Stochastic Modelling and Computational Sciences

EMOTIONS ANALYSIS USING DEEP LEARNING

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ABSTRACT
This research project in Computer Science and Engineering addresses the crucial need for understanding human emotions in an increasingly digitized society. Focusing on Emotion Analysis and Recognition (EAR), the study explores groundbreaking applications in industries such as healthcare, education, mental health and transportation safety. Specifically, the project aims to contribute innovative solutions in the field of Emotions Analysis and Recognition (EAR) which can facilitate the problem of mental health and related issues to the EAR. The objectives include improving user experiences in human-computer interaction. The methodology involves a comprehensive approach, integrating video stream processing, facial tracking, emotion analysis to create a robust model. The anticipated impacts span diverse domains, from academia to industry, promising advancements in accuracy, innovation and healthcare. This project signifies a significant stride towards leveraging technology for the betterment of society, addressing real-world challenges in the society and human-computer interaction.

Keywords: Emotion Analysis, Emotions Recognition, Facial Recognition, Deep Learning, EAR.

I. INTRODUCTION
Understanding human emotions has become a crucial task with significant changes and upgrades in a society that is being more and more digitally connected in recent times. Emotion Analysis and Recognition (EAR) has been a groundbreaking pathway in human - computer interaction. It helped in revolutionizing several industries like healthcare, education, and many more. Moreover EAR has helped in several aspects of mental health analysis as well as solving all of the related problems.

The base emotions includes seven emotions which include anger, disgust, fear, happiness, neutral, sad and surprise. This project focuses on the journey of the domain of Emotion Analysis and Detection with applications like mental health, analysis for data driven applications, rage detection and many more. The project applies the latest as well as the cutting edge technologies and algorithms of deep learning for the emotions recognition and the analysis part. In today's world, the world is not only becoming more digitized, but also indulges and participates in the activities in the online and digital mode which includes, learning, studying, giving exams and interviews and much more. Emotions can be a way which falls under the category of nonverbal communication. Humans use their emotions to show their feelings, their conditions and get emotionally connected with other people and entities. Thus analyzing and detecting emotions can help a lot in the modern day world to help analyze the state and conditions of their minds which can be helpful to developing analytics data and developing modern day applications. The solution to this idea is proposed with the help of CNN i.e. Convolutional Neural Networks which can be implemented in a Deep Learning Model and can provide a deeper insight for analyzing the emotions of a human being.

II. LITERATURE SURVEY/REVIEW
[1] Emotions and their role in human's life
Emotions have played a very important role in human beings' lives from a very early age. Scholars have proposed different theories about emotions and emotional intelligence from the very early ages as much as 200 years ago. Ekman and Friesen listed five basic emotions that are in human beings, joy, sorrow, anger, fear and disappointment.

With the increasing digital adoption of technologies, emotional analysis and recognition (EAR) has become the need of the hour.

These techniques can be helpful to build more cognitive and interactive applications in the future which can be a breakthrough in human-computer interaction.

[2] Multimodal approach to face detection and tracking

The approach tends to explain the detection and tracking of faces which is used for several applications. The emotion detection model will also be dependent on the face detection and tracking which is going to act as a primary step for the process of EAR to give relevant output.

[3] Deep Learning and Neural Networks

The concept of deep learning can really come in handy when training a deep neural network for the CNN architecture for the model to complete EAR over the face.

Deep learning consists of training a neural network with millions of parameters over the dataset which can help build a feature map in the vector space to be able to draw the inference over the model.

Several Convolutional and Pooling layers are used in these Deep Neural Networks with their own activation functions specific to their architecture.

This process also helped in the detection of face and drawing a rectangle around it for ease of tracking and analysis.

[4] Facial Emotions Analysis using Deep Convolutional Networks

Using the techniques of deep convolutional networks, facial emotions analysis can be done. Several popular datasets like FERC can be used for this purpose. The model proposes a CNN which can process the face of a human through several convolution and pooling layers which can propose a value which can determine the state of emotion of the person.

[5] Modified CNN architecture analysis for Facial Emotion Recognition

The following model also proposes a deep learning based convolutional model for facial recognition and emotions analysis. The model uses a dataset to train the model with 12 layer architecture of Convolutional Neural Networks which includes a combination of convolutional and pooling layers for developing the CNN architecture. This can help in analysis of the emotion detected through the input module.

III. RELATED WORK

In the world of related works, a good amount of research has been conducted in the domains closely aligned with the objectives of this project. Noteworthy studies in the field with the techniques leveraging facial analysis, eye tracking, and EAR have been done, emphasizing the critical role of computer vision in addressing this safety concern [1] [6]. Multimodal approaches to face detection and tracking have been explored as well as implemented, shedding light on the importance of accurate and robust techniques for emotion analysis and recognition [2]. Vision-based frameworks have been proposed, indicating the potential of emotion analysis in enhancing mental health. road safety by identifying and mitigating aggressive behavior and much more [3]. Furthermore, advancements in deep learning, particularly the use of Convolutional Neural Networks (CNNs), have been pivotal in facial emotion analysis, offering sophisticated and well established models capable of discerning complex emotional states from facial expressions [4] [5]. These existing works lay a strong foundation for the current project, providing valuable insights and methodologies that can be leveraged and extended to address the need for EAR.

Additionally, studies exploring the ethical implications and privacy concerns associated with similar projects contribute significantly to the overarching understanding of implementing emotion analysis in real-world scenarios. The recognition of potential privacy issues and the need for localized, edge-based processing mechanisms which stores and inference over a client's data at the customer side itself, as opposed to cloud-based

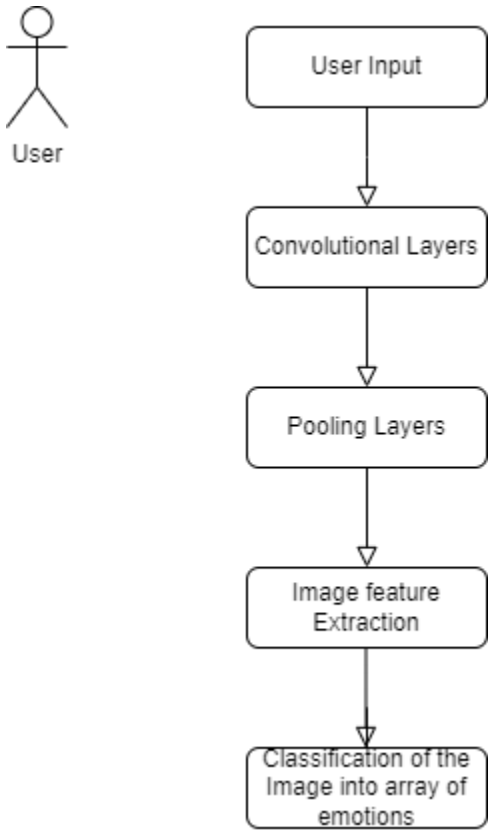
solutions, has emerged as a critical aspect [7]. Cross-domain applications have also been examined, indicating the potential for integrating emotion analysis models into various sectors, such as healthcare and customer service. These interdisciplinary investigations underscore the broader societal impact and applications that extend beyond the immediate scope. By delving into these related works, this project not only builds upon the existing knowledge base but also strives to address emerging challenges and ethical considerations crucial for the responsible implementation of emotion analysis technologies in diverse domains.

IV. IMPLEMENTATION AND RESULTS

The implementation of the proposed research methodology in the project involves the integration of advanced technologies and machine learning models to address the critical issues of emotions analysis and recognition. The initial steps, including video stream capture and processing using OpenCV libraries, lay the foundation for upcoming next stages. The facial recognition model successfully tracks faces amidst varying environmental conditions, providing essential input for subsequent analyses by the model. The model dedicated to eye and facial expression detection works utilizing machine learning techniques to show six types of emotions that are, angry, disgust, fear, happy, neutral, sad and surprise. The model is made of 11 layers with a combination of convolutional and pooling layers. The pooling algorithms that are used in the model are MaxPooling which helps in the building of a feature map in the CNN architecture. The model currently stands at an accuracy of 72.8% up to which it can easily detect human emotions.

There are combinations of 5 convolutional layers and 5 pooling layers, each placed sequentially in a consecutive manner.

The last layer is a mapping layer with an activation function of softmax.



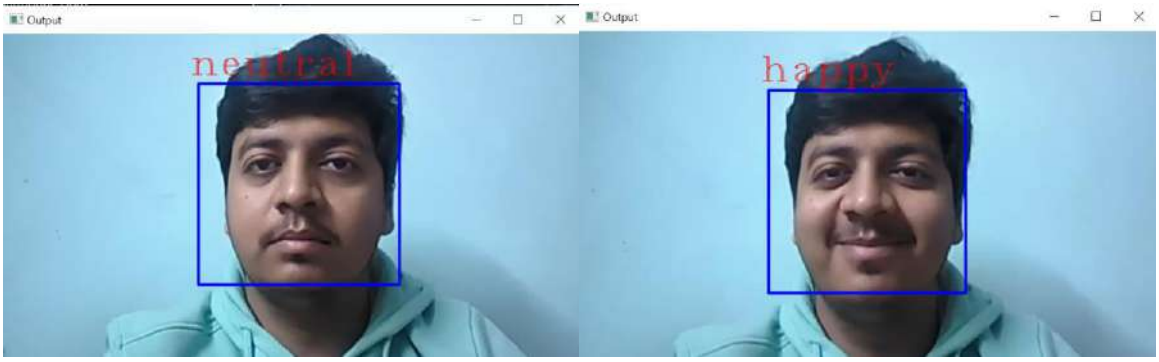
Furthermore, works to improve a model's accuracy are under way. The real-world application of this methodology in rage detection which represents a significant stride towards enhancing passenger and driver

safety, mental health analysis that can be done during any online activity such as studying as well as giving assessments. The results obtained from the implementation showcase the potential of a proposed system which can be documented for the analysis of emotional mental problems at a broader level. Furthermore, the integration of this system is not only limited to its immediate applications in transportation safety and mental health but also extends to broader implications for industries relying on human-computer interaction. The successful implementation of the proposed methodology promises astounding results for revolutionizing user experience design and customer service in diverse sectors. The adaptability of the models, capable of categorizing and responding to a spectrum of emotions, positions this system as a potential catalyst for building empathetic and personalized user experiences. Beyond its immediate applications, the research results open avenues for cross-domain utilization, getting the way for advancements in healthcare, where emotion analysis can be applied for patient well-being assessments, or in customer service, where it can contribute to understanding and addressing user needs more effectively. As such, the outcomes of this implementation not only mark a significant stride in transportation safety by rage and anger detection, but also hold the potential to transcend into various domains, fostering innovation and advancements in human-computer interaction and well-being.

The results are effectively shown below here, which describes the emotions of a human and shows some examples regarding the same.

The last layer of the model acts as the classification layer which classifies the output in the array of the classified categories. This type of classification is called multi-class classification which is helpful in the classification of multiple labels, which in our case is the categories of the emotions of a human being.

The multi class classification can be further expanded into a large number of classes which totally depends upon the broader range of emotions that are covered.



V. CONCLUSION

In conclusion, this research project represents a substantial contribution to the evolving field of Emotion Analysis and Recognition (EAR). The meticulously designed research methodology, employing advanced technologies and machine learning models, offers a comprehensive solution to the pressing challenges of detecting human emotions. The successful implementation of the proposed system showcases its adaptability and potential applications beyond its initial scope, impacting not only the mental health sector, but also user experience design and customer service in various industries. The promising results obtained from the implementation affirm the efficacy of the models in enhancing overall experience of the users. By addressing critical issues related to rage and emotional well being of a person, this project stands as a testament to the transformative power of technology in fostering safer and more secure environments. The interdisciplinary nature of the research further hints at the far-reaching implications of its outcomes, potentially influencing diverse domains and opening new frontiers for innovation and human-computer interaction.

VI. REFERENCES

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