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FaceMark Pro: Smart Attendance Tracker with Liveness Detection Feature

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Abstract: ***The goal of this project is to build a "FaceMark Pro: Smart Attendance Tracker with Liveness Detection System" in order to enhance and modernize the existing Attendance System, which was formerly marked on paper and based on cards. The current system has many problems, including inaccurate attendance records and other human error. To address the shortcomings of the previous systems, there is a solution in the form of the FaceMark Pro: Smart Attendance Tracker, which uses face recognition technology to take, store, and identify images to show individual presence. An aspect of the project involves gathering up-to-date portraits of people and organizing them into a database. Consequently, numerous recognition algorithms, such as LBPH, HaaR Classifier, HoG, and others, work as part of OpenCV while the system is in operation and a human face is recognized. We'll record everyone's attendance if any images turn up. It will first record attendance, then supply the necessary information about the participants, and last, it will deliver a sheet listing all of the names of those who are and are not present.***

Keywords: OpenCV, LBPH Algorithm, HoG Algorithms, HaaR Classifier OpenCV, Liveness Detection.

I. INTRODUCTION

The most recent advancement in the administration and tracking of attendance is represented by facial recognition attendance-based systems. These systems use cutting-edge facial recognition technology to reliably and quickly record and confirm people's presence in a variety of locations, including offices, classrooms, events, and more. Facial recognition attendance systems provide a smooth and frictionless way to track attendance, improve security, and expedite administrative procedures, in contrast to conventional attendance techniques like manual sign-ins or card swipes. It's challenging to keep track of attendance when taking part in regular activities. Proxy attendance is always a possibility, and the traditional method of calling on each student individually takes a lot of time.

The next system tracks the attendance of students by using facial recognition.The administrator has already recorded and stored the daily attendance of the students. When the assigned topic's time comes, the system begins gathering pictures automatically. It then uses face detection and identification software to analyze the provided images. If any students are identified, their attendance is updated with the relevant subject ID and time. Multiple faces can be recognized in real time by the technology we use. The main objective of this project is to create an automated student attendance system with an efficient liveness detection function based on facial recognition. To achieve better performance, this suggested method limits the test and training images to frontal, upright, single-face facial images. The training and test photos need to be taken with the same device in order to guarantee that there is no difference in quality. In addition, students need to register in the database in order to be identified. Enrollment may be completed instantly thanks to the user-friendly interface.Recent years have seen major developments in facial recognition technology, increasing accuracy and dependability. But it has also spurred conversations and arguments about ethics, privacy, and possible abuse. Despite such concerns, facial recognition systems remain at the forefront of technological advancement, providing a plethora of advantages in terms of efficiency, convenience, and security. The need to add a liveness feature to the current face recognition-based attendance systems becomes important in order to prevent anti-spoofing and manipulation in the attendance marking process.

II. LITERATURE REVIEW

1) Shrikhande, et al. (2023) [1], After carefully examining this work, we discovered that its goal is to determine which popular classifiers—SVM and RF—when combined with three distinct facial recognition techniques—LBP, HOG, and CNN—perform best in order to determine which is the most accurate and efficient method for a smart attendance system. CNN is a supervised distance metric approach, HOG is a gradient-based method, and LBP is a texture-based method.

2) Muhammad, et al. (2023) [2], Reviewing this research has shown that the suggested system, which uses facial biometrics to identify users, has been effectively created for online attendance tracking. Users do not need to install specialized apps because the interface is web-based and can be accessed on any computer with any browser. The server application includes the server interface script and a facial recognition program written in Python. This program evaluates every selfie that users post in order to identify them. This Python software's facial recognition feature requires a trained model. Identifying users is the main goal of this technology, regardless of whether they are wearing masks or not. For the purpose of doing this, real user images as well as artificially created photographs for the virtual face mask application are included in the sample dataset used to train the face recognition model. For testing and analysis, more than 200 user face data points were successfully gathered. The system is known to have various shortcomings. Notably, inadequate user face data sample sizes impair the precision of face recognition and face mask detection algorithms. Thus, in order to improve accuracy, more user-face data samples must be obtained.In summary, the research successfully produced a system that can improve public safety by recognizing masks to slow the COVID-19 virus's spread and by making attendance tracking faster and simpler.

3) Shrey, et al. (2022) [3], In order to meet the requirement for automatic classroom testing, the approach put forward in this paper is highly effective in that it helps to improve accuracy and speed while finally achieving the highest accuracy of real-time arrival. It talks about how different approaches, such face, iris, and RFID (Radio Frequency Identification) based identification systems, are currently being employed in technologies to detect attendance. The performance of the system suggested in this research may be impacted by inadequate illumination in the classroom, hence video quality needs to be enhanced to account for this possibility.

4) Khalwa, et al. (2021) [4], This paper presents a deep learning-based facial recognition attendance system. The suggested approach integrates transfer learning by using three convolutional neural networks that have already been trained. A comparative examination shows that the system performs exceptionally well compared to other methods, with high prediction accuracy and short training times. The validation accuracy rates attained by SqueezeNet, GoogleNet, and AlexNet were 98.33%, 93.33%, and 100%, in that order. The suggested approach has potential uses in door access and attendance systems in a variety of contexts, including public and private sectors, airports, colleges, and schools. This work could be further advanced by combining more diverse data from human face photos and investigating more pre-trained CNN models. Applying these models to tasks involving face recognition of masked persons is a particularly intriguing research direction.

5) Dwi, et al. (2021) [5], This study suggests using facial recognition to power an Android-based course attendance system. The method prompts every enrolled student to take a selfie with their smartphone and use it to scan the QR code that is posted at the front of the classroom. After it is taken, the picture is sent to the server, where facial recognition and attendance monitoring are started. A classifier is restricted to use facial recognition only for a given course in order to maximize accuracy and processing time. The experimental findings show that the proposed attendance system, using Linear Discriminant Analysis (LDA), achieves a 97.29% face identification performance, using only 0.000096 s for the face recognition procedure on the server.Future studies will investigate the integration of a Bluetooth device to measure the distance between a student's smartphone and a Raspberry Pi placed in the classroom for attendance verification in order to address any issues of student cheating during attendance.

6) Akash, et al. (2021) [6], This work taught us how to separate the processing portion of an image. For example, the first phase, or pre-processing stage, involves scaling the image's size to minimize or avoid information loss. The following stage involves turning the color image into a grayscale image after applying "median filtering" to eliminate noise. Subsequently, the images undergo the application of CLAHE (Contrast Limited Adaptive Histogram Equation) in order to improve the contrast. Overall, a productive Python software is developed that retrieves an image from the database, does the required image recognition conversions, and then uses an intuitive user interface to access the camera to verify the image in videos or in real-time. The attendance sheet is updated with the person's name and time upon the discovery of a successful match.

7) Nurkhamid, et al. (2021) [7], This study states that the primary goal of the research is to create an intelligent attendance system employing facial recognition technology that can recognize multiple persons at once without requiring face-to-face interaction through the use of Deep Convolutional Neural Networks. After that, the system's precision in recognizing and documenting student attendance is examined and tested. According to the findings of a study done on 16 students in a lecture, the system can accurately record student attendance with 81.25% when the students are facing forward, 75.00% when they are facing sideways, and 43.75% when they are facing down. There are many face recognition algorithms, such as the HOG (Histogram Oriented Gradient) face search, face landmark estimation, deep convolutional neural network (DCNN) face encoding, and SVM classifier algorithm for identifying the owner of a face.

8) Sanyukta, et al. (2021) [8], This research focuses on the deployment of an automated attendance system that uses facial recognition technology to record attendance and maintains the class information. By being installed in every classroom and intelligently tracking student attendance, the technology seeks to supersede traditional methods of taking attendance. Because it is simple to compute, the local Binary Patterns Histogram, or LBPH for short, is a widely used face recognition method. This method, which is a component of OpenCV, recognizes the face by going through several phases.Building the database and performing face detection are the first steps. Cascade is one face detection method. In order to train the classifier, this method takes a few pictures, extracts the features, and computes them. The estimated irrelevant characteristics are removed using the Adaboost, a training process that distinguishes between facial and non-facial qualities. The cascade classifier removes all of the non-facial elements from the image at once because there are more of them, giving the algorithm more facial regions to identify. OpenCV comes includes a variety of pre-trained classifiers that can be downloaded as XML files, in addition to the detector and the trainer. The LBPH algorithm detects the face and records the attendance of the student whose face matches the database when the tracked photo and the training image data are compared.

9) Muhammad, et al. (2020) [9], In order to address the issues the Student Attendance System (SAS) was having with using face recognition to record student attendance, this research study critically reviews twelve previous studies that used various face recognition techniques and algorithms. The study delivers a comprehensive overview of face recognition, encompassing methods, techniques, challenges, and previous efforts in implementing face recognition within the context of SAS. While earlier studies utilized a fixed camera for image capture, this paper proposes the use of a mobile device's built-in camera for capturing student pictures. Subsequently, selected features are extracted from the detected faces. The hybrid approach of employing Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) algorithms compares the attributes of training and test images. The publication asserts that capturing student images with a mobile device's camera proves to be a superior method for attendance recording, effectively addressing lighting issues. The simplicity and reduced hardware requirements of mobile cameras, coupled with the avoidance of setting up a dedicated camera in the classroom, make them a convenient choice for managing student attendance in SAS.

10) Hao, et al. (2020) [10], The four fundamental components of face recognition are covered in this paper: face picture acquisition, preprocessing, feature extraction, and hard recognition integration using hardware cameras, network connections, and computing systems.The utilization of Linear Discriminant Analysis (LDA) is highlighted for the extraction of facial features from subjects. The paper recommends various techniques, such as the Geometric Feature Method, Subspace Analysis Method, Neural Network Method, and Support Vector Machine Method (SVM), to achieve precise face detection.

11) Serign and associates, 2020 [11], This work explores the best practices for altering lighting, eliminating noise from faces, adjusting scale and location, and other factors to minimize noise in images. In order to solve some of the problems influencing face recognition accuracy, this research study provides a novel strategy that combines the Local Binary Pattern (LBP) algorithm with sophisticated image processing techniques as Contrast Adjustment, Bilateral Filter, Histogram Equalization, and Image Blending. This will enhance the LBP codes and increase the face recognition system's overall accuracy. The sample image quality attributes of the required input and reference face photographs were used to improve the face identification accuracy of the LBP approach. Scale, posture, resolution, sharpness, noise, and illumination were some of these attributes. The goal was to obtain the best quality images possible, which would expose more information about the image properties and allow for a more precise extraction and comparison of characteristics.

12) Foteini, et al. (2020) [12], In this work, they are focusing on the scenario of a single sample face identification challenge with the goal of developing a real-time visual presence application. In this case, five popular pre-trained CNNs were evaluated. According to the experiment's findings, DenseNet121 is the most efficient and dependable model for tackling practice challenges involving the use of deep CNNs on tiny datasets (up to 99% top-1 accuracy), especially those involving single sample per person facial recognition tasks.

13) Bharat, et al.(2020) [13], The primary objective of this work is to create a facial recognition-based attendance system that can recognize and capture photographs of people who are not known to the system while lowering the false positive rate through the use of a confidence threshold or Euclidean distance value. The Local Binary Pattern Histogram (LBPH) method outperforms existing Euclidean distance-based methods such as Eigenfaces and Fisherfaces. Because of their resilience, we employed the LBPH algorithm for face recognition and the Haar cascade for face detection. It is resistant to repetitive grayscale shifts. Some of the situations used to evaluate our system include facial recognition rate, false-positive rate for that, and false-positive rate with and without employing a threshold in identifying unfamiliar individuals.

14) Ngo, et al. (2020) [14], This study documents the design, implementation, and empirical comparisons of machine learning open libraries in creating interior security camera-based attendance-taking (AT) support systems (ATSS). The trial method was utilized to record the appearances of 120 students studying on the third floor of the FPT Polytechnic College building during the course of five classes. The proposed technology enables flexible system extension and may be used for both a school and a general-purpose attendance system with CCTV. The results of the measurements show that the precision is suitable in a variety of situations.

15) Rabab, et al. (2019) [15], This project focuses on tracking students' attendance in class using facial recognition. The proposed method can handle normal facial changes caused by minor medical conditions, differences in color, and grooming. The results show that the proposed method can improve the timing and authenticity of the attendance process. Two essential elements are combined in the proposed system. First of all, it employs biometrics for automated attendance authentication, specifically facial recognition. Similar to speech recognition, which, in contrast, does not incorporate the real proportion of the features, this approach is the least evasive and simply needs simple acquisition devices. Furthermore, the lecturer's override option enhances the system's functionality by enabling it to distinguish faces that are unidentified due to surgeries and other medical conditions, as well as identical twins.

16) Ofualagba, et al. (2018) [16]The aim of this study is to develop FACECUBE, an automated facial recognition system for student attendance management that uses cloud computing (CC) infrastructure to guarantee affordability, efficiency, and non-intrusiveness. Utilizing an IP camera positioned in front of a classroom, FACECUBE captures images of each student to record attendance. The system detects faces within the images and compares them against registered faces in the database. Attendance is marked as present if a registered face is identified in the acquired image collection; otherwise, it is marked as absent. Notably, the system is developed using an open-source image processing library, eliminating the need for vendor-specific software or hardware.

17) Sakshi, et al. (2018) [17], This paper presents a novel and efficient approach to attendance recording, leveraging face recognition as a primary means of identification. Face recognition provides a precise method, addressing issues like fake attendance, high costs, and time consumption. The system employs a face recognizer library for face recognition and attendance storage. In the case of absenteeism, emails are automatically dispatched to the parents or supervisors, notifying them of their wards' or employees' absence, respectively. The eigenface, LBPH, and Haar cascade algorithms, which typically require a substantial number of samples to compute pixel and point distances, are utilized. Additionally, the email functionality embedded in the Raspberry Pi is harnessed to capitalize on Internet of Things (IoT) capabilities.

18) Omar & associates (2018) [18], The approach for creating a complete embedded class attendance system that combines facial recognition and door access control is suggested in this study. The Raspberry Pi, which comes with a micro SD card that runs the Raspbian (Linux) operating system, is the system's core component. The Raspberry Pi has a 5-inch screen attached to it along with the Raspberry Pi camera. Turning toward the camera takes a picture, which is then sent to the Raspberry Pi. For facial recognition, the system is set up to use the Local Binary Patterns (LBPs) method. If the student's input image matches one in the training dataset, a servo motor is used to open the prototype door. A MySQL database is then used to hold the attendance data. Because the database and the Attendance Management System (AMS) web server are connected, any web browser with an internet connection can access the attendance results. Based on a dataset of eleven person photos, the algorithm shows a 95% accuracy rate.

19) Anshun, et al. (2017) [19], This study performs a comparative analysis and makes methodology recommendations for an automated attendance system based on facial recognition and video, where the input is a video and the output is an Excel sheet with student attendance data. Face recognition is unique among biometric techniques in that it can be used to build an automated attendance system without the need for human intervention. To register attendance from a class video, the method combines face detection—which separates faces from non-faces—with face recognition, which compares the discovered face to a face database that contains student names and photos. When there is a genuine match, attendance is recorded in an Excel document. The study compares the face recognition accuracy of the Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) approaches. The suggested system uses PCA and LDA to construct a face recognition system, namely Eigenfaces-based recognition system for feature extraction and matching with a Fisherfaces subspace projection Classifier for Euclidean distances. Observations reveal that PCA and LDA perform well under specific conditions, such as normal lighting, no change in posture, and an optimal camera distance of one to three feet. Higher resolution is essential as both methods rely on pixel-by-pixel calculations. While the performance of PCA and LDA is comparable, PCA excels in the recognition phase, providing faster clock times. However, due to its superior recognition rate, LDA is the preferred choice.

20) Nazare, et al. (2016) [20], This study sheds light on the various techniques used by facial recognition software. The suggested system integrates the modified Viola-Jones algorithm for face detection and recognition, as well as the alignment-free partial face recognition approach.

The suggested approach surpasses current attendance management systems in several ways:

a) Automated monitoring of student data
b) Reduction of manual work and alleviation of stress on instructors for accurate attendance recording
c) Decrease in the time required for attendance recording, allowing more time for the actual teaching process
d) Enhancement of the overall efficiency of the system
e) Augmentation of security measures

21) Samuel, et al. (2016) [21], This work proposes a face recognition approach for a classroom attendance system that uses Discrete Wavelet Transforms (DWT) and Discrete Cosine Transforms (DCT) to extract facial information from pupils. The identified facial features are then categorized using the Radial Basis Function (RBF). In an experimental classroom setting with sixteen students, the findings indicated that the proposed approach successfully identified the faces of 121 out of 148 students. About 82% of the students seated in the classroom had their faces correctly recognized by the developed method.

22) Priyanka, et al. (2015) [22], this paper addresses the primary problems with the previously developed attendance systems, such as the head pose and intensity of light problems. Principle component analysis, the Viola and Jones algorithm, illumination invariant, and other techniques are some of the methods provided in the proposed paper to address these problems. The basic idea is to take the needed picture, convert it to grayscale, and then perform histogram normalization, which is used to improve contrast. Finally, noise removal is carried out. Following the removal of noise, a process known as skin classification is applied, in which every pixel is turned black with the exception of those that are closely associated with the skin. Face detection algorithm accuracy is improved after skin classification. Following the use of skin classification algorithms like Jones and Viola to identify a person's face. Following face detection and recognition, each face is independently validated using the EigenFace method by comparing it to the enrolled images in the face database.

III. PROPOSED WORK

The system requires students to register by providing the necessary details, and their images will be captured and stored in the dataset. Subsequently, during each class session, the system will detect faces from the live-streaming video and compare them with the dataset.

If a match is found, attendance will be marked for the respective student. The goal is to capture each student's face comprehensively, including features, seating, and posture.

The system eliminates the need for manual attendance taking, as it records a video and updates the attendance database through facial recognition. It's important to acknowledge that this system employs facial recognition technology to automate the attendance process in the classroom.

Additionally, the proposed system aims to capture facial features, seating arrangements, and student postures to enhance the accuracy of attendance tracking.

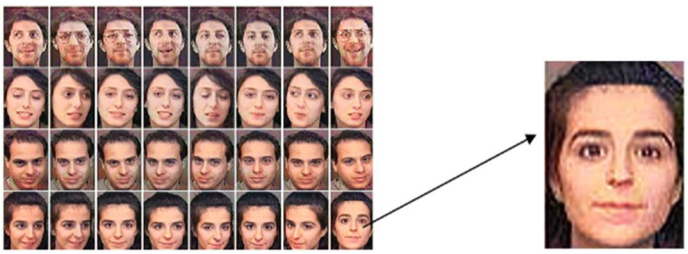

Figure 1: Selection of image

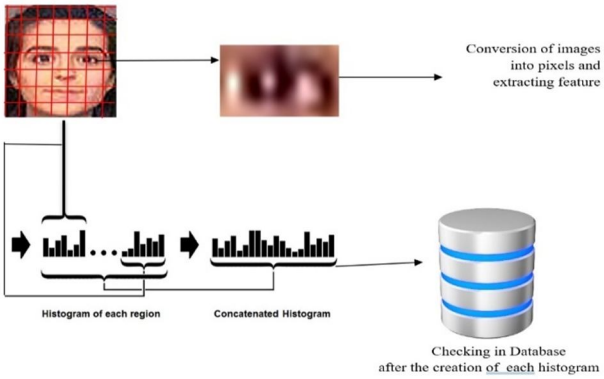

Figure 2: Conversion of image into pixels and extracting the necessary features to generate a histogram

Figure 3: Successful match

1) *Step 1:* All students in the class should register by providing the necessary details. Subsequently, their images will be captured and stored in the database to create a dataset.
2) *Step 2:* In each session, facial detection will be conducted using various techniques such as LBPH algorithm and classifiers like HOG classifier.
3) *Step 3:* The input image undergoes pixel conversion to enable comparison with stored images in the database.
4) *Step 4:* Object detection and feature-based object detection are integral components of the methodology. Histogram of Oriented Gradients (HOG) is employed for object detection, while Haar classifier is utilized for feature-based object detection.
5) *Step 5:* Following image detection, the verification process ensues, comparing the identified images with the ones present in the database to determine their existence.
6) *Step 6:* Once verification is successful, the attendance task is considered complete, and the student's attendance is marked.

IV. CONCLUSION

In conclusion, the "FaceMarkPro: Smart Attendance tracker with liveness detection feature" is a creative and innovative approach to the tracking and upkeep of attendance. By seamlessly integrating technology, the time-consuming process of taking attendance can be made as accurate and robust as possible, while also being very easy to monitor and maintain. With the help of internet-connected devices and sensors, it offers businesses and educational establishments the ability to track and maintain attendance in real-time, saving time and preventing spoofing. The system lowers waiting times, enhances the overall quality of attendance tracking, and has the potential to surpass traditional attendance marking methods.

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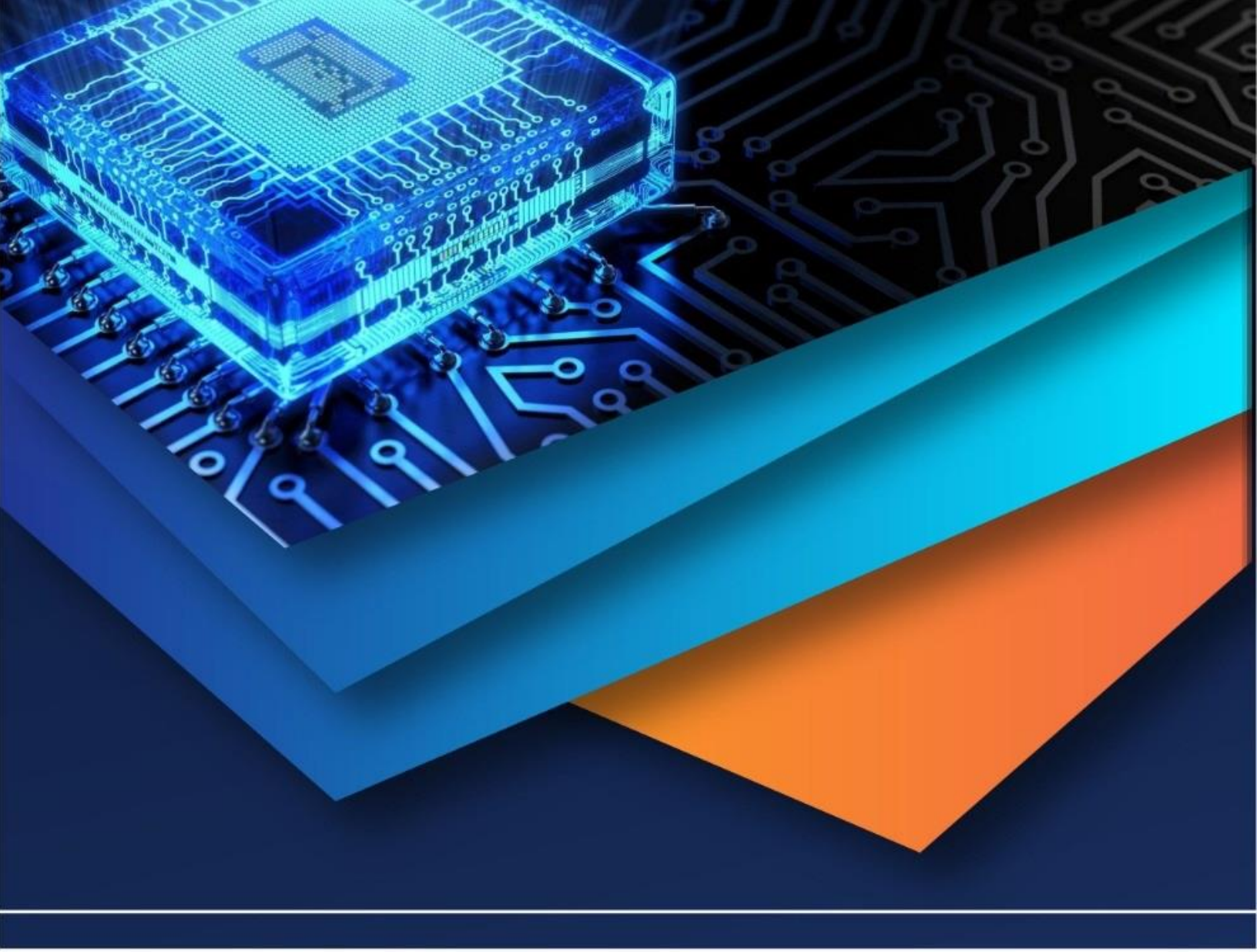

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