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Facial Expression Detection Using CNN Algorithm

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Abstract — This project introduces a real-time facial expression detection system developed in Python. It focuses on the importance of accurately detecting facial expressions for applications like human-computer interaction, emotion analysis, and psychology research. The system utilizes Python's image processing and machine learning capabilities to address the challenge of real-time detection and classification of facial expressions. It integrates advanced computer vision techniques to capture, preprocess, and analyze facial images from video streams. Additionally, the system is optimized for efficient performance across different hardware setups, making it suitable for real-world applications. It focuses on the importance of accurately detecting facial expressions for applications like human-computer interaction, emotion analysis, and psychology research. The system utilizes Python's image processing and machine learning capabilities to address the challenge of real-time detection and classification of facial expressions.

Index Terms— Facial Expression, Machine Learning, Deep Learning, SVM(Support Vector Machine), FER, Convolutional Neural Network, Accuracy Optimization.

I. INTRODUCTION

At present, an issue of excellent interest is the agreement bounded by information mirrored in and sent separately human face and the customer's concurrent sentimental knowledge. There are various current studies reporting judgments that first signs and verbalizations can supply acumens into the analysis and categorization of poignant states Many research everything have happened developed that are had connection with making the conduct of human. Human actions maybe acknowledged in the form of scaffolding, silhouettes, biography-metric walks and in the form of figures . Visual following method is secondhand for identifying whole of human conduct. Researchers secondhand various techniques to make human conduct to a degree hierarchic probabilistic approach , multi-modality likeness of intersections . Already earlier Darwin disputed that first expressions are worldwide, that is most sentiments are articulated in the same way on the human face however race or breeding. According to Darwin, first verbalization can influence the course of communication accompanying another woman when we express our feelings, belief, in addition to our intentions in an adept habit. In addition, in welcome studies of human management he explicitly states that aforementioned verbalizations more specify information about the intelligent state of one. This involves environments such as disinterest, stress, disorientation and so forth. Darwin's work is extraordinary cause at the time when he lived he had before pretended that poignant verbalizations are multimodal patterns of behavior, and accordingly settled welcome own itemized descriptions of the proofs of in addition 40 impassioned states . Although face verbalizations doesn't inevitably express emotions (such as the corporeal individuality of the face later stroke), when performing face discovery (if we are speaking about the brilliant plans research area), most of the authors of professional brochures concern the categorization of first face that was introduced by Ekman. This is cause different added empathy (in his ending Darwin recognized in addition 40 verbalizations), they are easily and without question capable of being traced. Classification model of 6 sympathy are : 1. satisfaction, 2. sadness, 3. surprise, 4. fear, 5. anger, 6. Disgust

II. LITERATURE SURVEY

Towards multimodal emotion recognition in e-learning environments.

This article presents a framework (FILTWAM (Framework for Enhancing Learning Through Webcams and Microphones)) for thinking in real time in elearning using webcams. FILTWAM provides timely and relevant feedback based on students' suggestions and comments. FILTWAM's facial recognition software module was developed and tested in a proof of concept study. The main aim of this study is to analyze the use of webcam data to quickly and adequately transform faces into emotional content. The software was calibrated by 10 testers.They received the same computerbased task in which they were each asked to follow a specific face 100 times. All sessions were video recorded.To validate the facial recognition software, two experts described and rated participants' behavior. When the results of the experts' study were compared with the software results, the overall kappa value was seen to be 0.77. Our software has an overall accuracy of 72% based on the needs of emotions and emotional intelligence. While current software only allows for continuous, continuous and interactive facial detection, our software can be continuous and

noninvasive to monitor student behavior and change those habits directly to the heart. This leads to ways to increase the effectiveness and efficiency of learning by keeping the student's thoughts in mind. Automatic facial expression analysis: A survey. Pattern RecognitionOver the years, automatic facial recognition has become afield of research that finds applications in areas such as humancomputer interaction, avatars, image retrieval,and human emotions. The face shows not only emotions but also other psychological, social and physical signs. In this survey, we present the most important automatic face analysis methods and systems in the literature. Facial motion and deformation extraction techniques and classification techniques are discussed, including topics such as facial normalization, facial expression, and facial reference, as well as their sensitivity to environmental change..

Facial recognition and analysis: technological advances.

Automatic recognition of facial expressions has been a subject of research since the early nineties. Over the past few years, some advances have been made in face detection and tracking, object removal techniques,and classification techniques. In this article, some studies published from 2001 to the present are examined. This article describes the progress in the field, the use of automatic face detection, the characteristics of the ideal system, the data used, and the progress in modeling, with detailed information on the state-of-the art.This article also discusses the recent advances in face detection, tracking and feature removal techniques. Emotions, expressions, and facial expressions are also noted, and six archetypal expressions are discussed along with recent research on teaching methods. The article concludes with a description of the challenges and future work. This article is written in a tutorial style and aims to help students and researchers new to the field.

Assessing emotions in intelligent teaching: What, when, and how to measure.

Affect or thought-oriented computing is new research but is still in its infancy. Since there is no such thing as a phenomenon, there are many research concepts, theories, models and tools along with the complexity of thinking. In this article, we will provide a critical review of the state-of-the-art in measurement theory, models and tools, and present some informal guidelines for practical use.

Face Recognition using SVM Algorithm.

This paper explains about the capturing of face and facial expression using an machine learning model algorithm Support vector Machine also known as SVM. It follows average pooling mechanism in order to achieve good results but may lack in some corners which also focuses on accuracy and the amount of data that is been processed. It follows a model of three-stage support vector machine. Privacy is also a very main constrain in this part of technology usage. Thus various other models have been explored for sustainability.

III. EXISTING SYSTEM

In recent years, CNN has been widely used in FER. CNN maps the image layer by layer and the final map is the result of feature extraction. Traditional CNN usually uses only the last set of algorithms for image classification. However, the features obtained through the average convolution process also have some information and some capabilities presented in the image. Rashid M proposed adeep learning method for accurate classification using fusion and selection of multiple deep layers. Ren proposed a CNNbased covalent detection model that has two main features, including the integration of multilayer convolutional features extracted from image clusters and temporal saliency expression. These show that using the features of the convolutional averaging process canimprove the representation ability of the image, thus improving the accuracy of the CNN. Moreover, CNN often uses SoftMax for classification, but experiments show that SoftMax is not suitable for the FER domain due to the discrimination of sentences. Many researchers have now combined the features provided by CNN with classifiers to achieve better performance and results. Continuing the hybrid classification and regression forest method, proposed a multilevel hybrid forest (MSHF) for the integration of head and prediction. Online training of SVM classifiers to identify objects and improve accuracy. The classification accuracy and robustness of SVM classifiers are better than traditional classifiers. Pham used five machine learning methods and analyzed their performance using ROC curves and metric-based methods

A. SUPPORT VECTOR MACHINE (SVM) ALGORITHM

SVM is often used in classification problems. They distinguish between two classes by finding the best hyperplane separating the closest data of different classes. The number of features in the input data determines whether the plane is a line in two dimensional space or a plane in n-dimensional space. Since many hyperplanes can be found to distinguish classes, distinguishing between points allows the algorithm to find the decision boundary between classes. This also allows it to generalize well to new data and make accurate distribution estimates. Lines adjacent to the ideal hyperplane are called support vectors because these vectors pass through the data points that determine the maximum.

IV. PROPOSED SYSTEM

Convolutional Neural Network(CNN) Algorithm

Convolutional neural networks are known for their advantages over other artificial neural networks due to their ability to process visual, text and audio data. CNN architecture consists of three main layers: convolution layer, pooling layer, and fully connected (FC) layer. Thiscan perform various convolution and pooling procedures. The more layers there are in a network, the more complex the machine learning model will (theoretically) be. Each additional layer of data processing improves the model's ability torecognize objects and patterns in the data.

CNNs often use ReLU (rectified linear unit) to transform each feature map after each merge to add nonlinear features to the ML model.. Convolutional layers are generally based on pooling layers. The convolution layer and pooling layer together form a block.Additional convolution blocks will follow the first block and create a hierarchical structure with the next layer learning from theprevious layer. For example, a CNN model can be trained to detect a car in an image. A car can be thought of as a balance of its parts, including the wheels, body, and doors. Each feature of the vehicle is equated to a low-level model that is recognized by the neural network and then combines these elements to create a high-level model.

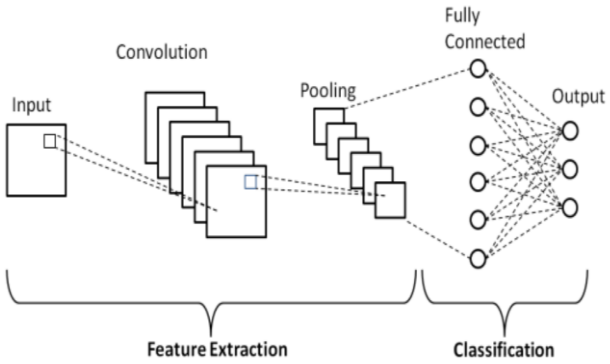

Figure 4.1: Overview of CNN.

Pooling or downsampling layers reduces the dimensionality of the input. Like the convolution process, pooling uses a filter to scan the entire input, but no weights. Instead, the filter uses an integrated circuit to create an output based on input values. Pooling has two main features:
Average pooling: The filter calculates the intake area, which is the average value when scanning the input area.
Maximum Pooling: The filter sends pixels with maximum pooling to the output. This method goes beyond average pooling.

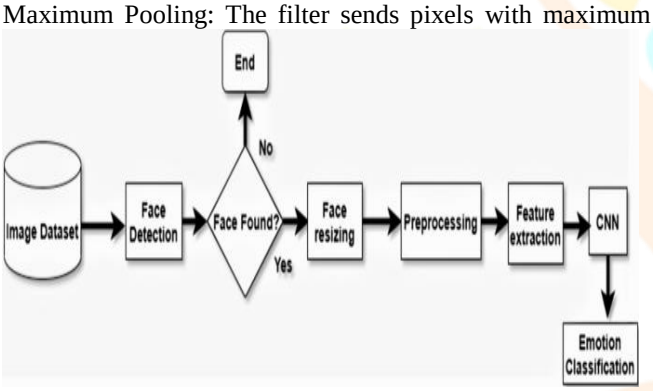

Figure 4.2: Block Diagram for Proposed System

FER generally consists of four steps. The first is to identify the face in the image and draw a rectangle around it, the next step is to define the characters in the area where the face is located.The third step is to extract the spatial and temporal features of the facial components.The last step is to use the extraction process (FE) and use the extracted product to obtain the result.The proposed facial image captured by the network era will be processed using the CNN algorithm, where the extraction takes place. The extracted data is then sent to the training model to determine the similarity between the current data and the previous data stored as data in the warehouse. If any of the required data matches the existing data, a flag is displayed for the face view.

V. RESULTS

Facial Expression Detection Interface

Figure 5.1: Registration Interface.

In above screen enter person ID and person name and then click on ‘Register Person’ button to capture person face and to get below screen

Figure 5.2: Training of Data

Here person face is captured and now we add this person to training model so while detecting expression person name can be identified. In above screen person registered as kumar.
This training data is seperatly stores in an another folder from when the labeled data can also be retrieved.
If the person is already registered then his/her details may be seen and if he is a new for the system then also it can show his expression but with a little lesser accuracy.
In case if the person is not registered and his/her data is not present in the database, in that case as well we may obtain the expression but with a little lower accuracy, because the output generated in that case would on the basis of the whole data that is present currently in the database and has been trained on thus lowering the accuracy a little bit.
If the person is registered before then that person id or name which ever information is stored while registration will be visible to the concerned authority.

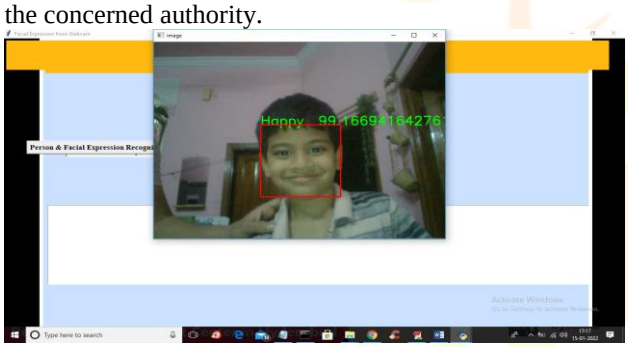

Figure 5.3: Facial Expression Recognition

In this project we have created two separate applications like Person Registration and Face Recognition.Using this application we can add details of the person like id,person's name and face.
Face recognition:Using this application we can guess the face and then to predict the people's emotions from the images.

VI. CONCLUSION

Face detection using convolutional neural networks (CNN)has become a powerful technique in computer vision. CNN performed well at tasks such as facial recognition.Compared with traditional methods such as reference or matching methods, CNN based face recognition generally output forms traditional methods in terms of accuracy and generality of invisible information.

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