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Emotion Analysis from Customer Shopping Experience using ML

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Abstract: ***Understanding how customers feel is one of the most valuable insights a business can gain. Traditionally, companies depend on surveys, ratings, or written feedbacks to collect reviews—but these methods are often time-consuming, biased, or ignored by users. With the rapid advancement of Artificial Intelligence (AI) and Machine Learning (ML), it is now possible to automatically detect and interpret human emotions using technologies like facial recognition, video analysis, and Natural Language Processing (NLP). This paper presents a comprehensive survey of the latest research efforts aimed at improving customer feedback systems using AI-powered emotion recognition. Many researchers try to understand emotions such as happiness, sad, anger, neutral, surprise by studying people's facial expressions, often using images or videos taken from cameras or webcams. Popular techniques include Convolutional Neural Networks (CNNs) for image-based emotion classification, Support Vector Machines (SVMs) for quick categorization. This document gives formatting instructions for authors preparing papers for publication in the Proceedings of an IEEE conference. The authors must follow the instructions given in the document for the papers to be published. You can use this document as both an instruction set and as a template into which you can type your own text. Keywords: Emotion Recognition, Facial Expression Recognition, Machine Learning, CNN, Viola-Jones Algorithm***

I. INTRODUCTION

In today's fast-moving world of online shopping and smart retail, understanding how customers feel has become crucial for improving their experience and making better business decisions. Traditional feedback methods like surveys or star ratings don't always give a complete picture of a customer's true emotions. That's why Facial Expression Recognition (FER) and Machine Learning (ML) are becoming important tools—they can detect and analyse emotions in real time without needing customers to say anything. People's facial expression usually says a lot about how they feel. Using Artificial Intelligence (AI), these expressions can be analysed automatically.

This process involves three main steps: first, the system detects a person's face using the Viola-Jones algorithm; second, it extracts important facial features; and finally, it uses a Convolutional Neural Network (CNN)—a powerful deep learning model—to recognize emotions like happiness, sadness, anger, fear, surprise, and more. This research builds a real-time AI system that can analyse customer emotions while they shop in places like malls, supermarkets, or service centres. The goal is to help businesses better understand customer mood and satisfaction, so they can adjust services accordingly. By combining computer vision and deep learning technologies, this project supports the growing field of affective computing— where machines can understand human emotions.

This approach makes it easier and quicker to understand how people feel, allowing businesses to tailor their services and improve the overall customer experience.

II. LITERATURE REVIEW

The facial expression recognition system presents a robust face recognition model based on the mapping of behavioral and physiological biometric variables. The physiological properties of the human face that are relevant to various expressions such as happy, sad, neutral, anger, surprise, are linked to geometrical structures that are reconstituted as the recognition system's basis matching template. This work focuses on analyzing live facial expressions of consumers who are viewing a certain product, allowing us to conduct a real-time assessment of that product and score it based on the customer's facial expression analysis results. This product rating will assist the business owner in increasing product sales while also ensuring that the top items are available for his clients. This feature is significantly more accurate and quicker than previous techniques, which had a greater margin of error.

III. PROBLEM STATEMENT

In today's digital commerce environment, understanding customer sentiment is essential for delivering meaningful shopping experiences. Traditional feedback methods such as surveys, ratings, and review forms provide limited insight, as they fail to capture the emotional depth of customer interactions. These approaches mainly rely on structured data, which often overlooks subtle emotions like satisfaction, frustration, or loyalty.

This limitation is more evident in online and e-commerce platforms, where the lack of face-to-face interaction makes it difficult to interpret emotional cues. As a result, businesses struggle to gain a complete and real-time understanding of customer experiences. Additionally, existing systems rarely present sentiment insights through interactive or visual interfaces that support timely decision-making.

Hence, there is a growing need for intelligent systems that can analyze and interpret customer emotions from feedback sources such as text, voice, and social media using artificial intelligence and natural language processing techniques.

IV. METHADOLOGY

A. System Architecture

The workflow begins by capturing customer facial expressions using a webcam or image input. The acquired frames are preprocessed through grayscale conversion, noise reduction, and resizing to ensure consistency. Face detection is then performed using a Haar Cascade classifier, and the extracted facial region is passed to a Convolutional Neural Network (CNN) for emotion classification into categories such as happy, sad, angry, or neutral. The recognized emotions are stored in a MySQL database along with corresponding product information and time Tkinter-based graphical user interface, enabling smooth and user-friendly interaction.

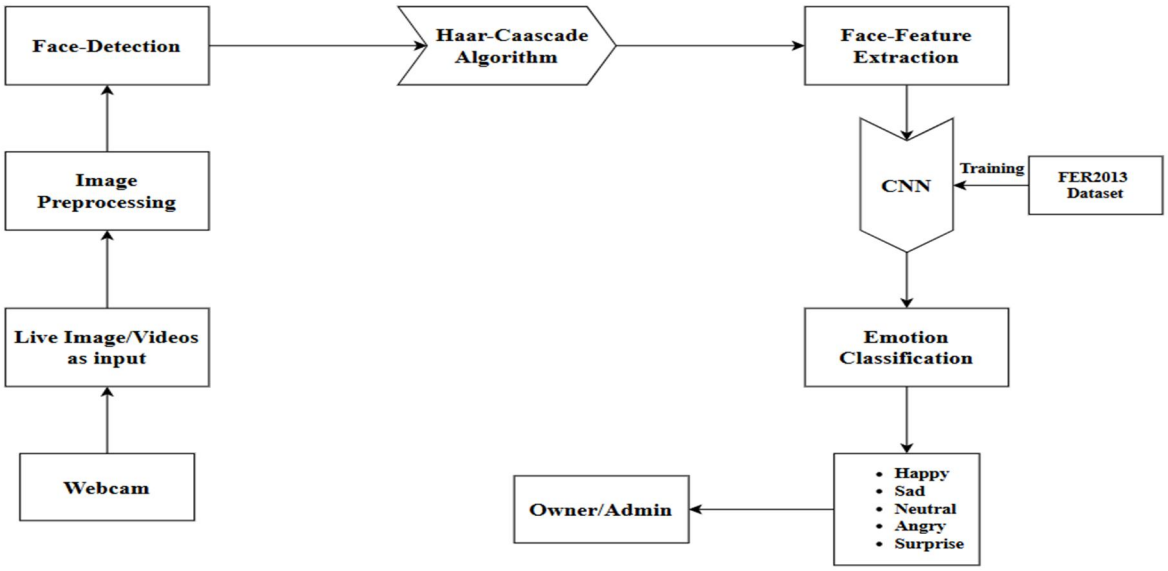

Figure 1: System Flow Diagram

B. AI Model Integration

The AI model integration is a key component of the proposed system, enabling effective recognition of customer emotions from facial expressions. A Convolutional Neural Network (CNN) is used to automatically extract facial features and classify emotions such as happy, sad, angry, and neutral. The trained model is integrated with the application to process real-time facial inputs captured through a webcam. The model interacts seamlessly with the face detection, database, and visualization modules, ensuring efficient emotion analysis with low processing delay. This integration supports reliable real-time operation and provides meaningful emotional insights into customer shopping experiences.

C. Detection Process

The detection process begins with capturing the customer's facial image using a webcam during product interaction. The acquired frame is preprocessed by converting it to grayscale, reducing noise, and resizing to maintain uniform input dimensions. A Haar Cascade classifier is then applied to detect and extract the facial region from the image. The detected face is passed to a trained Convolutional Neural Network (CNN), which analyzes facial features and classifies the emotion into predefined categories such as happy, sad, angry, or neutral. The predicted emotion is recorded along with relevant product details and time information for further analysis. This process operates in real time, enabling continuous monitoring of customer emotional responses during shopping activities.

D. User Education

User education plays an important role in ensuring effective interaction with the proposed emotion analysis system. Users are guided on proper camera positioning, lighting conditions, and basic system operation to ensure accurate emotion detection. Clear instructions are provided through the graphical user interface to help users understand how facial data is captured and analyzed. Additionally, stakeholders are informed about how emotional insights can be interpreted and used to improve customer experience and product strategies. This awareness ensures ethical usage of the system while maximizing its practical benefits in real-world shopping environments.

E. Multimodal Data Handling

The proposed system supports multimodal data handling to enhance the accuracy of customer emotion analysis. In addition to facial expression data captured through a webcam, the system can incorporate related contextual information such as product details and time-based interaction data. Each data modality is processed independently and then combined at the analysis stage to provide a more comprehensive understanding of customer behavior. This multimodal approach helps reduce ambiguity caused by relying on a single data source and improves the reliability of emotional insights. By integrating multiple data streams, the system delivers richer and more meaningful interpretations of customer shopping experiences.

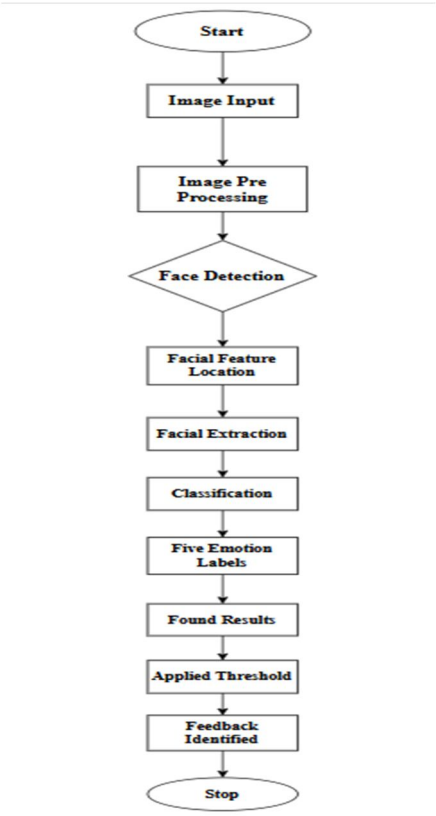

Figure 2: Deepfake Detection Framework

V. RESULTS

The experimental results demonstrate that the proposed emotion analysis system effectively identifies customer emotions from facial expressions in real-time shopping scenarios. The Convolutional Neural Network accurately classified emotions such as happy, sad, angry, surprise and neutral, even under moderate variations in lighting and facial orientation. The integration of face detection, emotion classification, and database storage enabled continuous tracking of customer emotional responses associated with specific products. Visual analysis through graphical representations revealed clear emotion trends, helping interpret customer satisfaction levels more intuitively. The results indicate that the system provides meaningful emotional insights that go beyond traditional feedback methods, supporting its practical applicability in improving customer experience and decision-making processes.

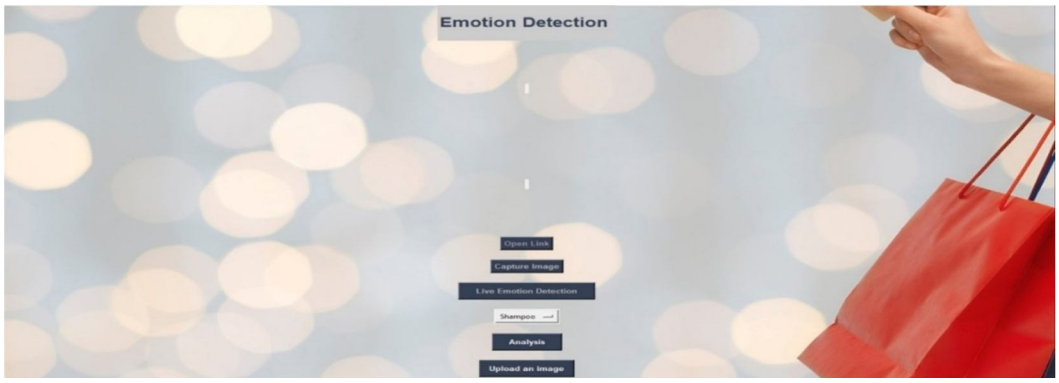

Figure 3: Interface for getting facial emotions

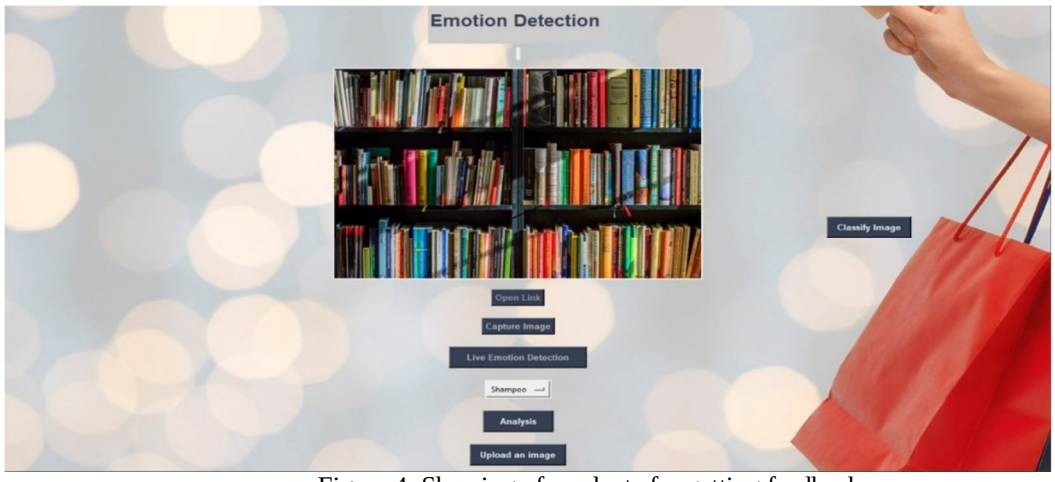

Figure 4: Showing of products for getting feedback

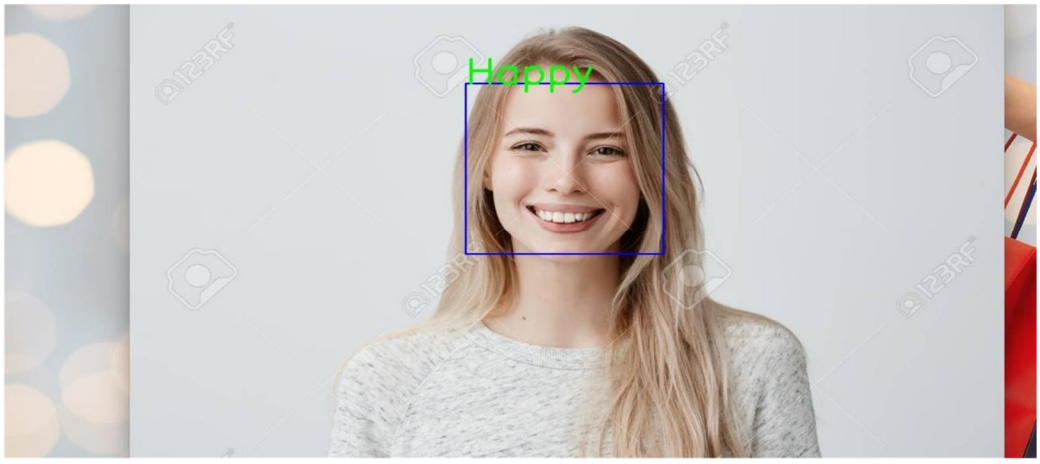

Figure 5: Capturing the feedback through facial emotion

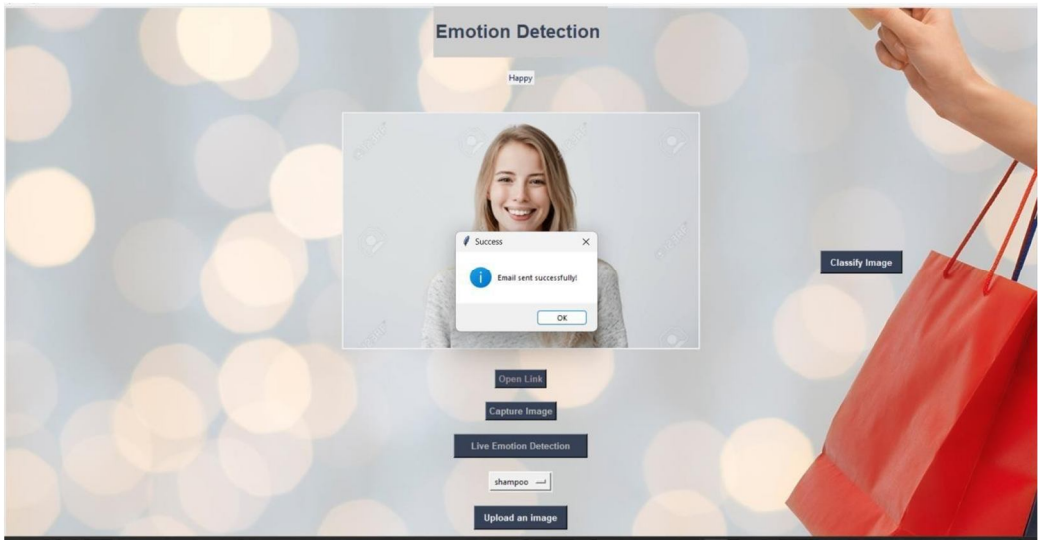

Figure 6: Trigger message to acknowledge the owner through email

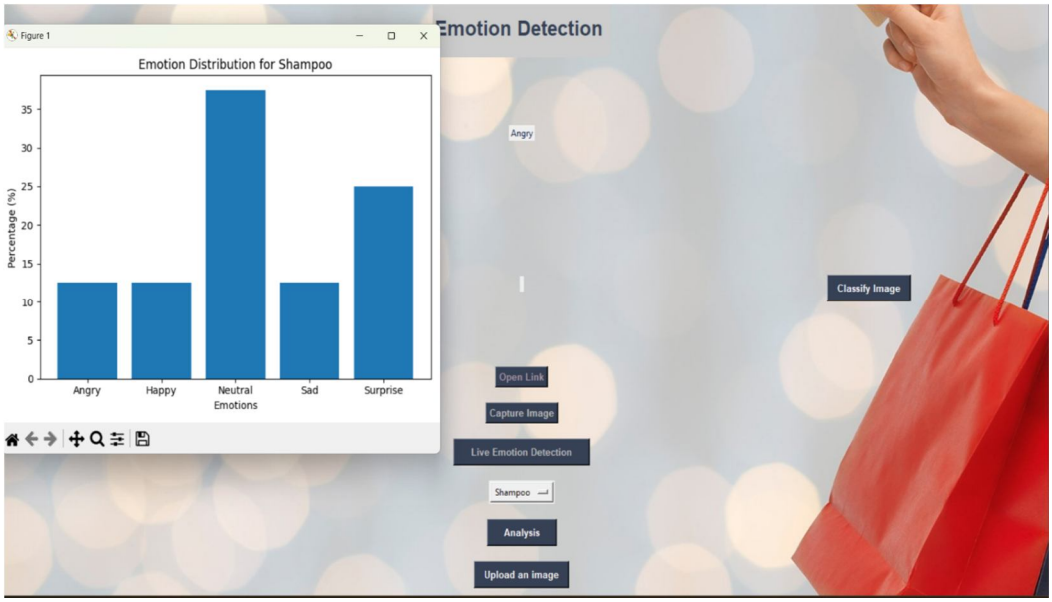

Figure 7: Emotion Analysis using Bar graph

VI. ADVANTAGES

The proposed emotion analysis system offers a reliable and non-intrusive way to understand customer behavior by capturing real-time facial expressions during shopping interactions. By reducing dependence on manual surveys and ratings, the system provides more natural and unbiased feedback. The use of machine learning enables accurate emotion recognition with minimal human intervention, while real-time processing supports immediate insight generation. Integration with database storage and visual analytics allows businesses to track emotional trends across products and time periods. Overall, the system enhances decision-making, improves customer experience, and supports scalable deployment in modern retail environments.

VII. LIMITATIONS AND FUTURE WORK

Although the proposed system demonstrates effective real-time emotion recognition, its performance may be influenced by factors such as lighting conditions, camera quality, facial occlusions, and variations in head pose. The current implementation focuses primarily on facial expressions and considers a limited set of emotion categories, which may not capture the full emotional spectrum of customers.

In future work, the system can be enhanced by incorporating multimodal inputs such as voice tone, textual feedback, and behavioral cues to improve accuracy and robustness. Additionally, expanding the training dataset and adopting advanced deep learning architectures could further strengthen emotion recognition performance and enable broader application across diverse shopping environments.

VIII. CONCLUSIONS

The paper presented an intelligent emotion analysis system designed to understand customer shopping experiences using machine learning techniques. By analyzing facial expressions in real time, the proposed approach captures natural and unbiased emotional responses without relying on traditional feedback mechanisms. The integration of face detection, deep learning–based emotion classification, data storage, and visual analytics demonstrates the system's effectiveness in providing meaningful insights into customer behavior. The results indicate that such AI-driven emotion analysis can support better decision-making, improve customer satisfaction, and enhance overall shopping experiences, highlighting its potential for practical deployment in modern retail environments.

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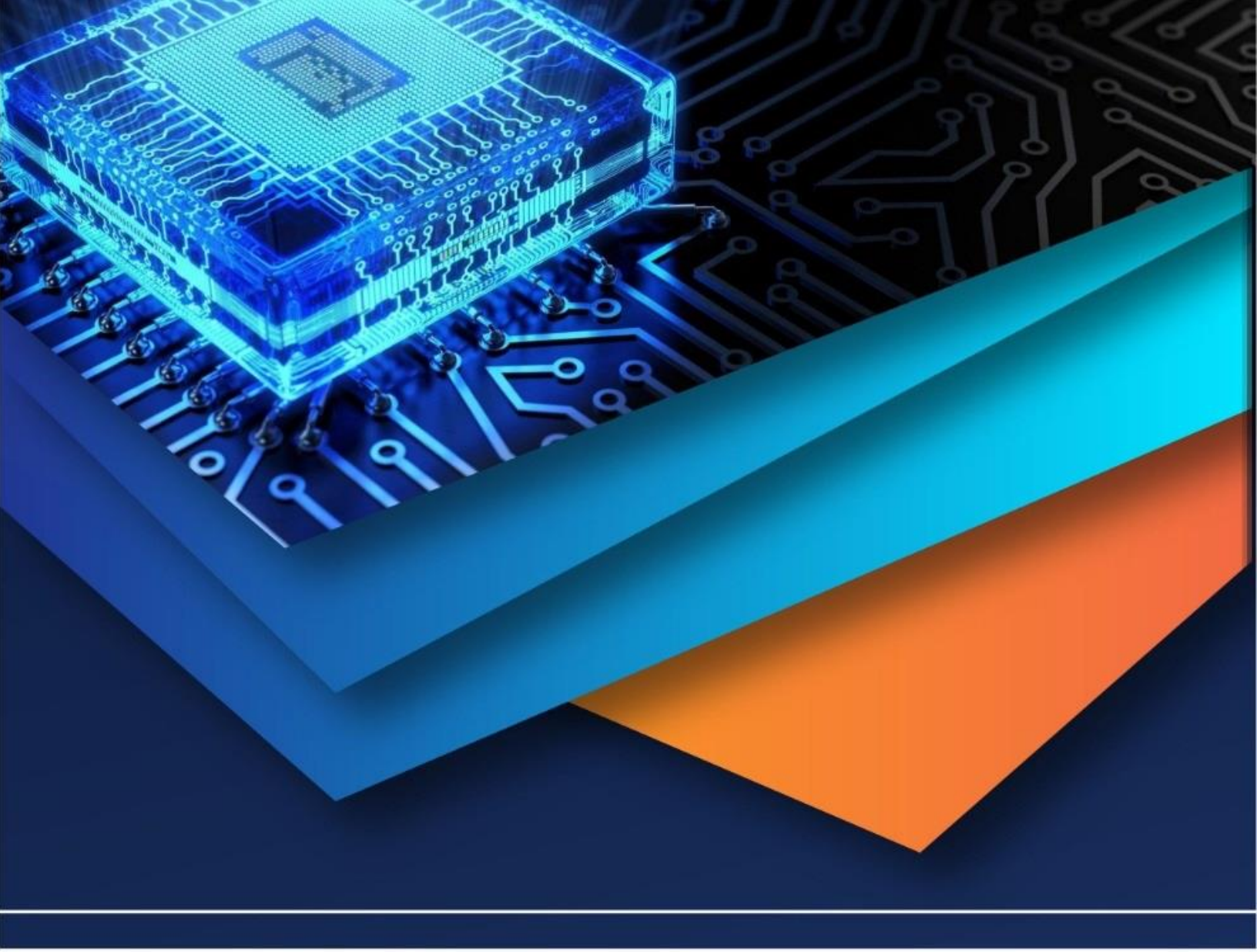

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