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Performance Analysis of Child Emotion Detection using Haar Cascade and CNN

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Abstract*: A method for identifying human emotions from facial expressions is called facial emotion detection. This essay focuses on analyzing youngsters with autism's facial expressions to determine their feelings. In this research, five emotions are examined. These feelings include anger, surprise, sadness, happiness, and neutrality. Image processing and machine learning techniques are used to identify the emotions of autistic youngsters. The local binary pattern features are taken from the faces of youngsters with autism. Emotions are categorized using machine learning algorithms. Neural networks and support vector machines are two types of machine learning classifiers used in the classification process. Child age detection in film shots plays a vital role in ensuring compliance with age-restricted content regulations and safeguarding the well-being of underage actors. This abstract presents an overview of recent advancements, methodologies, and applications in using machine learning (ML) for child age detection.

Keywords: CNN, Num Py, Keras, Open CV.

I. INTRODUCTION

Facial expression recognition is a powerful tool for expressing our intentions, feelings, and knowledge to one another. It is a creative technology for computer-human interaction. Multiple studies have been completed to categorize face expressions. Facial expressions may represent five basic universal emotions: happy, sadness, anger, surprise, and neutral. In this project, a webcam can be used to implement emotion detection in real-time. The FER dataset would be used to train a model. Next, pre-processing is done on the photographs in the collection. This includes adjustments like image resizing and color mode changes, among other things. A multi-layer CNN model was then developed as a result. Subsequently, the model would be trained using the designated dataset, producing the pre-trained model file (.h5). This file can be used to anticipate the outcomes rather than continually training the model. It is also focused on the real-time analysis of people's problems and providing solutions based on their emotions; that is, it will automatically play a video-based solution when input indicates that a user is happy, sad, angry, surprised, or neutral [2]. Traditional facial expression recognition faces several challenges, including imbal anced data, privacy concerns, and limitations in handling only single-person facial images. For example, datasets containing human faces are often incomplete and limited due to privacy concerns. Additionally, the dataset also suffers from data sparsity due to the limited number of samples for specific emotion categories. Furthermore, existing facial emotion recognition systems are constrained by their ability to process only single-face images. Therefore, we adopted data augmentation to enhance the facial image and improve the data sparsity problem. Subsequently, a CNN with the Haar cascade classifier ensemble was employed as the backbone network for the method. While the CNN with the Haar cascade classifier approach may not necessarily yield the highest accuracy, it possesses the capability to perform real-time detection on multiple individuals. This makes it valuable in applications such as automatic attendance systems in classroom settings, negative emotion alerts for mental health patients, and surgical assessments for facial deformities. We pro pose a method for facial expression recognition with low-cost hardware. In this method, facial expression recognition is regarded as an emotion classification task. We augment the facial image data, utilize the Haar cascade classifier for face localization, and employ a convolutional neural network (CNN) for emotion classification [5].

II. LITERATURE SUREY

The machine immediately identifies the faces using the suggested algorithm. they took 200 pictures of one customer and group all photographs under one customer ID. they also capture the picture from real-time video [1]. This project utilizes facial expression recognition to detect emotions in real-time using the FER-2013 dataset. It employs OpenCV and a webcam to classify emotions. Additionally, it addresses real-life problems by automatically playing videos to help individuals overcome stress, fear, or anger based on their detected emotions [2][7][8][9].

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This study suggests that facial expressions can indicate attention in young children, with more expressive faces correlating with higher attentiveness. However, accuracy in detecting these expressions is limited by software capabilities, particularly with factors like head movements and partial face views [6]. The authors addressed the lack of children's emotional databases by creating one for kids aged 7 to 10, using 3D 468 landmark geometric points from LIRIS and their own datasets. They utilized seven CNNs and achieved up to 90.98% accuracy across four dataset versions [3]. These results were subject-independent and conducted under consistent conditions. However, real-world accuracy may vary due to individual variations in expressing emotions and other factors [4][10][11].

III. PROPOSED SYSTEM

The suggested method explains how it can accurately assess a child's focus by analyzing their facial expressions. For this research, forty (40) first-graders (1) participated. A webcam video that had been recorded served as the source of the data. In order to extract the essential facial traits for using the OpenFace application to determine the expression on each face, each video was processed frame by frame.

Training the Cascade Classifier: Initially, the Haar cascade algorithm requires training a cascade classifier using a large dataset of labeled facial images. These images contain examples of various facial expressions, along with annotations specifying the location of key facial features and the corresponding emotions. During training, the algorithm learns to distinguish between positive samples (images containing desired features) and negative samples (images without the desired features).

Feature Extraction: The Haar cascade algorithm employs a set of pre-defined features called Haar-like features, which are simple rectangular patterns used to represent local image characteristics. These features are calculated at different positions and scales across the image to capture variations in intensity. By evaluating these features, the algorithm can identify regions of interest that may contain facial features.

IV. ADVANTAGES

The ability of the feature extraction software correctly recognize the subjects' facial expressions from the provided regions of interest (mouth, eyes, and brows) and required data (appearance features, shape features, and action units of the student's face) is limited.The accuracy of identifying the facial expression is reduced by frequent head movements, side view faces, and postures in which the software cannot see or detect the entire region of the face. After obtaining the characteristics, the model's accuracy in identifying focus was 74.49%.

V. IMPORTING LIBRARIES

For successful implentation of this project, the following packages of Python and insalled NumPy, OpenCv and Keras libraries. A real-time emotion recognition system for children with autism is suggested in this section. The three steps of emotion recognition are face identification, facial feature extraction, and feature categorization. The Propound method can identify five different facial emotions: happy, anger, sadness, natural, and surprise. A Convolutional Neural Network (CNN) architecture for face expression identification is presented in this study. The proposed architecture does not require any physically constructed feature extraction and performs better than previous convolutional neural network-based techniques.

A. NumPy

A Python package called NumPy is used to work with arrays. It also includes functions for working with matrices, the Fourier transform, and linear algebra. In the year 2005, Travis Oliphant founded NumPy. You are free to use it as it is an opensource project. Numerical Python is referred to as Num Py. Lists can be used in place of arrays in Python, although processing them takes a while. Up to 50 times faster array objects than standard Python lists are what NumPy wants to deliver. The NumPy array object is known as ndarray, and it comes with a number of helpful functions that make using it simple. In data research, when resources and performance are critical, arrays are used regularly. A large portion of NumPy, a Python library, is written in C or C++, although the majority of the pixels that must be calculated quickly are written in Python.

B. OpenCV

A collection of Python bindings called OpenCV-Python is intended to address issues with computer vision. Python is a general-purpose programming language that was created by Guido van Rossum. It achieved popularity quickly, mostly due to its simplicity of use and readable code. Numpy is a highly efficient library for numerical operations with MATLAB-style syntax that is used by OpenCV-Python. Numpy arrays are transformed into and out of OpenCV array formats. Also, this allows interaction with other Numpy-using libraries like SciPy and Matplotlib. Since this section won't cover them, it is suggested that you have some previous knowledge of Python and Numpy. Writing efficient code with OpenCV-Python requires a solid understanding of Numpy.

C. Keras

An open-source, high-level neural network library designed in Python that can be used with CNTK, TensorFlow, or Theano is called Keras. Francois Chollet, one of the Google engineers, created it. It is designed to be modular, flexible, and easy to use in order to speed up deep neural network experiments. While it is unable to do low-level computations, the Backend library is used to solve the problem. It can operate on TensorFlow because the backend library acts as a high-level API wrapper for the low-level API

VI. FUTURE SCOPE

Future research on age and emotion recognition in children is extremely promising, particularly in the areas of child psychology, education, and healthcare. Here are a few specific points:

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Education: To give kids a more individualized learning experience, emotion detection technologies can be included into educational systems. Teachers can better engage pupils and meet their particular needs by recognizing their emotions and modifying their teaching methods and content accordingly. The process of age identification can also assist in adjusting instructional materials to correspond with a child's developmental stage.

Healthcare: In pediatric healthcare settings, emotion and age detection can be used to evaluate children's emotional health and, if necessary, give focused interventions. Early identification of emotional issues or developmental delays can be facilitated by it, enabling prompt support and therapies.

Child Psychology Research: To learn more about the behavior, development, and emotional patterns of children, researchers can use age and emotion detecting technologies. This may result in a deeper comprehension of the different elements affecting kids' cognitive and emotional growth.

Parental Guidance: Parents can benefit greatly from receiving insightful input on their child's emotional development and state using emotion detection instruments. This can encourage better parent-child connections by giving parents the confidence to provide their kids the right kind of support and direction.

kid Safety: By guaranteeing age-appropriate access to internet information and services, age detection technology can improve kid safety precautions. In order to notify caregivers in the event of distress or possible danger, emotion detection can also be included into child safety devices or platforms. Ethical Considerations: Privacy, permission, and data protection are important ethical issues that need to be taken into account while using technology with children. To protect children's wellbeing, ethical norms and appropriate data use must be given top priority in this field's future advances. In general, child emotion and age detection has great potential to improve many facets of children's lives in the future, but in order to assure appropriate and advantageous implementations, ethical and privacy problems must be carefully considered.

VII. RESULT AND DISCUSSION

Fig 1: Result Image

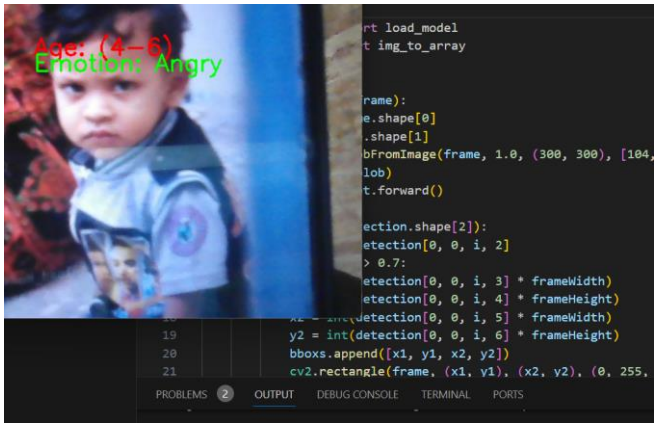

Fig 2: Result Image

VIII. CONCLUSION

This study provides evidence that younger children's facial expressions can be used to identify and detect attention. The more likely they are to react and use their faces to communicate, the more probable it is that they will pay attention. Individuals identified as having multiple. These identical subjects, whose expressive looks indicated that they were paying close attention, also scored higher on the exam and in the interview.

The ability of the feature extraction software to accurately identify the subjects' facial expressions from the provided regions of interest (mouth, eyes, and brows) and required data (appearance features, geometry features, and action units of the student's face) is constrained. Continuous the accuracy of identifying the facial expression is reduced by head movements, side view faces, and postures where the entire region of the face cannot be viewed or identified by the program. After obtaining the characteristics, the model's accuracy in identifying attentiveness was 74.49%. Since the researchers had only utilized a 10- to 15-minute film, they suggest creating a deeper video for the individuals to watch. Additionally, it would allow them to assess how expressive they were in the initial few minutes against the last few.

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Authors Contributions	All authors have equal participation in this article.

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