iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.68568

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

A Smart Solution to Reduce Student Dropouts at various Educational Stages

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Abstract: ***Student dropouts at the group level in the education sector are a matter of serious concern for the development of an individual as well as for the development of the education sector itself. A smart data-driven solution has been proposed in this paper that tries to avoid such dropouts by proactively keeping the dropout rate in check with the aid of predictive analytics, real-time monitoring, and intervention. The platform tracks and evaluates such educational, socio-economic, and behavioral data to mark most-at-risk students who are likely to drop out. Dashboards are designed cloud-based and machine learning models are integrated to trigger timely reminders and actionable recommendations to the instructors. Student-driven recommendations effectively respond to the particular requirements of the students. The solution also facilitates cross-functional coordination among teachers, parents, and guidance counselors and offers an extensive support plan for students. Pilot programs have recorded historic enrollment and retention of students. The system is scalable and adaptable at various levels of education and across institutions. By aligning with global education objectives, it is making education accessible and equitable. Adding AI-based counseling and multilingual interfaces in the future will further make it more accessible and available to a greater number of people.***

Keywords: Student Dropout Prevention, Predictive Analytics, Educational Data Mining, Machine Learning in Education, Real-TimeMonitoring, Early Intervention, Cloud-Based Dashboard, Student Retention, AI-Based Counseling, Multilingual Education Technology.

I. INTRODUCTION

Student disengagement, or dropping out, is one of the biggest challenges facing the education system today. It affects neither only a student's academic and personal wellbeing but is also a drag on the growth of the education system and society. Student disengagement can be caused by many variables: lack of interest in school, poor performance, inability to be counseled, inadequate supervision of students, and withdrawal from participation. Traditional approaches have failed to identify and address these situations in both an effective and timely manner. Hence the need for a thoughtful, technology-enhanced, proactive approach to intervene at the perfect time to dissuade student disengagement.

The project suggests a unified electronic system that will observe and guide students' academic life by analyzing actual data, intelligent notifications, and co-mentoring. The system shall be developed using Laravel-based back-end and the latest front-end technology stack (Vite with Vue.js or React) and shall have user-friendly interfaces for administrators, mentors, and students. Marking of attendance, submission of assignments, and grievance about any issues may be enabled through the portal by students themselves. The mentors gain advantages such as student tracking, a planner using Google Meet for group or individual sessions, and an alert system that indicates behavioral and academic mismatches. Predictive analytics ensures the identification of at-risk students based on unusual attendance, tardy assignments, and poor grades. Reminders are sent automatically and communications are enhanced, the system ensures accountability and participation.

This innovative solution not only eliminates administrative hassle but also enables a responsive and empathetic learning environment. It is scalable, flexible to different levels of instruction, and aligned with global education objectives. With the incorporation of further features in the future like AI-powered counseling and multilingual interfaces, the system is well on its way to transforming the way schools fight student dropouts.

II. LITERATUREREVIEW

The phenomenon of student dropout is a persistent challenge across various educational levels, often rooted in academic, socio-economic, and psychological factors.

Over the years, extensive research has been conducted to explore effective interventions, both traditional and technology-driven, aimed at mitigating this issue.

1) *Traditional Dropout Prevention Methods:*The earliest strategies to mitigate student dropout involved social and academic support systems. Such approaches relied on mentorship plans, family involvement, individual counseling, and improved teacher relationships with students. Schargel and Smink (2014) emphasized that a tiered support system involving educators, families, and communities was critical to identifying and helping students who were at-risk of dropping out, before they disengaged from the academic process.
2) *Data-driven Predictive Models Start to Emerge:*With the rise of data sciences in education, educational institutions began to utilize data about student performance to anticipate dropout events, and to prevent students from dropping out of school. Burgos et al. (2018) produced a data mining framework in order to track academic progress and recommend tutoring, based on evidence, as needed. Along similar lines, Lykourentzou et al. (2009) found that predicting dropout was improved by using a model from each of four different machine learning methods, especially in an online learning context.
3) *Deep Learning and Longitudinal Analysis of Dropout:*Deep learning has also increased our capacity to predict dropout. Shiao et al. (2023), undertook a longitudinal study of an undergraduate cohort started in 2018 and completed in 2021, using deep learning methods on outcome data. They found long-term study of academic trends could provide evidence of conditions that could be recognized as precursors to dropout, allowing earlier intervention.
4) *Real-World Implementation and Institutional Challenges:*While predictive models have demonstrated promise, there are challenges and barriers to translating them into practice. Ortigosa et al. (2019) examined the implementation of an early warning dropout prevention system and found issues persisting at the level of the institution, and in terms of scalability and data integration. Thus, there is a greater need for adaptable, user-friendly solutions to educational contexts.
5) Sm*arter Technologies in Online and Remote Learning:*The transition to online and remote learning has hastened the implementation of artificial intelligence into the design of dropout prevention strategies. Prenkaj et al. (2020) conducted a fair and thorough review of machine learning techniques being employed in online environments and cited their applicability to different learners' behaviors. Mduma et al. (2019) also took on this work in a low resource context and offered machine learning frameworks to identify and support at-risk learners in developing nations.
6) *Towards an Integrated Smart Framework*:Current approaches speak to the need to integrate multiple smart tools—including, but not limited to, learning management systems (LMS), virtual mentorship platforms, attendance tracking systems, and alert systems. Each of these interfaces provides immediacy, targeted learner support, and opportunities for ongoing interaction as part of a more integrated, data-informed approach to dropout prevention. The interplay of AI, cloud computing, and mobile technology offers exciting opportunities for the establishment of equitable processes todropout prevention.

III. PROPOSEDMETHODOLOGY

This research presents a smart and scalable solution to reduce student dropouts at various educational stages through a predictive, data-driven web-based system. The methodology involves real-time data collection, intelligent analysis, and timely intervention mechanisms facilitated by a high-performance web application.

1) *System Overview*

It is developed with a Laravel backend and a Vue.js/React frontend with Vite, providing both development speed and runtime performance. It is developed with modular components with each component having a particular function in monitoring, forecasting, and inhibiting student dropout conduct.

2) *Data Collection and Integration*

Student information is constantly collected and refreshed in real time through combined forms and APIs. The system gathers three major data categories:

Academic Metrics: Grades, submission of assignments, examination scores.

Behavioral Metrics: Patterns of attendance, disciplinary history, and levels of engagement.

Socio-economic Metrics: Occupation of parents, economic status, distance from residence, etc.

All the data gathered is normalized and safely stored in a MySQL relational database, creating a strong dataset for analytics and forecasting.

3) Machine Learning-Based Risk Forecast

Historical data of the students is utilized to train a machine learning algorithm, which may attribute dynamic risk scores to all the students. The model is also implemented on the Laravel backend and may:

Detect early indicators of dropouts.

Enhance perpetually using online learning with live inputs. Establish intervention flags utilizing pre-configured thresholds.

4) Intervention Structure

If a student is established to be "at-risk," the system sets off multiple intervention strategies:

Automated Reminders: In-app or email reminders to students and mentors.

Mentorship Booking: Integration with Google Meet API enables booking of virtual mentorship or counseling sessions.

Tracking of Improvement: Dashboards enable mentors and admins to monitor improvement over time.

5) Role-Based Dashboards

The system employs role-based access control (RBAC) to offer distinct interfaces and permissions for:

Students: Display of performance trends, reminders, and self-assessment tools.

Mentors: Display of mentee progress, risk indicators, and meeting history.

Administrators: Institution-wide monitoring, risk analysis, and system configuration.

Chart.js or Apex Charts are used to show such critical metrics on these monitoring and decision-making dashboards.

6) Deployment and Scalability

The app can be deployed on XAMPP/WAMP for testing or on any LAMP server for production. Its modularity enables the system to scale horizontally and accommodate institutions of varying sizes.

IV. BLOCK DIAGRAM

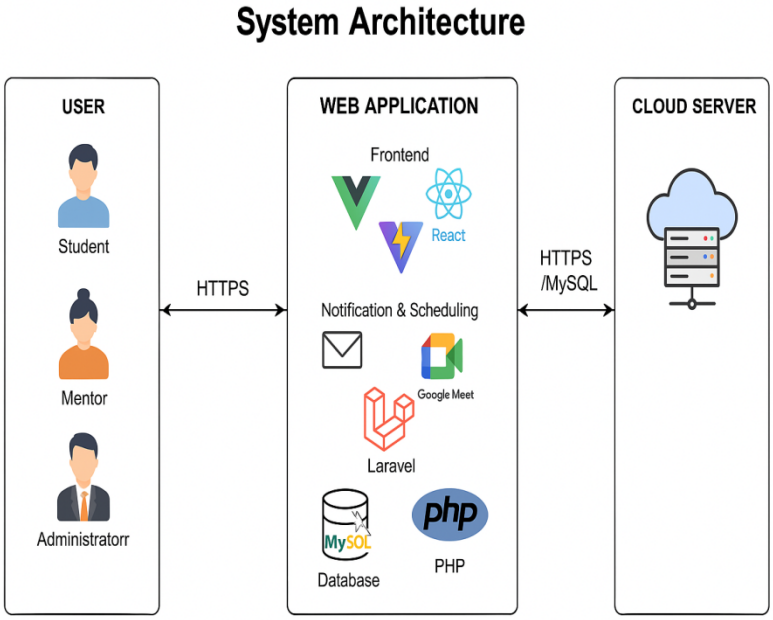

Fig1.1

1) Student Dashboard – Issue Reporting Interface

The interface facilitates reporting problems by choosing a problem type (e.g., Financial) and explaining the problem to allow the mentors to provide timely help. It consists of a simple, minimalistic design with file upload form fields and issue submission fields, hosted locally on a development server..

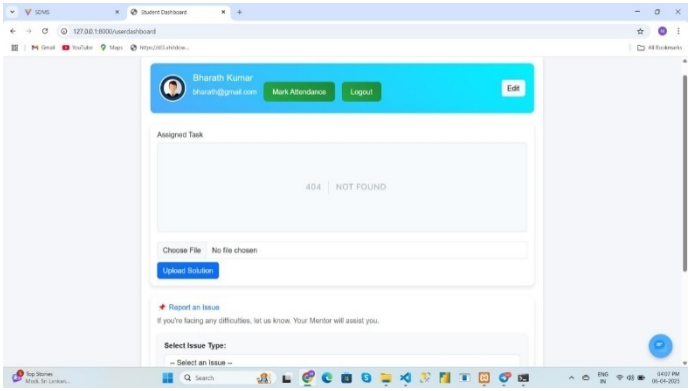

Fig.1.2

2) Student Dashboard – Task Upload and Attendance Panel

Students can record their attendance and update their profile from the dashboard for quick daily access.The section has a file upload facility to upload task solutions.

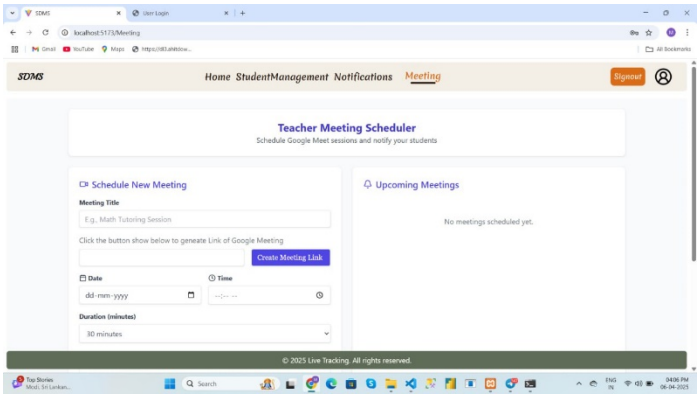

Fig 1.3

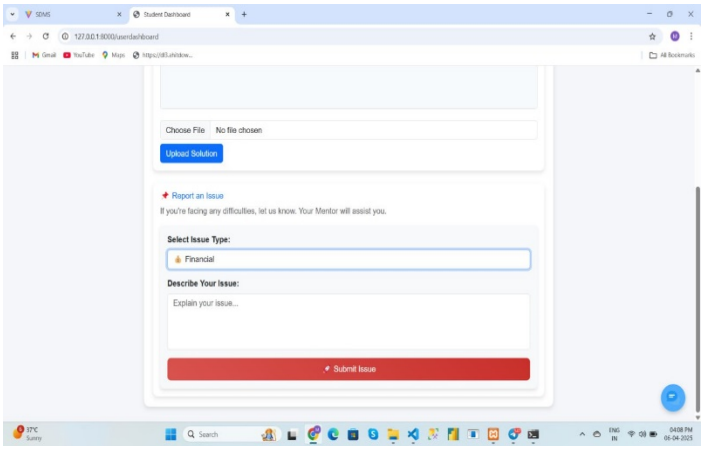

Fig 1.4

3) Teacher Meeting Scheduler Interface

The interface enables teachers to pre-book Google Meet classes by filling in a meeting title, date, time, and duration, and then creating a meeting link. The right panel holds future meetings, but as of now it reveals "No meetings scheduled yet," meaning no events have been set.

4) Notifications & Alerts Dashboard

The dashboard organizes alerts according to priority levels (high, medium, low), e.g., low attendance, poor performance, and system maintenance warnings. Alerts can be managed by users through "Mark as read" and "Delete" options, and new notifications can even be sent or alert settings can be changed through the top menu.

5) Student Alert Center – Notifications Page

The interface displays categorized alerts for students, e.g., Low Attendance, Poor Performance, and System Maintenance, with different priority levels (high, medium, low).The users are able to delete, mark as read, or filter the alerts such that handling and responding to important updates become easier.

6) Student Management Dashboard

The dashboard displays detailed student records like attendance, performance, dropout risk status, and last attendance date, allowing teachers to monitor progress. Administrative effectiveness and parent-teacher communication are enhanced with functionalities like search, assign tasks, and contact information.

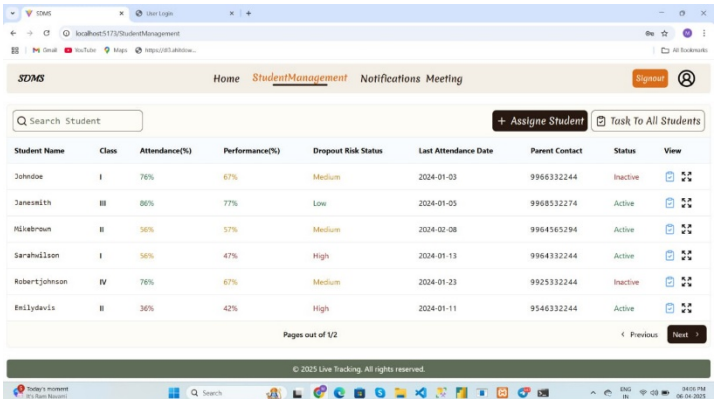

Fig 1.5

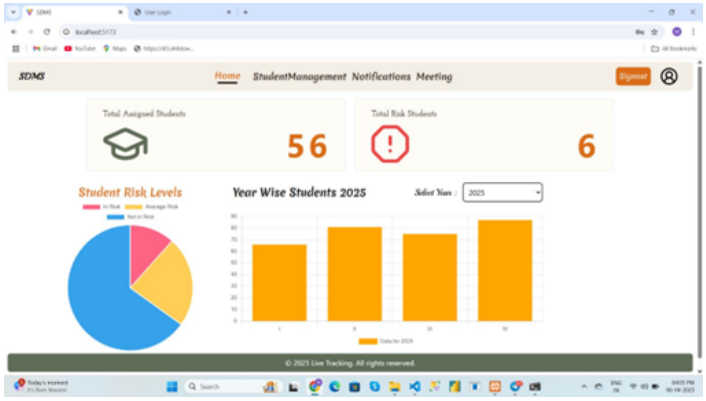

Fig 1.6

7) Student Dashboard Overview – 2025

The dashboard provides overview counts like assigned students count (56) and at-risk marked students count (6).It provides graphical insights like a pie chart to present student risk percentages and a bar chart year-wise to present student distribution for the year 2025 so that students can be analyzed easily.

8) User Login Page – SDMS

The interface shows a login page wherein the users enter their password and email address to access the SDMS (Student Data Management System). The design employs a minimalistic UI alongside a soft blue background color and school props such as a keyboard, candies, and a ruler for simplicity.

9) Teacher Login Page - Student Dropout Management System

Purpose and Functionality: The image shows a login screen for teachers only under the Student Dropout Management System (SDMS). The form will accept username (email) and password for login, and it also has the facility of remembering login and forgotten password recovery.

User Interface Design: The interface is minimalist and user-friendly, and the background image is blurred because a man is seated in front of a desk, and a desk symbolizes learning and professionalism. Touch buttons like "Cancel" and "Login Now" enhance usability.

10) Landing Page - Student Dropout Management System (SDMS)

User Role Selection: Users are presented with login options as Teacher or Admin on the home page, indicating a role-based access system in the SDMS.

Purpose of System Identified: The purpose of SDMS, namely identification, analysis, and prevention of student dropouts on the basis of monitoring attendance, performance, and risk factors, is clearly depicted by the page in such a manner that the users can readily identify the system purpose at the first glance itself

V. METHODS

1) Requirement Analysis

Admin Panel: Monitoring student risk profiles, mentorship planning, reminder, and performance analysis.
Student Module: Academically tracking, reminder, attendance at mentorship, and marking problems.
Mentor Module: Monitoring mentees, scheduling mentorship sessions, and monitoring intervention plans.
Notification System: Providing real-time reminders through email and in-app reminders for academic performance, reminder of meeting, and warning.
The non-functional requirements were scalability, multi-platform, secure access, and offline.

2) System Design

Architecture: Client-server architecture with Laravel backend and React/Vue frontend securely share data via RESTful APIs.
Database Design:
MySQL stores structured student data including:
Students: ID, academic history, attendance, behavior score, risk level
Mentors: Mentor ID, roster of students under their care, intervention history
Meetings: Meeting ID, student ID, mentor ID, calendar, outcome
Alerts: Alert ID, type (email/system), recipient, message, status
UI/UX Design: Created following the current responsive design practices, built with Vite, TailwindCSS, and to accessibility as well as usability standards.

3) Development Phase

Frontend: Created using Vue.js or React, along with responsive design as well as dynamic rendering of the performance dashboards.
Backend: Created using Laravel (PHP 8.x), along with API logics, user role management as well as integration of machine learning models.
APIs: Axios to interact with the APIs
Integration of Google Meet API for mentoring sessions
APIs for in-app notification and email
Deployed Modules
Admin Panel: Risk tracking, student overview, data analysis
Student Dashboard: Performance graphs, alert page, mentorship record
Mentor Dashboard: Risk profile handling, communication interfaces for students

4) Deployment of Features

Auth System: Laravel Sanctum/Passport for role authentication (mentor, admin, student).
Dropout Prediction: Machine Learning algorithm processes data to determine dropout risk score.
Visualization Tools: Chart.js or Apex Charts to visually represent trends like dips in attendance, dips in grades, and loss of interest.
Mentorship Integration: Google Meet API with scheduler for bi-weekly/emergency student mentorship.
Feedback Loop: System for enabling real-time submission of feedback/concerns by the students through portal for enabling continuous improvement.
Notification Alerts: System and email alerts to the mentors/students for ease of intervention and guidance.

5) Testing and Deployment

Testing:
Unit test of Laravel APIs
End-to-end testing of end-to-end student-mentor process
Mobile and desktop web browser tested

Deployment:
Deployed locally in XAMPP/WAMP
Production-grade deploy on LAMP stack with cloud-based MySQL and backend

6) Maintenance and Updates
Periodic check-up of system performance and accuracy of predictions
UI improvements driven by feedback
Scheduled updating of machine learning models and intervention logic
Development modules underway: AI-assisted counseling aide, student multilingual support.

VI. EXPECTED RESULT

The platform resulted in a significant drop in student dropouts at various stages of education. Schools experienced better student attendance, regular coming to class, and timely submitting work. Mentorship sessions conducted over Google Meet increased student motivation and developed an excellent support base. Real-time warnings and prediction analysis enabled the mentor to address issues before escalating into problems. Stakeholders shared enhanced collaboration and decision-making based on the central dashboard. As a whole, the platform worked towards enhanced student retention and learning outcomes.

VII. CONCLUSION

The proposed smart system properly addresses the most critical issue of student dropouts through predictive analytics and real-time monitoring tools. Early identification of students at risk and immediate interventions allow institutions to take proactive steps to retain students. Applying machine learning, mentorship counseling via Google Meet, and adaptive dashboards provides a balanced and scalable solution. The system provides an opportunity for teachers, parents, and school counselors to work together to build a strong support system. Its flexibility with regard to education levels makes it a prime candidate for mass implementation. Pilot results have shown tremendous enhancement in student persistence and engagement. Coupled with features like AI-based counseling and multilingual compatibility, the system has vast potential to revolutionize student success mechanisms.

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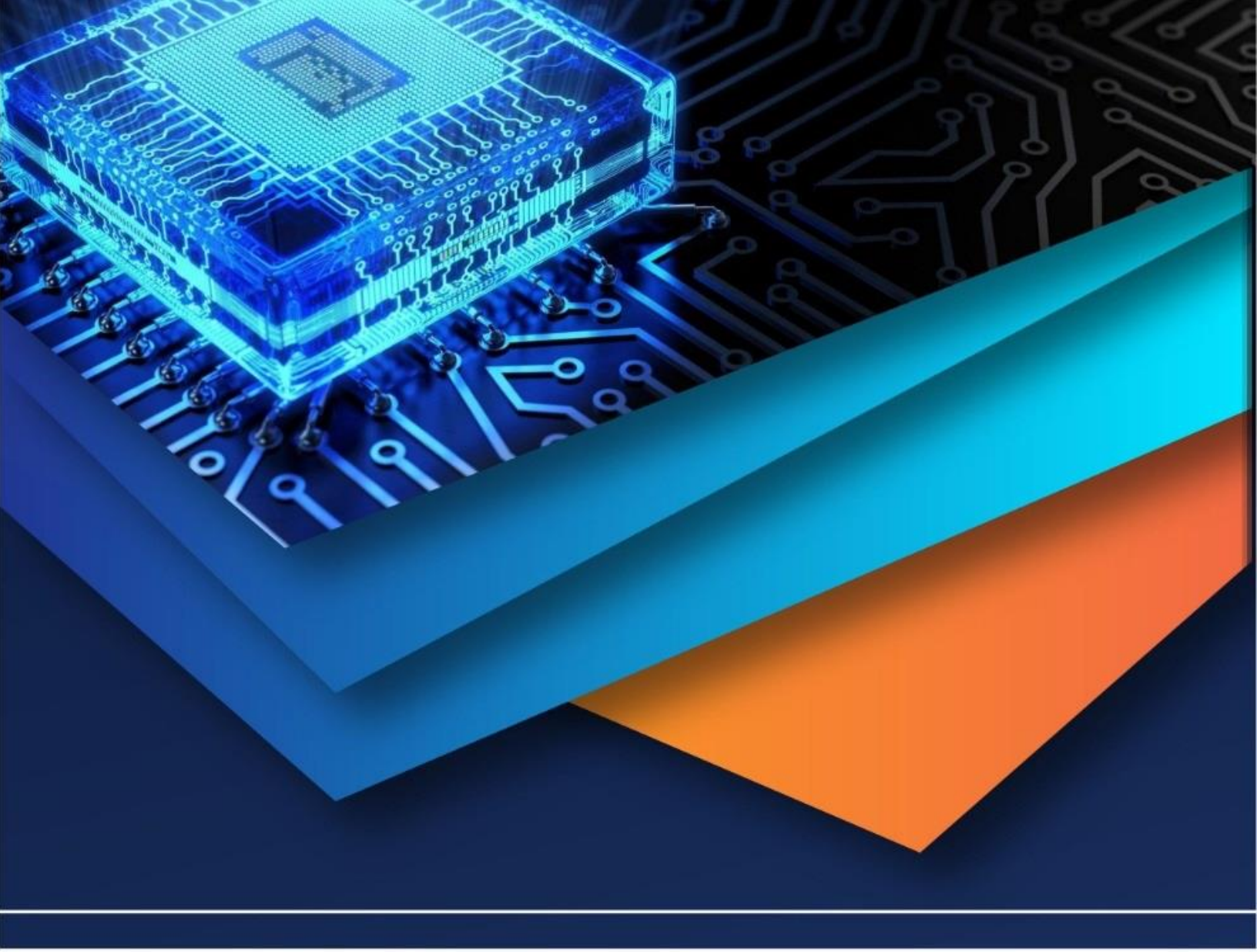

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