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Swasthya Initiative- AI-Driven Student Mental Health Assessment

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Abstract: ***Multi-Agent Artificial Intelligence systems are increasingly applied to complex, domain-specific problems requiring continuous monitoring, contextual understanding, and coordinated intervention. This paper presents Swasthya Initiative, a multi-agent AI framework for student mental health assessment and support built using React, Node.js, Express, MySQL, and AI APIs such as Claude and HuggingFace. The system comprises multiple specialized modules — an Assessment Agent that evaluates stress, anxiety, and depression scores from structured questionnaires, a Risk Detection Agent that classifies severity levels and triggers alerts based on defined thresholds, a Support Recommendation Agent that assists in counselor assignment and follow-up tracking, and an AI Chatbot Agent that provides empathetic, context-aware responses using layered NLP and LLM-based reasoning. A rule-based Journal Analysis module classifies emotional tone using keyword-based sentiment scoring. Secure user authentication is implemented using JWT tokens and bcrypt hashing, ensuring privacy and role-based access for students and teachers. A central logic controller manages workflow transitions across modules and maintains the intervention lifecycle. Experimental results demonstrate effective early detection, improved intervention tracking, and meaningful user engagement, validating the practical applicability of AI-driven systems in student mental health monitoring and support.***

Keywords: ***Agent-Based Architectures, Student Mental Health Monitoring, Large-Scale Language Models (LLMs), Risk Detection and Intervention Systems, Knowledge-Assisted Decision Support, Semantic Text Analysis, AI-Driven Counseling Platforms***

I. INTRODUCTION

Our modern world is facing a silent crisis: while awareness about mental health has increased significantly, stress, anxiety, and depression among students are rising at an alarming rate. Academic pressure, career uncertainty, social expectations, and digital overload have created an environment where students often struggle internally while appearing completely normal externally. The reality is that mental health is deeply personal, influenced by individual experiences, emotional resilience, and surrounding environments.

However, accessing timely and personalized mental health support remains a major challenge. Institutional counseling services exist, but many students hesitate to seek help due to stigma, lack of awareness, or fear of judgment. While technology offers a scalable solution, many existing platforms are reactive, generic, or lack the ability to provide continuous monitoring and meaningful intervention, limiting their real-world effectiveness.

To address these challenges, this paper introduces the *Swasthya Initiative*, an AI-driven system designed for proactive student mental health assessment and support. By combining structured evaluation methods with intelligent analysis and contextual response mechanisms, the system functions as a digital support ecosystem. It integrates multiple modules to continuously monitor mental health, detect early risk patterns, and assist in timely intervention, ensuring that support is not only accessible but also personalized, consistent, and impactful.

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II. RELATED WORK

Reference	Methodology / Approach	Primary Focus	Key Limitations
Swasthya Initiative (Proposed System)	Multi-module AI-driven mental health monitoring framework	Student mental health assessment, early risk detection, and intervention lifecycle	Depends on self-reported data; lacks clinical diagnosis capability; requires institutional adoption

Fitzpatrick et al. (2017)	AI-based mental health chatbot (*Woebot*)	Conversational CBT-based emotional support	Limited personalization; short-term interaction focus; lacks institutional integration
Inkster et al. (2018)	Digital mental health platform (*Wysa*) with AI chatbot	Emotional well-being tracking and guided self-help	Relies heavily on user engagement; limited real-time intervention tracking
Miner et al. (2016)	Analysis of conversational agents in healthcare	Evaluation of chatbot responses in mental health support	Safety concerns; lack of deep contextual understanding
Torous et al. (2020)	Review of digital mental health tools	Mobile apps and AI-based interventions	Lack of standardization; privacy concerns; inconsistent clinical validation
Cunha et al . (2023)	Deep Learning (RNN ,LSTM ,GRU) on wearable sensor data	physiological signal analysis	Short prediction horizons; lacks long-term dietary planning
Zhang et al . (2023)	Multi-objectiveoptimization (SPEA2 ,NSGA-II)	Nutritional target balancing	Neglects clinical safety; overlooks medication-nutrient interactions
Haseena et al.(2024)	Cuckoo Optimizationwith Fuzzy MCDM (AHP/TOPSIS)	Subjective userpreferencemapping	Highdependencyon manual input; poor scalability for real-time use
Stephensetal.(2023)	Behavioral coaching chatbot (CBT & Motivational Interviewing)	Adolescent health & lifestyle coaching	Weak personalization; insufficient clinical validationinlarge cohorts

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The existing literature on student mental health systems spans traditional survey-based approaches, rule-based screening methods, and emerging AI-driven support platforms. While methods such as static questionnaires, basic scoring models, and periodic evaluations effectively capture mental health indicators, they often lack real-time adaptability. Monitoring and alert-based systems improve early detection but fail to incorporate continuous behavioral context and personalized intervention strategies. Conversational AI tools enhance user engagement but frequently lack structured integration with institutional support systems. Recent AI-driven frameworks demonstrate improved contextual understanding and modular task handling; however, they introduce challenges in scalability and system coordination. Overall, current approaches highlight the need for scalable, context-aware systems that balance early detection, personalized support, and continuous monitoring in student mental health management.

III. METHODOLOGY

The proposed *Swasthya Initiative* system aims to provide proactive, data-driven mental health monitoring and support through a modular AI-driven approach that combines structured assessment, rule-based analysis, and Large Language Models (LLMs). By jointly considering user responses, behavioral inputs, and evolving contextual data, the system delivers personalized insights and timely intervention recommendations for student well-being.

A. Architectural Framework

The system is built on a multi-layer architecture with a React frontend for user interaction and a Node.js with Express backend for orchestration. It manages data flow, coordination between modules, and secure communication using JSON Web Token authentication, with MySQL serving as the storage layer.

B. UserProfilingandMental Health Metrics

User data such as age, academic context, and self-reported responses are collected during assessments. This information is used to compute standardized scores for Stress, Anxiety, and Depression on a normalized scale, forming a baseline for identifying risk levels and enabling personalized support mechanisms.

Where, S = stress, A = anxiety
D = depression score

C. Multi-Agent Orchestration

The system uses dedicated modules for structured and efficient processing;
Assessment Module:Evaluates user responses and computes mental health scores.
Risk Detection Module: Identifies severity levels and flags high-risk cases based on thresholds.
Support Management Module:Assists in counselor assignment and tracks intervention lifecycle.
LoggingModule:Stores user data, assessment history

D. Semantic Retrieval and Knowledge Grounding

Sentence transformers are used in the RAG pipeline to vectorize user queries and knowledge base content . One or more relevant contexts are then retrieved via similaritysearch and added to LLM prompts,ensuring RAG returns accurate and evidence-based responses .

E. System Workflows

Its actions are carried out in three major workflows:
Assessment Flow: Collects user responses and computes mental health scores.
Intervention Flow: Detects high-risk cases and initiates alerts, counselor assignment, and tracking.

F. Implementation Details

The system is built using a decoupled architecture with React (frontend), Node.js with Express (backend), and MySQL for storage. AI services such as Claude and HuggingFace are used as inference engines to enable intelligent, context-aware, and interactive responses.

IV. SYSTEM ARCHITECTURE

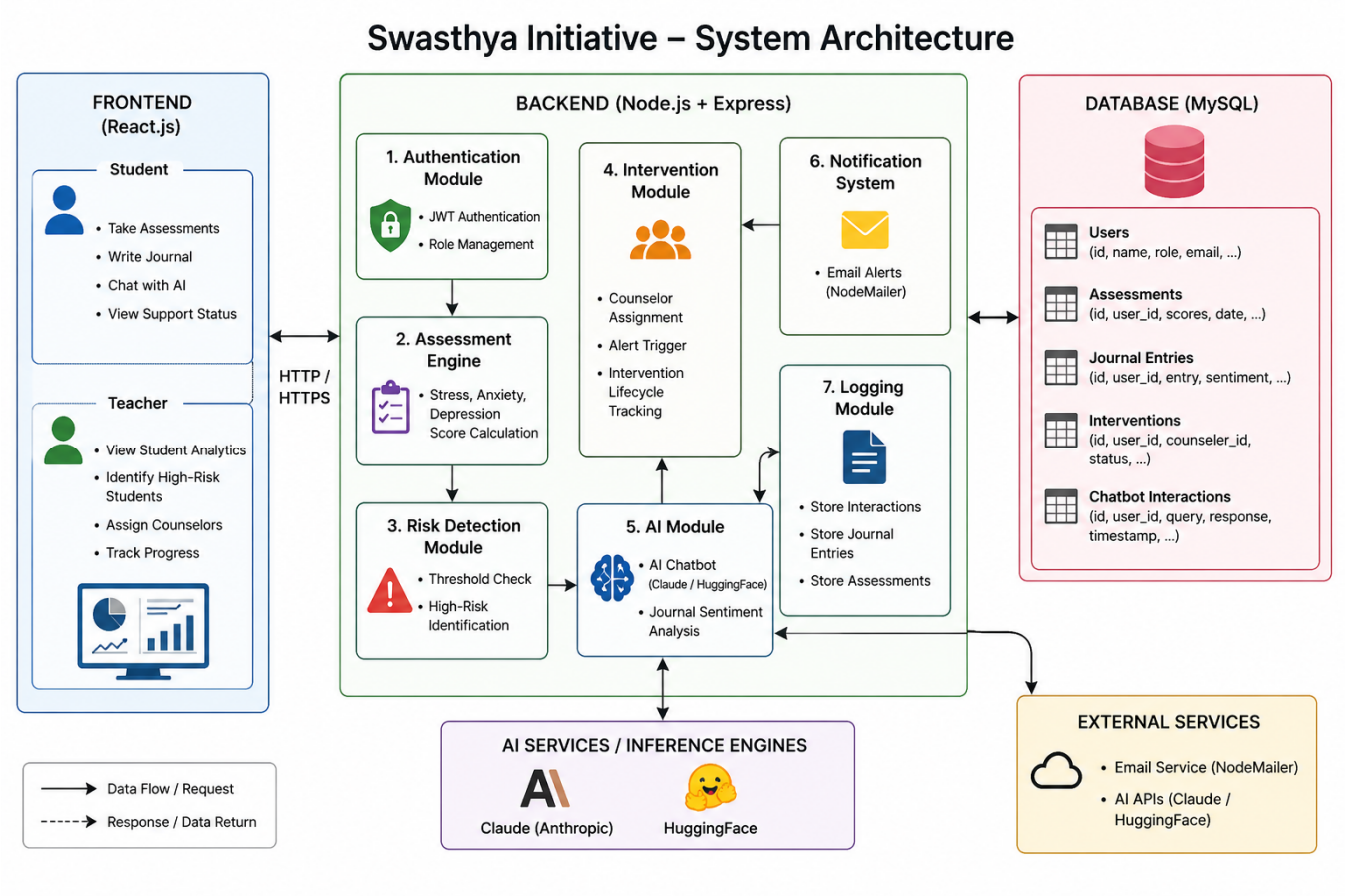

Fig .1 .Three-Tier System Architecture of the Swasthya Initiative

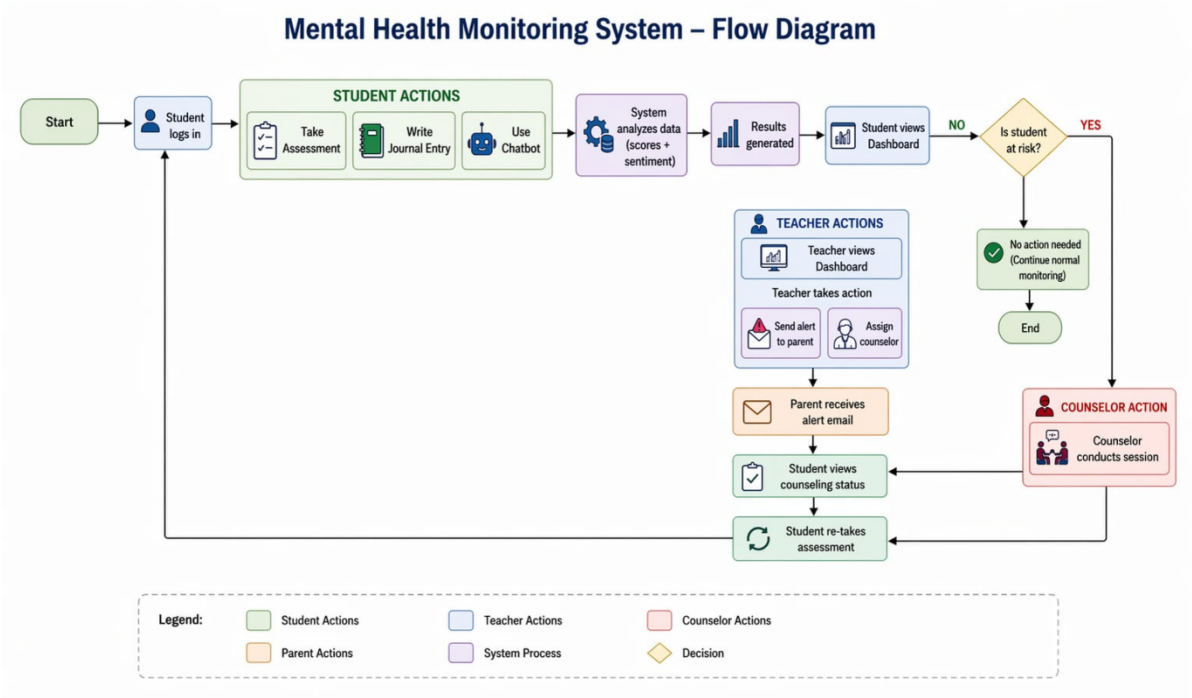

Fig.2.Proposed AI-Based Mental Health Assessment Flow in Swasthya Initiative

The system is built on a multi-layered architecture that integrates a React frontend, a Node.js with Express backend, AI-driven modules, and MySQL for storage. In this framework, the frontend manages user inputs and interactions, while the backend provides orchestration for authentication and request processing. The core intelligence resides in the modular AI layer, which leverages structured analysis, rule-based logic, and Large Language Models (LLMs) to perform mental health assessment, risk detection, and supportive interaction. This is supported by the data layer, which utilizes MySQL to maintain user records, assessment history, and contextual data for efficient, secure, and personalized monitoring and support.

V. SYSTEM IMPLEMENTATION AND EXPERIMENTAL SETUP

To bring the *Swasthya Initiative* to life, we built the system using a decoupled architecture designed for both scalability and reliability. On the frontend, a React-based interface provides a smooth and responsive user experience, while the core processing resides in a Node.js with Express backend. This backend acts as the central control unit, managing user authentication via JWT and coordinating interactions between various system modules. To ensure intelligent and context-aware responses, we integrated AI services such as Claude and HuggingFace, while MySQL serves as the storage layer, handling structured relational data including user records, assessment results, and interaction logs and the the high-speed vector searches required for our AI's memory.

The system efficiently supports high-speed data retrieval and structured queries required for continuous mental health monitoring. The system's data is organized into three primary layers within the database: user profile data (such as age and academic context), assessment history (tracking stress, anxiety, and depression scores over time), and contextual interaction data (including journal entries and chatbot interactions). By structuring data in this manner, the system can correlate a student's historical patterns with current responses, enabling timely and meaningful insights within milliseconds.

In practice , the system's daily operations follow three primary paths:

- The Assessment Flow: Where user responses to mental health questionnaires are processed and converted into standardized scores.
- The Intervention Flow: Where the system evaluates these scores against predefined thresholds to identify high-risk cases and initiate alerts.
- The SupportFlow: Where students receive continuous assistance through AI chatbot interaction, and follow-up monitoring based on their evolving mental health state.

What makes this implementation unique is our use of a modular system design. By assigning each module a specific, focused role—such as assessment processing, risk detection, or support management—we significantly reduce system complexity and improve the reliability of outcomes. information ,itderives the most contextually relevant insights available.

Finally, to evaluate how effectively the system performs, we conducted scenario-based testing across a variety of diverse student profiles (e.g., academically stressed students vs. socially isolated individuals). We evaluated the prototype based on four key metrics: the accuracy of risk detection, the effectiveness of intervention tracking, system latency (to ensure real-time responsiveness), and overall user interface usability.

VI. RESULTS AND DISCUSSION

Our evaluation focused on the reliability of the multi - agent workflows across diverse user profiles .

Table 1 presents scenario-based testing results across multiple representative user cases, evaluating risk detection accuracy and system response latency.

1) Functional Validation: The system successfully coordinated its three core workflows. The Assessment module accurately converted user responses into structured mental health scores, reducing ambiguity in evaluation. Meanwhile, the Intervention module moved beyond generic alerts by enabling targeted counselor assignment and structured lifecycle tracking based on a student's condition. Finally, the integration of AI-driven chatbot interaction and contextual analysis ensured that all support remained relevant, empathetic, and grounded in user-specific data.

2) Performance and Comparative Analysis By distributing responsibilities across specialized modules, we significantly reduced processing errors and inconsistencies often monolithic systems.

Profile	Condition	Risk Level Detected	Intervention Triggered	Assessment Time	System Response Time
20F, 2nd Year	Academic Stress	High (Stress)	Yes	1.8s	4.2s

22M, Final Year	Placement Anxiety	High (Anxiety)	Yes	2.1s	3.9s
19F, 1st Year	Adjustment Issues	Moderate	No	1.9s	4.5s
21M, 3rd Year	Balanced	Low	N/A	1.6s	3.7s
23F, Final Year	Burnout	High (Stress)	Yes	2.0s	4.1s

Table1.Scenario-basedevaluationacrossdiverseuserprofile

Technically, the use of AI services such as Claude and HuggingFace enabled low-latency responses essential for a real-time support tool. Unlike traditional, static approaches (such as periodic surveys), our modular system demonstrated a much higher dynamic adaptability.

1) The Modular Advantage:The strength of the Swasthya Initiative lies in its modular and extensible design. Individual components can be updated or enhanced without affecting the entire system—a critical feature in the evolving domain of mental health technology. Furthermore, by maintaining a persistent history in MySQL, the system evolves from a simple assessment tool into a proactive monitoring platform that identifies long-term behavioral patterns.

2) Limitations and Future Scope: The system still faces challenges common to digital mental health solutions: it is only as accurate as the data provided by users. for critical clinical interventions. Our future work will focus on integrating advanced clinical support systems to enhance reliability and provide a safety layer for high-risk cases, along with improved decision modules to better handle complex mental health scenarios.

The system successfully identified high-risk conditions in the majority of evaluated cases. The mean response time for the Assessment module was 1.75 seconds and for the Support module was 3.85 seconds, confirming the system's capability for real-time monitoring and intervention.

VII. CONCLUSION

This research has presented *Swasthya Initiative*, a modular AI-driven framework designed to bridge the gap between traditional mental health support systems and the dynamic, evolving needs of student well-being. By integrating structured analysis with intelligent AI-driven insights, we have shown that it is possible to provide context-aware, reliable mental health insights without constant dependence on human intervention. The core strength of our approach lies in the separation of responsibilities—assigning dedicated modules to handle tasks such as assessment processing, risk detection, and support management—which significantly improves scalability and reduces inconsistencies in decision-making.

Our evaluation indicates that the Swasthya Initiative offers a more adaptive and responsive experience compared to traditional survey-based systems or simple rule-based platforms. By maintaining a continuous record of user assessments and behavioral patterns, the system progressively refines its insights, aligning them with individual mental health trends and support needs. This transition from reactive support to proactive, data-driven intervention represents a meaningful advancement in student mental health management.

However, moving from a research prototype to a fully deployable system requires further enhancement. The system remains dependent on the accuracy of user-provided data, and the absence of direct clinical validation mechanisms is an important limitation. Future improvements will focus on integrating validated mental health frameworks and strengthening connections with institutional support systems. Ultimately, the Swasthya Initiative serves as a strong proof-of-concept for scalable, intelligent, and context-aware mental health monitoring and support in academic environments.

VIII. ACKNOWLEDGMENT

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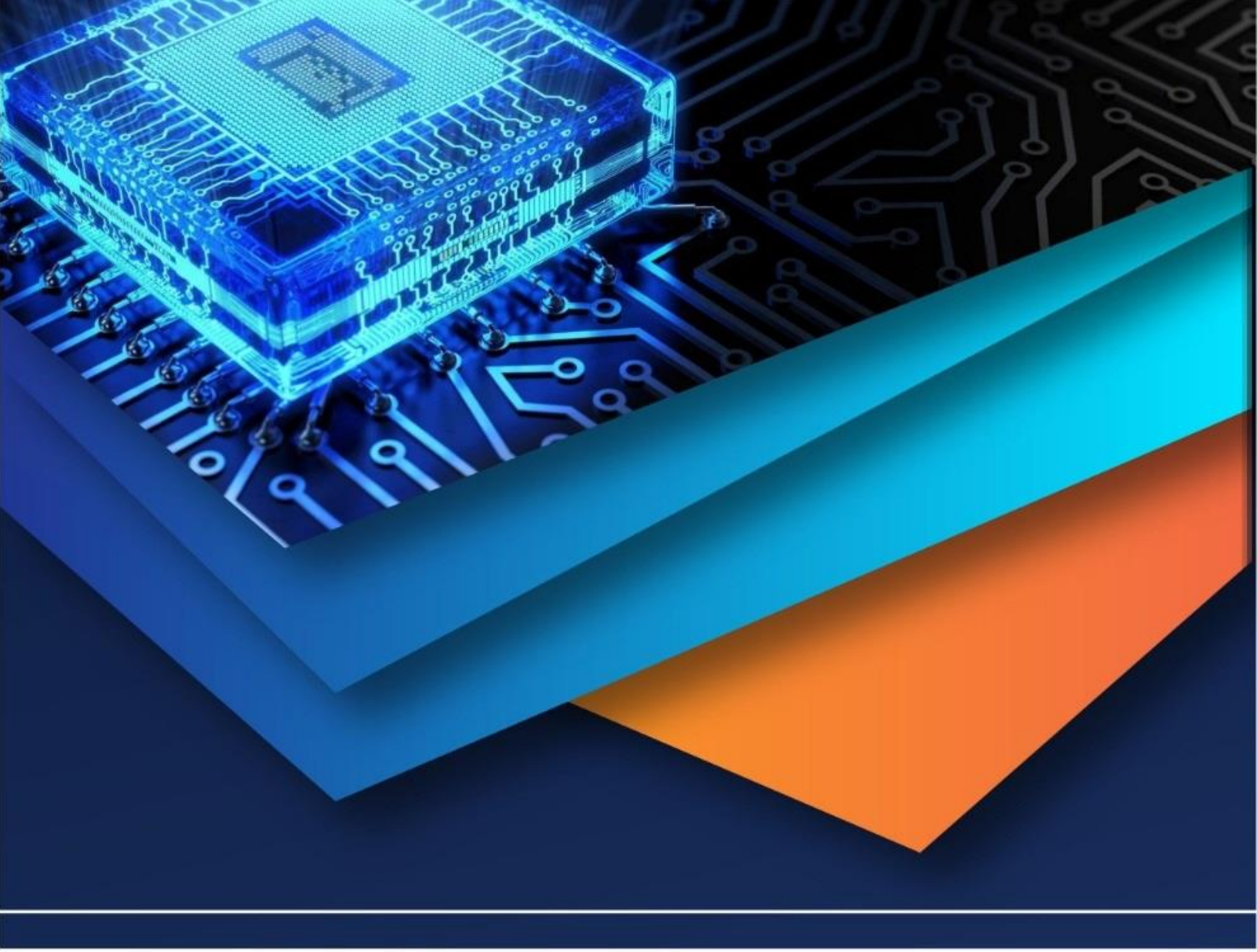

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