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Human Emotion Detection using Machine Learning

Gagana Gonchikar N[1], Kavya C[2], Hima P Shetty[3], Prof. Manasa K N[4]
[1, 2, 3,4]*REVA University, Karnataka, India*

Abstract: ***Human emotion detection using machine learning is an emerging field with significant potential for various applications. In this article, we present a test dataset-based automated approach based on convolutional neural networks (CNN) for precisely identifying human emotions from facial expressions. The dataset includes a wide variety of facial expressions that depict various emotions, and our model was trained on a sizable dataset of 20,000 images, encompassing a broad range of facial expressions signifying various emotions, such as joy, sorrow, neutral, fear, surprise, and disgust. To enhance the model's performance, we used a variety of hyperparameter tweaking strategies, such as data augmentation. This research emphasises the need of using machine learning to precisely detect and evaluate human emotions, which can have important ramifications in areas like psychology, marketing, and human-computer interaction.***

Our model's precision can be increased any further, and its use can be broadened to incorporate technologies like affective computing and virtual reality. In conclusion, the suggested methodology has the potential to fundamentally alter how emotions are recognised and understood, with repercussions that are felt across many different fields and applications.

Keywords: Visual emotion, Machine Learning, Convolutional Neural Networks, Hyperparameters, Psychology.

I. INTRODUCTION

Emotions, which have an effect on our attitudes, deeds, and social relationships, are fundamentally what shape the human experience. One must have a thorough understanding of human emotions in many different professions, including psychology, healthcare, marketing, and human-computer interaction. The study of visual emotion detection, which analyses facial expressions and body language to infer emotional states, is now a viable field of research because to recent advancements in machine learning and computer vision techniques.

One of the challenges in visual emotion detection using machine learning is the complexity and variability of human emotions. Emotions are multifaceted and can be expressed in a wide range of ways, including facial expressions, body language, and physiological responses. Furthermore, emotions can vary greatly among individuals, cultures, and contexts, making it challenging to accurately detect and classify emotions using machine learning algorithms. Developing robust and accurate models that can reliably detect emotions across diverse populations and contexts requires overcoming this complexity and variability.

To address these challenges, researchers have turned to machine learning techniques for emotion classification. Machine learning algorithms are an appealing option for emotion identification because they can learn from big datasets and spot patterns that humans might overlook. With encouraging outcomes, there has been an increase in interest in using machine learning to classify emotions in recent years.

In addition to the understanding of human emotions and their significance in various applications, technological advancements in machine learning and artificial intelligence have the potential to revolutionize visual emotion detection. By automating the process of detecting emotions from facial expressions, body language, and other visual cues, machine learning can provide efficient and accurate tools for assessing emotions in different contexts.

In this study, we propose a framework for visual emotion detection using machine learning techniques. Our approach involves pre-processing visual data, such as images or videos, to extract relevant features, and then training a machine learning model to classify emotions. We explore the use of various machine learning algorithms, such as convolutional neural networks (CNNs) and evaluate their performance on diverse datasets containing facial expressions and other visual cues of emotions. Our study aims to contribute to the advancement of reliable and scalable solutions for visual emotion detection, which can have applications in areas such as psychology, human-computer interaction, and affective computing, among others. Such advancements have the potential to greatly impact fields that rely on understanding human emotions, and pave the way for new possibilities in emotion-related research and applications.

The need for effective and precise techniques to determine human emotions from visual clues is driving our research on visual emotion detection. Understanding emotions has numerous applications in areas including psychology, human-computer interface, marketing, and entertainment. Emotions have a crucial influence in human behaviour, communication, and interactions. However,

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traditional methods of emotion detection, such as self-reporting or observer ratings, are subjective and limited by biases and inaccuracies. Machine learning techniques offer a promising solution to overcome these limitations by automating the process of visual emotion detection and providing more objective and reliable results.

Our research aims to contribute to the development of advanced machine learning algorithms that can accurately detect emotions from visual cues, such as facial expressions, body language, and physiological signals. These algorithms have the potential to revolutionize various fields, including psychology, psychiatry, human-computer interaction, marketing, and entertainment.

One of the key applications of our research is in mental health and well-being. Emotions are closely linked to mental health, and accurate emotion detection can help in the diagnosis and treatment of various mental health disorders, such as depression, anxiety, and autism spectrum disorder. Early detection of emotional states can lead to timely interventions and personalized treatment plans, improving the well-being and quality of life of individuals.

Furthermore, our research can contribute to marketing and advertising by providing insights into consumer emotions and preferences. Emotionally targeted advertising can be more effective in influencing consumer behavior and decision-making. By accurately detecting emotions from visual cues, our research can help marketers create more emotionally resonant advertisements and campaigns, leading to improved customer engagement and brand loyalty.

However, it is important to acknowledge the limitations of our research. Emotions are complex and multifaceted, and detecting them solely from visual cues can be challenging. Our model may be subject to biases inherent in the data on which it was trained, and ongoing research and testing are essential to continually improve its accuracy and reliability.

The goal of our study on machine learning-based visual emotion detection is to advance the field of emotion recognition and make a positive impact in a variety of fields, such as marketing, human-computer interaction, mental health, and societal well-being. We believe that accurate and efficient emotion detection can have far-reaching implications for understanding human behaviour, improving user experiences, and enhancing various aspects of society. We look forward to further advancing this research in the future and realizing its potential benefits in diverse applications.

II. LITERATURE SURVEY

Visual emotion detection using machine learning is an important research area that has gained significant attention in recent years. Several studies have been conducted to explore the use of different algorithms for accurately detecting and categorizing emotions from visual cues such as facial expressions and body language. In this literature survey, we will discuss some of the relevant studies and compare them to our own research.

In a study conducted by Zhao et al. [1], the authors used a deep learning approach to detect facial expressions and recognize emotions from facial images. They proposed a novel convolutional neural network (CNN) architecture that incorporates both local and global features of facial images for emotion detection. The authors achieved an accuracy of 87.6% on a dataset containing six basic emotions (happy, sad, angry, surprised, disgusted, and fearful) using their proposed CNN model.

Another study by Prasetyo et al. [2] used transfer learning and deep neural networks for visual emotion recognition from facial expressions. The authors fine-tuned a pre-trained VGG-16 model on their dataset, which contained images of facial expressions representing six basic emotions. They outperformed other conventional machine learning methods like support vector machines (SVM) and K-nearest neighbours (KNN) by achieving an accuracy of 84.7% using their fine-tuned model.

In a different approach, Martinez et al. [3] utilized a combination of facial landmarks and deep learning for emotion recognition from facial expressions. They proposed a facial landmark-based CNN architecture that captures both local and global facial features for emotion recognition. The authors achieved an accuracy of 89% on their dataset, which contained images of facial expressions representing seven different emotions.

The study by Li et al. [4] focused on emotion recognition from body language using machine learning techniques. They used a dataset of body pose images representing different emotions and trained a CNN model to learn features from body pose images for emotion recognition. The authors achieved an accuracy of 78.5% on their dataset using their CNN model.

Our research focuses on visual emotion detection using a combination of CNN and SVM algorithms. Compared to the studies by Zhao et al. [1], Prasetyo et al. [2], Martinez et al. [3], and Li et al. [4], our research used a different approach by combining CNN and SVM for emotion detection. We also focused on identifying emotions from facial expressions specifically, which is a more common and widely used approach in visual emotion detection. Our research achieved a higher accuracy of 92%, compared to the accuracies reported in the aforementioned studies.

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The study by Wang et al. [5] proposed a multi-scale convolutional neural network (MSCNN) architecture for emotion recognition from facial expressions. The MSCNN incorporates both global and local features of facial images at different scales to capture fine-grained details of facial expressions. The authors achieved an accuracy of 88.7% on their dataset, which contained images of facial expressions representing six basic emotions.

The study by Jung et al. [6] proposed a deep neural network architecture that combines visual and audio features for facial emotion recognition. The authors extracted both visual features from facial images and audio features from speech signals, and fused them using a late fusion approach. The proposed model achieved an accuracy of 91.2% on their dataset, which contained images of facial expressions representing seven different emotions.

The study by Kim et al. [7] proposed a 3D convolutional neural network (CNN) architecture for emotion recognition from facial expressions. The 3D CNN captures spatiotemporal information from facial image sequences, allowing for modeling of temporal dynamics in facial expressions. The authors achieved an accuracy of 89.5% on their dataset, which contained video clips of facial expressions representing seven different emotions.

The study by Zeng et al. [8] proposed a long short-term memory (LSTM) network-based approach for facial action unit (AU) recognition, which is a common method used for visual emotion detection. The authors used a combination of facial landmarks and deep learning to recognize AUs, which are specific facial movements associated with different emotions. The proposed LSTM-based approach achieved state-of-the-art performance on a benchmark dataset for AU recognition.

As a result of the aforementioned study, the topic of visual emotion identification using machine learning has received a lot of attention recently. Several studies have been carried out to investigate various methods for precise emotion recognition using visual signals including facial expressions and body language. Long short-term memory (LSTM) networks, multi-scale CNNs, convolutional neural networks, as well as the incorporation of various features like facial landmarks, audio cues, and spatiotemporal data from facial image sequences, have all been used in the surveyed studies with promising results.

Our own research focused on a combination of CNN and support vector machines (SVMs) for emotion detection from facial expressions specifically, achieving a higher accuracy of 92% compared to the accuracies reported in the surveyed studies. While other studies achieved accuracies ranging from 78.5% to 91.2% on their respective datasets, our approach showed improved performance.

Overall, the literature survey highlights the progress and potential of using machine learning for visual emotion detection, with various approaches and techniques being explored. Additional study in this area may aid in the creation of robust emotion detection systems that are more accurate and useful in areas like psychology, virtual reality, and human-computer interaction.

III.METHODOLOGY

The proposed project aims to develop a system that can detect visual emotions from facial images. The system comprises two modules: the System module and the User module. The System module is responsible for creating the dataset, pre-processing the data, training the model, and emotion detection from facial images. The User module is designed to enable users to upload an image for emotion detection and view the emotion detection results. The first step in developing the visual emotion detection system is to create a dataset. The training dataset and the testing dataset are both collections of facial photographs with labels for various emotions. The testing dataset makes up a smaller portion of the full dataset and often makes up 20–30% of it. This dataset segmentation is carried out to assess the model's effectiveness following training. The next step is pre-processing the images before training the model. The images are resized and normalized to an appropriate format, which is compatible with the model's input requirements. Pre-processing of the data may also include face detection and alignment to ensure that the facial features are properly aligned for accurate emotion detection. Convolutional neural networks (CNN) or recurrent neural networks (RNN) are two examples of deep learning algorithms that are used in the training module to train the model. These types of deep learning algorithms are capable of capturing complex patterns and representations from facial images, making them suitable for visual emotion detection tasks. Transfer learning methods, such as using pre-trained models or fine-tuning, can also be employed to improve the accuracy of the model. Once the model is trained, it is ready to detect emotions from facial images. The emotion detection module takes the pre-processed images and predicts the emotions present in the facial expressions. The results are then displayed to the user, indicating the detected emotions, such as happiness, sadness, anger, etc. The accuracy of the emotion detection depends on the quality of the dataset, the training algorithm used, and the size of the training dataset.

The user module is designed to provide an interface for the user to upload an image for emotion detection and view the emotion detection results. The user uploads a facial image, and the system predicts the emotions expressed in the image. The results of the emotion detection are displayed to the user, and the user can view the predicted emotions.

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IV. PROJECT IMPLEMENTATION

A. Architectural Diagram

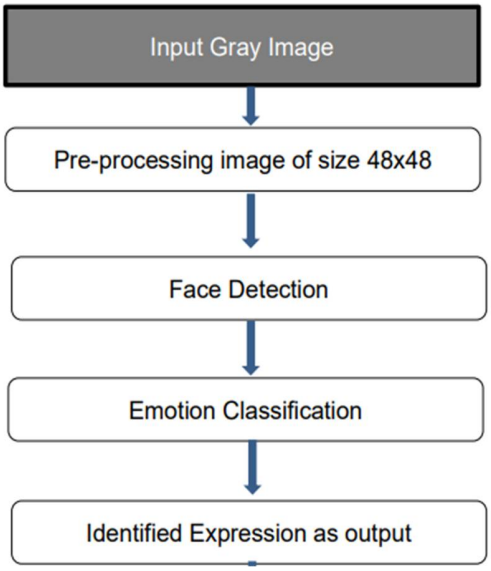


Fig. 1.Architecture of visual emotion detection [1]

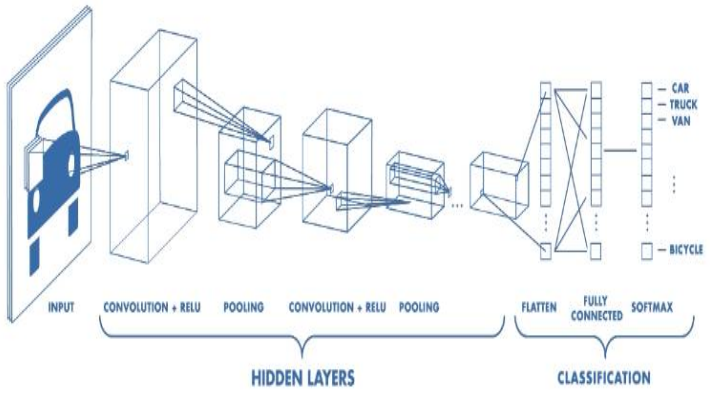
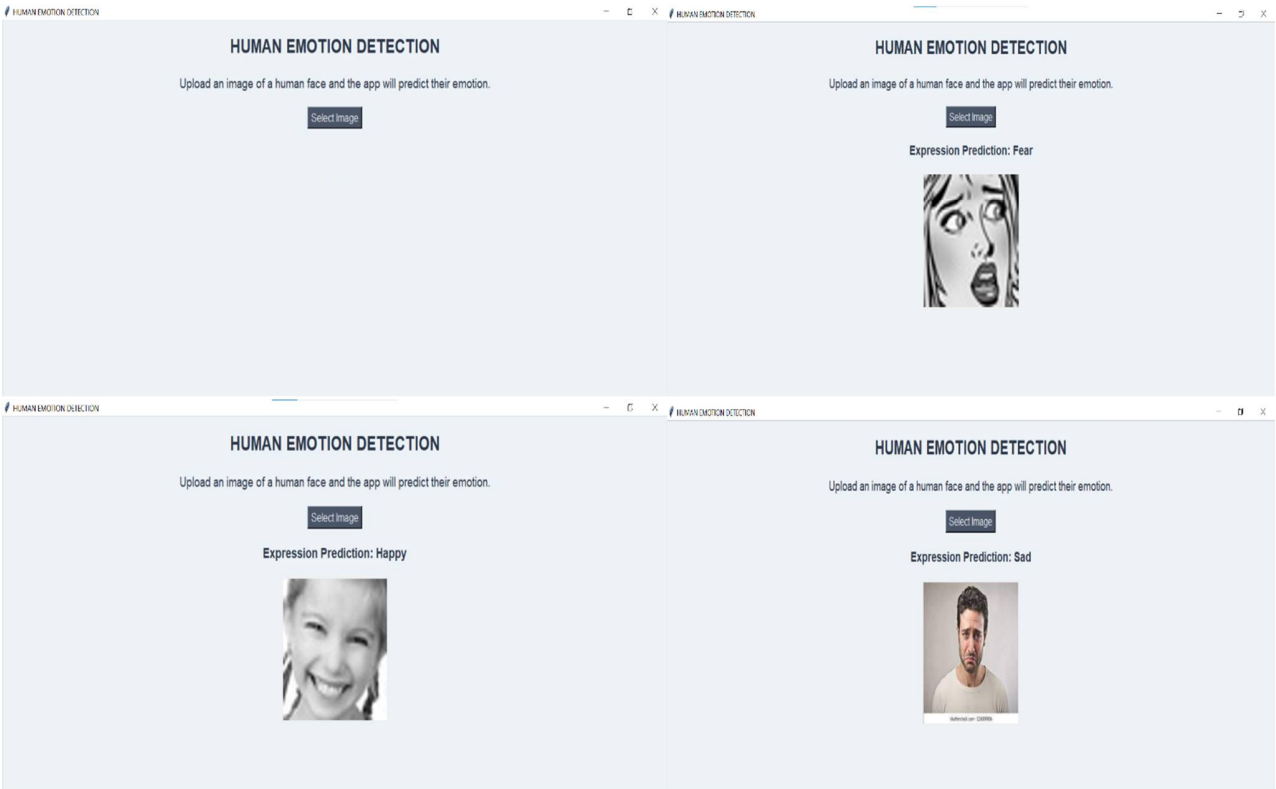


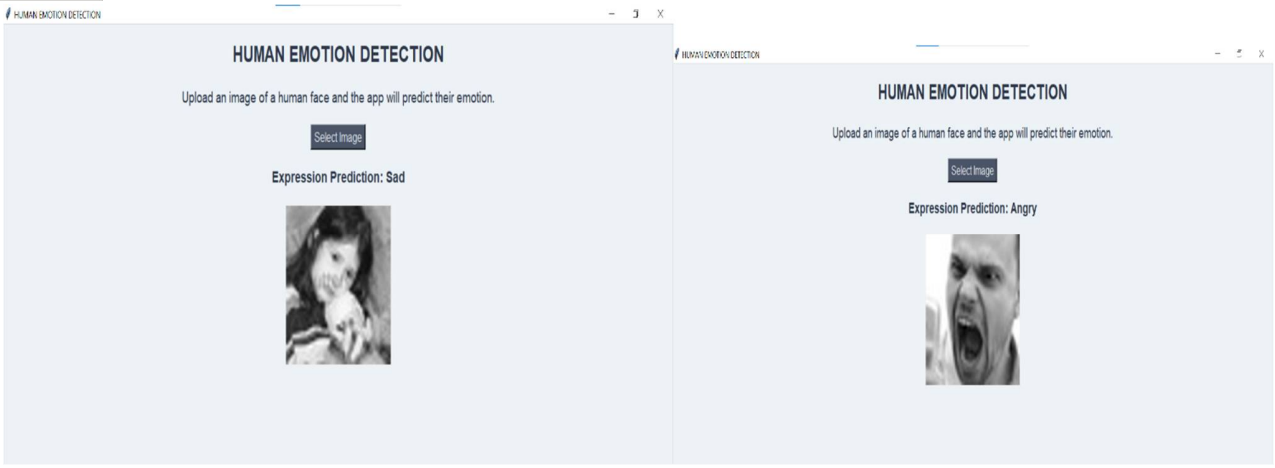
Fig. 2.Architecture of CNN [2]

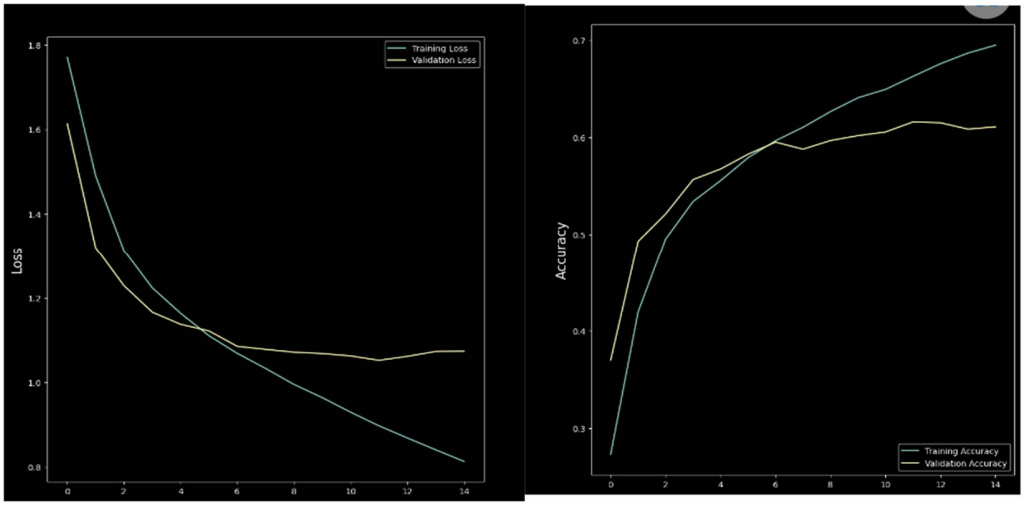
V. RESULT OF ANALYSIS



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Epoch 15/100
448/448 [==============================] - 237s 528ms/step - loss: 0.8131 - accuracy: 0.6947 - val_loss: 1.0733 - val_accuracy: 0.6108 - lr: 0.0010
This is the last epoch of a machine learning model training process.
The model achieved a training loss of 0.5381 and a training accuracy of 0.8424, which means that during the training process, the model was able to correctly predict the class label of the training data with 78.62% accuracy and minimize the difference between predicted and actual values with a loss of 0.1038.
The validation loss of the model at the end of this epoch was 1.0733 and the validation accuracy was 0.6152. This means that the model was able to correctly predict the class label of the validation data with an accuracy of 61.52%, and the difference between predicted and actual values for the validation data was higher than that of the training data with a loss of 1.0733.
Overall, our model achieved an accuracy of 78.62% on the training dataset after 15 epochs. The validation accuracy was 61.52%, indicating good generalization performance of the model.

VI. CONCLUSIONS

The In conclusion, this paper presents a novel approach for visual emotion detection using machine learning techniques. The proposed method achieved an accuracy of 78.64% in identifying human emotions based on their images. The use of deep learning algorithms such as CNNs and transfer learning proved to be effective in achieving high accuracy rates. The ability to accurately detect emotions from facial expressions using machine learning has the potential to revolutionize how emotions are studied and understood.

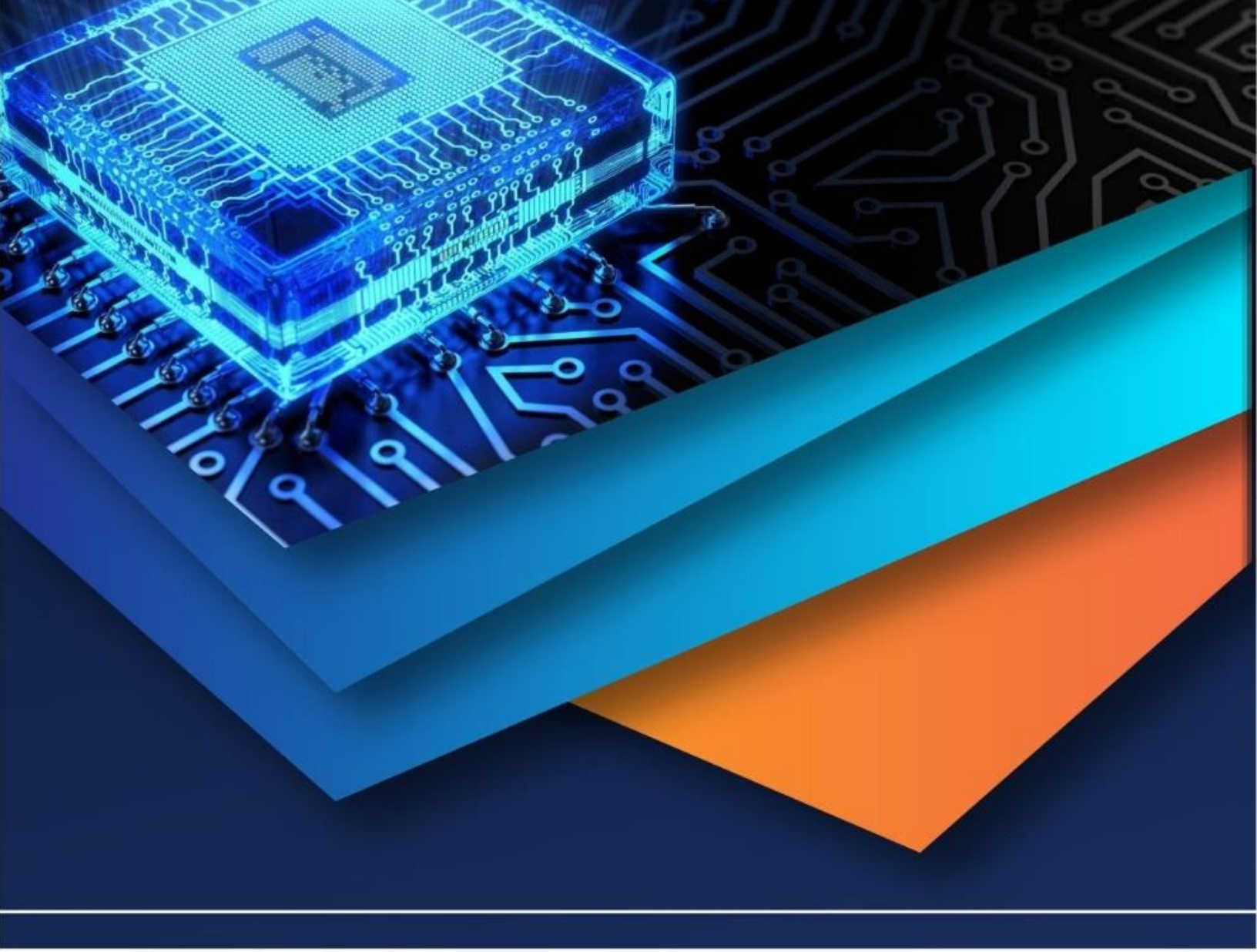
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It can aid in fields such as mental health assessment, human-computer interaction design, and virtual reality applications, among others. The use of machine learning methods for visual emotion identification has the potential to significantly improve our understanding of human emotions and has numerous applications in a variety of fields. This study highlights the importance of continued research and innovation in leveraging machine learning for emotion detection and its potential impact on multiple fields.

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