotion recognition in human-robot interaction. This paper implements the SRDSAN technique, which helps to reduce the distortion and identify the learning efficiency and dimensional complexity, whereas the DSAN helps with accurate feature extraction and the soft-max regression helps to classify the input signal. Babajee et al. [9] in this paper implemented the identification of human expressions from facial expressions using a deep learning algorithm. This paper proposed the seven types of facial expressions recognition like happy, sad, etc., through deep learning using a convolutional neural network. Thus, this paper contains a dataset of 32,398 for collecting various types of emotional recognition using the Facial Action Coding System (FACS). This paper only depends on the identification method not working as the optimization method. Hassouneh et al. [10] in this paper implemented the development of a real-time emotional recognition system using facial expressions and EEG based on machine learning and deep neural network methods. This paper implements the optical flow algorithm for identifying facial regression using virtual markers. Therefore, the system of the optical flow algorithm helps to physically challenge people since it recognizes less computational complexity.

Tan et al. [11] in this paper implemented the short-term emotion recognition and understanding based on the spiking neural network modeling of the spatio-temporal EEG patterns using neuro-sense. This paper implements the SNN technique for the very first time. It helps to identify the functions of the brain system. The EEG data are measured by using two techniques like arousal-valence space. The arousal-valence space consists of four types of columns, namely, high arousal, low arousal, and high and low valence space techniques. Satyanarayana et al. [12] in this paper implemented emotional recognition using deep learning and cloud access. Facial emotional recognition is one of the most important techniques in various applications. The deep learning algorithm plays a vital role in face recognition. Her thesis paper collects various types of emotions like sadness, happiness, calmness, and anger reactions. Therefore, this information goes through the python code, and then it creates its own IP address for every technique. Jayanthi et al. [13] in this paper implemented an integrated framework for emotional classifications using speech and static images with deep classifier fusion. Emotion recognition is one of the crucial techniques for identifying the stress level in a human being. The two factors that play a crucial role in the identification of the stress level in the human body, namely, emotion recognition and speech modulation.

This paper introduced the integral framework for the calculation of the stress thesis; therefore, this paper includes both emotional recognition and speech modulations in the form of static function, which helps to identify the mental state of human nature. Therefore, this result gives better accuracy when compared to the other algorithms. Li et al. [14] in this paper implemented the survey of deep facial expression recognition. Face expression recognition is considered one of the major challenges in the network system. The major challenge in facial expression recognition (FER) is based on the lack of training sets and the unrelatable expression variations. In the very first case, the dataset is arranged in the allocation of the neural pipeline technique. This will help to reduce the challenging issues in the FER technique. Yadahalli et al. [15] in this paper implemented facial microexpression detection using a deep learning algorithm. This paper collects the eight layers of the dataset while using six types of emotions, namely, happiness, sadness, anger, fear, neutral, and surprised faces. The collected dataset contains the FER model; thus, this paper implies that the FER with a convolutional neural network enhances better accuracy, and the cleared output results in the multimodal facial expression using a single algorithm.

Yang et al. [16] in this paper implemented the three-class emotions recognition based on deep learning using a staked auto-encoder. This paper implements that the EEG signal is measured with discrete entropy calculation methods. The auto-encoder technique in the deep learning algorithm provides better accuracy than the calculation methods in the encoding system. The emotions in this technique are evaluated as the alpha, beta, and gamma values. It gives better accuracy and the classification results by using a deep learning algorithm. Normally, the deep learning algorithm provides good results for the multiple classifications of emotional recognition.

Asaju et al. [17] in this paper implemented the temporal approach to facial emotional expression recognition. This paper implements the various types of emotional recognition in the human body through a deep learning algorithm using a convolutional neural network. The VGG-19 methods are used for feature extraction. Then the facial emotion recognition and the accurate mapping technique are carried out by using the BiL-STM architecture.

Therefore, the CNN- BiL-STM technique is used to evaluate better accuracy and good classification results with the help of the deep learning neural network. Therefore, the Denver Intensity of the Spontaneous Facial Action (DISFA) dataset is used to detect the happy, sad, angry, and neutral faces in the techniques, and then the dataset for the effective state in the E-Environment (DAiSEE) dataset helps to detect the confusion and the irritation. Sati et al. [18] in this paper implemented face detection and recognition and face emotion recognition through NVIDIA. Jetson Nano, in this paper implements both face recognition and face emotional detection, traditional to the present facial emotional identifications are one of the most challenging techniques, by adding some features in this technique helps to provide the better accuracy and the classification results. The ANN technique helps to identify and recognize facial emotions. Rajan et al. [19] in this paper implemented the novel deep learning model for facial expression recognition based on maximum boosted CNN and LSTM and proposed a slightly different model with the boosted FER method, at very first preprocessing methods helps to reduce the noise in the given input function and reduces the dimensionality space function. And then the dual CNN technique is applied, and it becomes more and more boosted. Therefore, this paper finally shows that the combination of the LSTM and MBCNN makes it possible to produce highly accurate feature extraction and classification results. Mirsamadi et al. [20] in this paper implemented automatic speech emotion recognition using recurrent neural networks. This paper demonstrates that the RNN architecture for feature selection and the novel weighted time pooling strategy are involved in this paper, which helps to increase the salient features extraction.

The IEMOCAP is the new method being used for better classifications in emotional recognition. Therefore, the final results compare the IEMOCAP classifier with the traditional SVM-based SER using fixed design features. Domnich et al. [21] in this paper implemented the gender bias assessment in emotional recognition based AI method, this paper implements the overview of the facial emotion recognition based on the artificial intelligence method, The SASE- FE dataset is collected based on the gender basis. Therefore, this dataset is further classified into two types depending on the male and female categories; therefore, each group consists of three neural networks. This process is carried out with the testing and the training phase because some groups are ready to work and some are not available for instant work, and then this work will be split up into three different ways, such as the whole work collection and both female and male data are individually split. Therefore, this function makes us think that the result might be accurate and perfect.

Ekundayo et al. [22] in this paper implemented the multilabel convolution neural network for facial expression recognition and ordinal intensity estimation, as there are many functions that work with the emotional recognition technique such as FER, but none of them is apt for the perfect multiclass emotional classification technique. This paper implements the multilabel convolutional neural network. This multiclass emotional classification leads to interclass variation. This problem will be overcome by using enhanced ML-CNN with the Binary Cross Entropy (BEC) loss and the loss from an island. The VGG-16 helps to overcome the fitting process in this technique; therefore, this paper implements the Multilabel Kernel Nearest Neighbor and the MLARAM for feature extraction and the classification is done using a chain classifier. Wang et al. [23] in this paper implemented the recently advanced technique in deep learning. This paper implements the four-category model for deep learning. The first category consists of deep architectures and convolutional neural networks. The deep neural networks are majorly convinced by the deep learning model. It is one of the most important functions in the machine learning algorithm. It plays a crucial role in the data accuracy and the classification contains both linear and nonlinear specific functions. The convolutional neural network has three most crucial layers, namely, the convolutional neural layer, the pooling layer, and the fully connected layer. The convolution layer is the very first layer that adds some filters to reduce the noise and the dimensional space in the filter. The pooling layer in the CNN helps to reduce the over-fitting problem. Then the fully connected layer is arranged after the convolutional layer and the pooling layer. Therefore, it removes the inaccurate data in the function. In this paper Gnana et al. [24] implemented the literature review for the feature selection of high-dimensional data. The simplest way of the feature selection method in the data is set of all data are sent to the statistical measurement approach, therefore this

helps to the select the feature selection approach. There are four types of approach involved in the feature selection methods,

3. EXISTING SYSTEM

Facial emotions are important factors in human communication that help to understand the intentions of others. In general, people infer the emotional state of other people, such as joy, sadness and anger, using facial expressions. Facial expressions are one of the main information channels in interpersonal communication. Therefore, it is natural that facial emotion research has gained a lot of attention over the past decade with applications in perceptual and cognitive sciences . Interest in automatic Facial Emotion Recognition (FER) has also been increasing recently with the rapid development of Artificial Intelligent (AI) techniques. They are now used in many applications and their exposure to humans is increasing. To improve Human Computer Interaction (HCI) and make it more natural, machines must be provided with the capability to understand the surrounding environment, especially the intentions of humans. Machines can capture their environment state through cameras and sensors.

DISADVANTAGES

a. Low Accuracy to detect the human emotion from faces

4. PROPOSED SYSTEM

In this project, we use a deep learning technique called Convolutional Neural Networks(CNNs) to establish a classification model that combines feature extraction with classification to detect the facial emotions. To develop a facial expression recognition system. To experiment machine learning algorithm in computer vision fields. To detect emotion thus facilitating Intelligent Human-Computer Interaction. With the goal to improve the process of facial sentiment analysis systems, a classification mechanism is proposed using a CNN architecture. The goals of this project are to establish a model that can classify 7 basic emotions: happy, sad, surprise, angry, disgust, neutral, and fear.

ADVANTAGES

a. High picture quality improves the effectiveness of facial recognition
b. Even low resolution photographs are usable with the suggested method
c. Higher accuracy while being more computationally efficient.

SYSTEM ARCHITECTURE

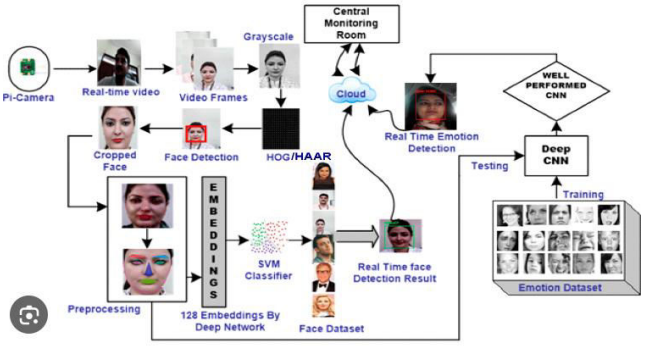

Fig 1: System Architecture

5. ALGORITHMS

5.1 Convolutional Neural Networks (CNN, or ConvNet) are a type of multi-layer neural network that is meant to discern visual patterns from pixel images. In CNN, 'convolution' is referred to as the mathematical function. It's a type of linear operation in which you can multiply two functions to create a third function that expresses how one function's shape can be changed by the other. In simple terms, two images that are represented in the form of two matrices, are multiplied to provide an output that is used to extract information from the image. CNN is similar to other neural networks, but because they use a sequence of convolutional layers, they add a layer of complexity to the equation. CNN cannot function without convolutional layers. In a variety of computer vision tasks, CNN artificial neural networks have risen to the top. It has picked people's interest in a variety of fields. A convolutional neural network is made up of numerous layers, such as convolution layers, pooling layers, and fully connected layers, and it uses a back propagation algorithm to learn spatial hierarchies of data automatically and adaptively. You will learn more about these terms in the following section

6. RESULTS

6.1 Output Screens

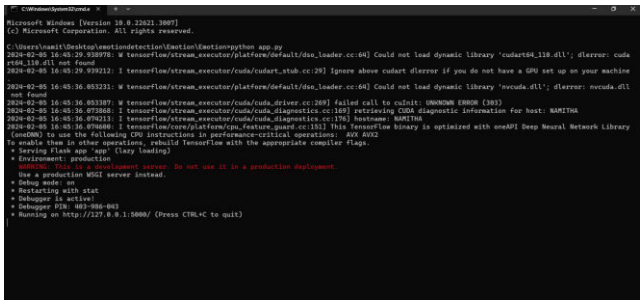

Fig 6.1 Run the app.py file

In the above screen shows the run the app.py file.

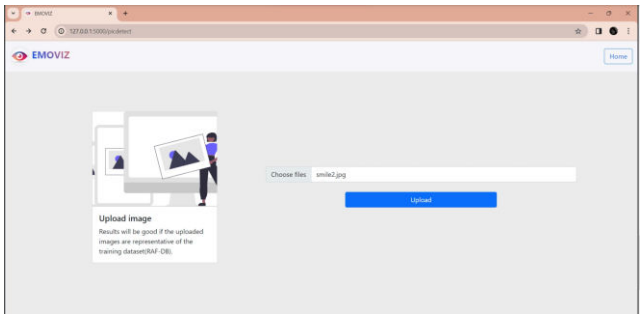

Fig 6.2 Upload the Image

In above screen shows the uploading the image.

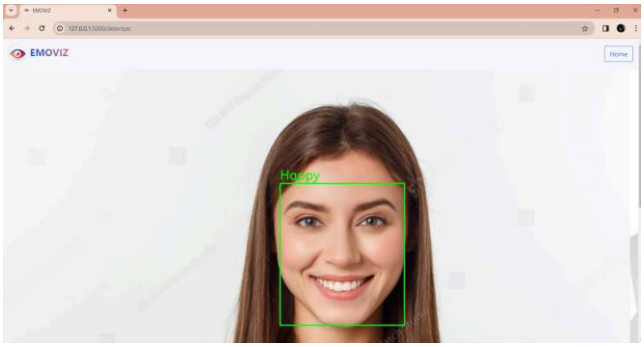

Fig 6.3 Rusult

In above screen shows the recognition of the human emotion

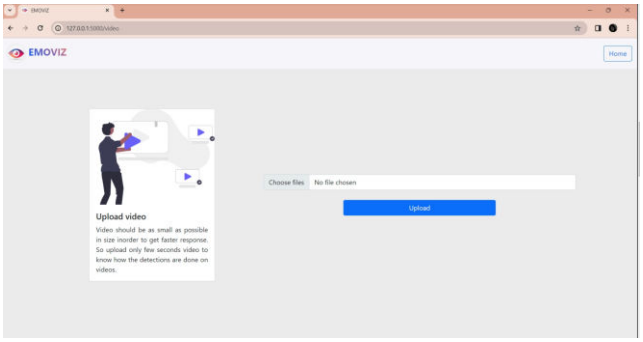

Fig 6.4 Upload the video

In above screen shows the upload the video.

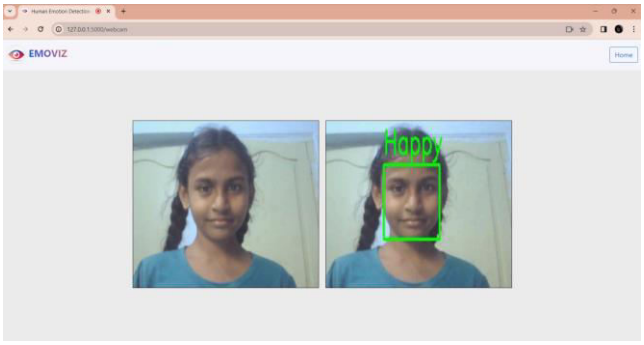

Fig 6.4 Result

In the above screen shows human emotion recognition from the video

7. CONCLUSION

This project proposes an approach for recognizing the category of facial expressions. Face Detection and Extraction of expressions from facial images is useful in many applications, such as robotics vision, video surveillance, digital cameras, security and human-computer interaction. This project's objective was to develop a facial expression recognition system implementing the computer visions and enhancing the advanced feature extraction and classification in face expression recognition. In this project, seven different facial expressions of different persons' images from different datasets have been analyzed. This project involves facial expression preprocessing of captured facial images followed by feature extraction using feature extraction using Local Binary Patterns and classification of facial expressions based on training of datasets of facial images based on CNN.

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