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ICAS: Intelligent Canteen Automation System - An AI Based Approach for Smarter Canteen Operations

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Abstract: ***University canteens face daily challenges that affect hundreds of students — long queues, food wastage, and no structured way for students to share feedback. This paper presents ICAS (Intelligent Canteen Automation System), a web-based platform built using HTML, CSS, and JavaScript that addresses these challenges in a simple and practical way. ICAS provides online food ordering with Dine-In and Takeaway modes, a token-based queue system, and two AI features: Queue Prediction for students and Demand Forecasting for canteen staff. A Best Dish of the Day voting feature allows students to rate their ordered dishes, with results shown on a live leaderboard. ICAS is lightweight, browser-based, and deployable without complex server infrastructure, making it well-suited for any college or university canteen.***

Keywords: Canteen automation, queue prediction, token-based ordering, demand forecasting, student voting, food wastage reduction, web application.

I. INTRODUCTION

College canteens serve hundreds of students every day. Despite this, most canteens still operate manually — students stand in long queues, pay by cash, and have no way to know how long their food will take. During a short lunch break between lectures, this causes frustration and wasted time.

Three problems repeat across almost every college canteen. First, overcrowding during peak hours when all students arrive at the counter at the same time. Second, food wastage because canteen staff have no reliable way to predict how much food will be needed the next day. Third, there is no feedback mechanism for students to tell the canteen which dishes they enjoy.

ICAS (Intelligent Canteen Automation System) is a web-based solution designed to solve all three problems without requiring expensive software or specialized hardware. Students log in, choose between Dine-In and Takeaway, browse the digital menu, and place their order. The system assigns a digital token number immediately after payment, so students do not need to stand in a queue. A Queue Prediction feature shows the estimated waiting time, and after collecting their order, students can vote for their favourite dish. For canteen staff, a Demand Forecasting feature in the admin dashboard predicts how many portions of each item will be needed the next day.

The system is built entirely with HTML, CSS, and JavaScript, technologies that are widely understood and easy to maintain. This paper describes the design, features, and implementation of ICAS, and presents a screenshot-based walkthrough of the working system.

II. RELATED WORK

Several canteen and cafeteria management systems have been proposed in recent years. Each contributes to the field but also leaves certain gaps that ICAS addresses.

Mukesh Krishnan et al. [1] built a Smart Canteen platform with online ordering, a virtual queue, and UPI payment. They also used machine learning for crowd estimation and food demand prediction. However, the system did not distinguish between Dine-In and Takeaway orders, and there was no student voting feature.

Nikhil et al. [2] developed an Android-based canteen automation system where students could order from an e-menu and the result would appear directly on a screen near the chef. The system was simple and practical but had no queue wait-time prediction.

Kulkarni et al. [3] proposed Smart Serve, a cafeteria system focused on improving the user experience with order tracking and digital payments. It did not include AI-based features or student feedback tools. Tejasri et al. [4] built one of the more advanced systems reviewed, using the MERN stack with the Prophet model for demand prediction and K-Means clustering for order analysis. However, there was no dine-in and takeaway distinction and no student engagement feature.

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Binu et al. [5] created E-Treat, a PHP and MySQL web application that digitised canteen ordering and billing. Kampli et al. [6] introduced CampoBite, which used a token-based queue and order notifications. Sharmila et al. [7] proposed Food Corner to reduce manual processes. Biradar et al. [8] built Intellicater, which used machine learning for personalised menu recommendations. None of these systems combined all five features: token-based ordering, dine-in and takeaway modes, AI queue prediction, demand forecasting for staff, and student voting.

Table I compares these systems against ICAS and shows the gap that this work addresses.

TABLE I: Comparison Of Existing Systems with Proposed ICAS

	Online Ordering	Token Queue	Dine-in & Takeaway	Demand Prediction	Student Voting
Smart Canteen (Mukesh Krishnan et al., 2021)	Yes	Virtual	No	ML-based	No
Canteen Android (Nikhil et al., 2022)	Yes	No	No	No	No
Smart Serve (Kulkarni et al., 2024)	Yes	Partial	No	No	No
Intelligent Canteen ML (Tejasri et al., 2025)	Yes	No	No	Prophet+K Means	No
CampoBite (Kampli et al., 2026)	Yes	Token	No	No	No
Food Corner (Sharmila et al., 2025)	Yes	No	No	No	No
ICAS (Proposed)	Yes	Token + AI Pred	Yes	Exp. Smoothing	Yes

III. PROPOSED SYSTEM

ICAS is designed as a unified canteen management platform with five main features. Each feature is described below.

A. Student Login and Role Selection

Users open the ICAS web application and log in with their institutional email and password. The login page provides a role selector — Student or Admin/Staff — so that each user is directed to the appropriate part of the system. Students see the ordering portal. Canteen staff see the admin dashboard. This role-based access ensures that features like demand forecasting are only visible to authorised personnel.

B. Dine-In and Takeaway Ordering

After logging in, students see the digital menu organised into categories such as Meals, Snacks, and Beverages. Before placing an order, the student selects the order mode: Dine-In (eating at the canteen) or Takeaway (picking up food to eat elsewhere). Items are added to a cart and the order is confirmed with an online payment. A queue wait-time estimate is visible on the menu page before ordering, helping students plan their time.

C. Token-Based Queue Management and Queue Prediction

Once payment is confirmed, the system instantly assigns a unique digital token number to the student's order. The student simply waits until their token number is called at the counter — there is no need to stand in a physical queue. The Queue Prediction module calculates an estimated wait time based on the number of pending orders ahead and the average preparation time observed during the day. This estimate is displayed clearly on the order confirmation screen.

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D. Admin Dashboard and Demand Forecasting

The admin dashboard gives canteen staff a real-time view of all incoming orders, their current status, and key metrics for the day. Staff can update each order from Confirmed to Preparing to Ready, and students receive an update when their token is about to be called. The Demand Forecasting panel applies an exponential smoothing model to past order data and displays predicted quantities for each menu item for the next day, shown as a bar chart sorted from highest to lowest demand. This helps staff decide how much food to prepare each morning.

E. Best Dish of the Day Voting

After collecting their order, students are prompted to vote for their favourite dish from among the items they ordered. Each order allows one vote, and only items from that order are shown as options. Votes are counted in real time and displayed on a public leaderboard. The dish with the highest votes at the end of the day is highlighted as the Best Dish of the Day. This feature increases student engagement and gives management useful daily feedback about which dishes are most enjoyed.

IV. SYSTEM ARCHITECTURE

The ICAS architecture is organised into three layers. The Presentation Layer is what students and staff see — built using HTML5, CSS3, and JavaScript, and responsive across desktop and mobile browsers. The Application Logic Layer contains the six JavaScript modules (auth.js, menu.js, order.js, queue.js, forecast.js, vote.js) that handle all system functions. The Data Layer uses the REST API to store menu data, order records, vote counts, and forecast parameters in JSON format. Fig. 6 shows the complete architecture.

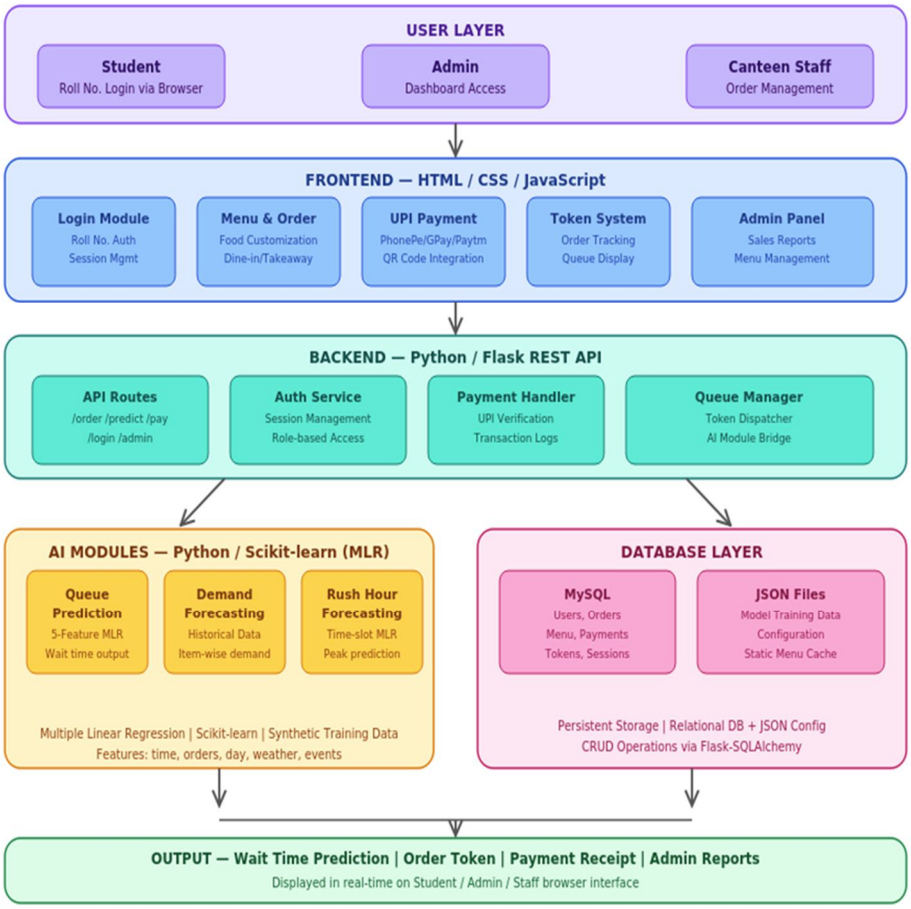


Fig. 6: ICAS system Architecture

V. IMPLEMENTATION

This section presents a walkthrough of the ICAS system through its key screens. The objective of the system is to reduce dependence on manual canteen processes and offer a smooth, digital experience for both students and canteen staff.

1) Screenshot 1. Login Page

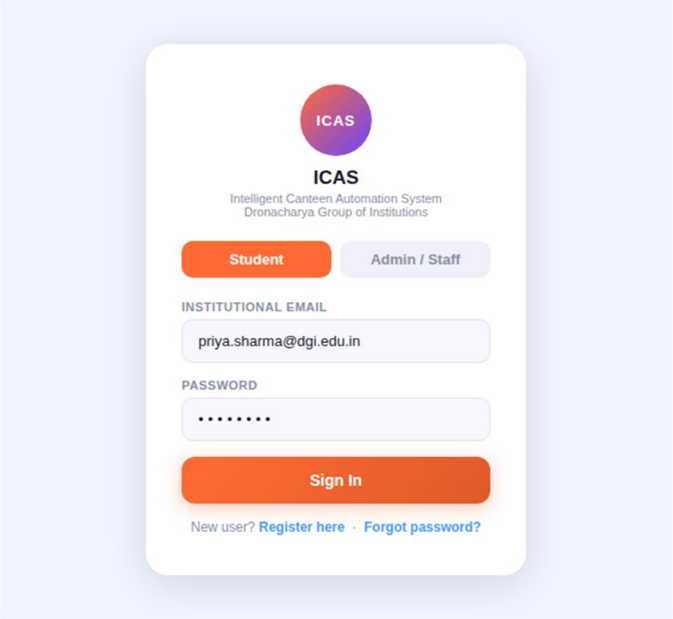


Fig. 1: ICAS Login Page

This is the ICAS login page. The system name and institution are displayed prominently at the top. Students and canteen staff both use this page to sign in. There is a role selector at the top of the form — choosing Student takes the user to the ordering portal, while choosing Admin / Staff opens the canteen management dashboard. The login page is built using HTML for structure and CSS for styling, with JavaScript handling form validation before submission.

2) Screenshot 2. Student Menu and Ordering

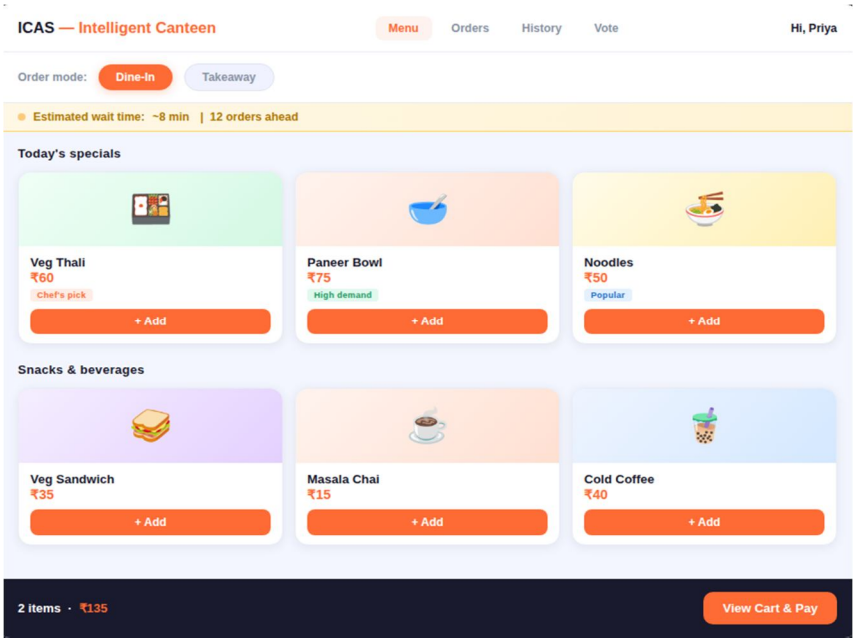


Fig. 2: Student Menu Page with Dine-In / Takeaway Selection

After logging in, the student sees the digital menu. At the top of the page are two buttons to select the order mode: Dine-In or Takeaway. A yellow information bar shows the current estimated queue wait time, so the student knows how busy the canteen is before even placing an order. Menu items are displayed as cards with the dish name, price, and category tags such as Chef's Pick or High Demand. The student adds items to the cart and proceeds to payment.

3) Screenshot 3. Token Confirmation and Queue Prediction

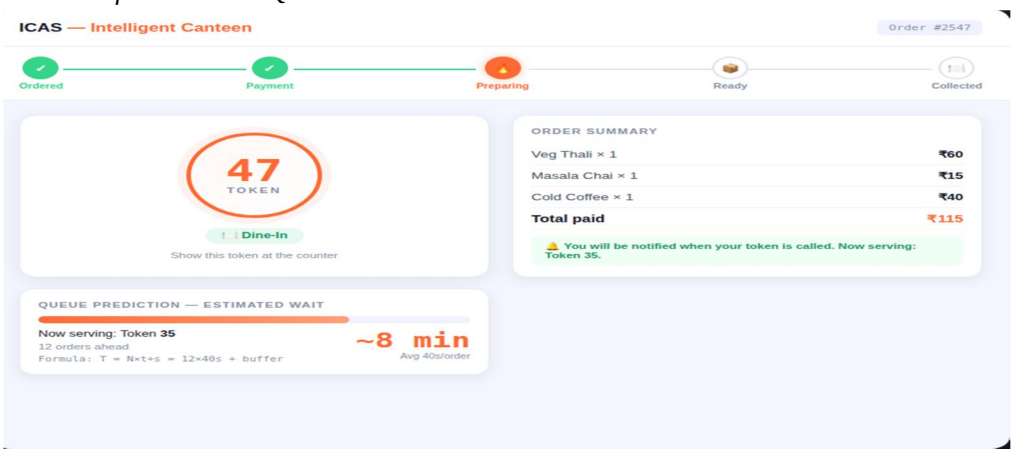


Fig. 3: Token Confirmation Screen with Queue Prediction

Once the payment is completed, the system immediately generates a digital token number for the student's order. This token is shown clearly on the screen along with the order summary. Below the token, the Queue Prediction panel displays the estimated waiting time, the number of orders ahead, and the token currently being served at the counter. An order status bar at the top shows the progress from Ordered to Payment to Preparing to Ready. The student can leave the queue and come back when their token is close to being called.

4) Screenshot 4. Admin Dashboard with Demand Forecast

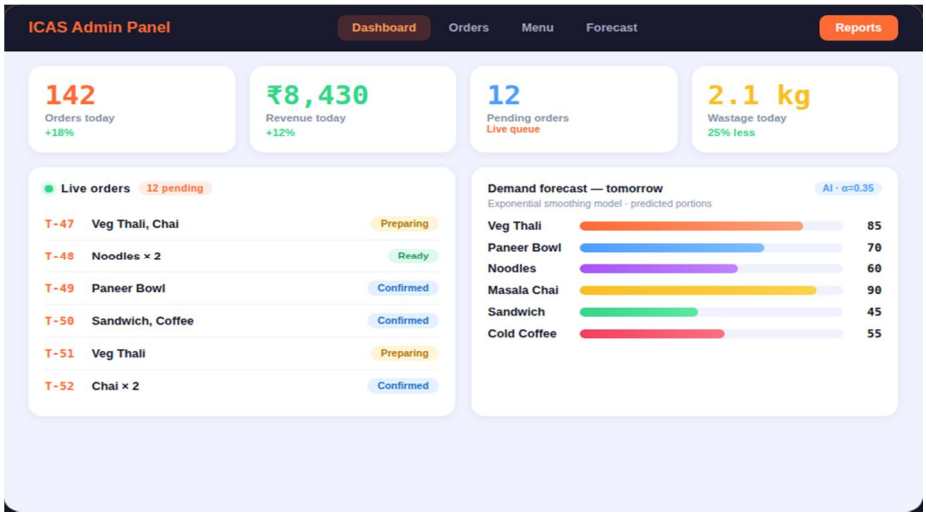


Fig. 4: Admin Dashboard showing Live Orders and Demand Forecast

This is the admin dashboard, which is the control centre for canteen management. The top row shows key daily metrics at a glance: total orders, revenue, pending orders, and food wastage for the day. The left panel shows a live list of all current orders with their token numbers, item names, and current preparation status. Staff can update each order status directly from this panel. The right panel shows the Demand Forecast for the next day — each menu item is shown with a predicted quantity as a horizontal bar chart, generated by the AI forecasting module. This helps canteen staff plan how much food to prepare each morning.

5) Screenshot 5. Best Dish Voting and Leaderboard

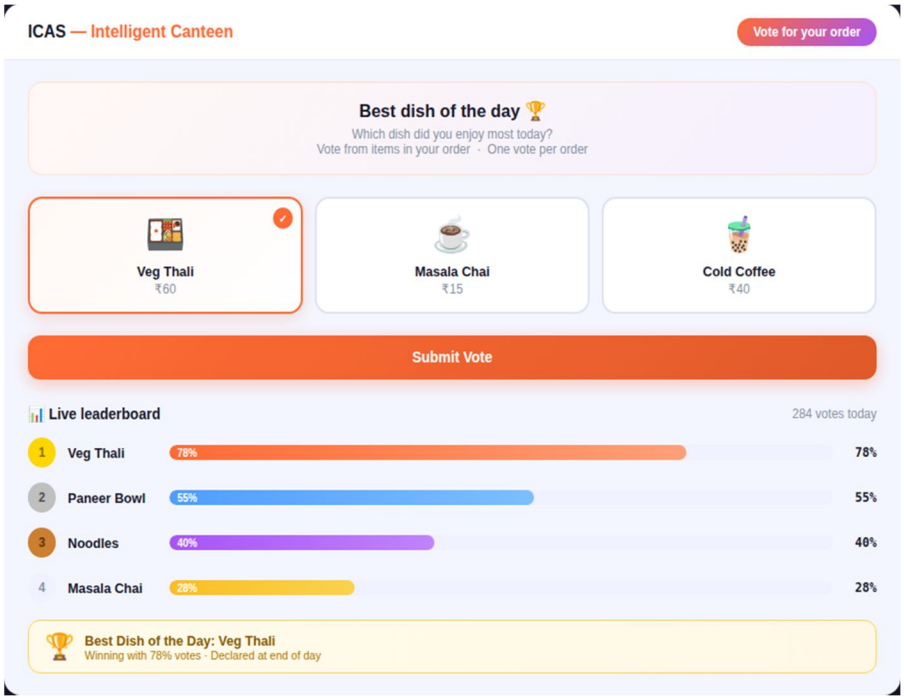


Fig. 5: Best Dish of the Day Voting Screen with Live Leaderboard

After receiving their order, the student is taken to the voting page. The system shows only the dishes from the student's current order as voting options — this ensures that votes are genuine and tied to actual purchases. The student selects their favourite dish and submits. The live leaderboard at the bottom of the page updates in real time and shows all dishes ranked by vote percentage. Any student visiting the page can see the leaderboard. The dish with the most votes at the end of the day is declared the Best Dish of the Day and highlighted with a special badge.

VI. CONCLUSION

This paper presented ICAS, an Intelligent Canteen Automation System that brings together five practical features to improve the daily experience of students and canteen staff: a digital menu with Dine-In and Takeaway mode selection, a token-based queue system, an AI powered queue prediction feature, a demand forecasting dashboard for staff, and a Best Dish of the Day voting and leaderboard system.

The system is built using HTML, CSS, and JavaScript — technologies that are lightweight, widely supported, and easy to maintain. ICAS does not require a complex server or expensive infrastructure, which makes it practical for deployment in any college or university canteen.

The screenshot walkthrough shows that ICAS covers the complete journey of a canteen user, from login to ordering, token collection, and post-order feedback. The admin side gives canteen staff everything they need to manage orders in real time and plan the next day's food supply using AI-generated forecasts.

Future improvements will include the integration of smart digital display boards at canteen counters to show real-time token status, wait times, and menu availability, along with the development of dedicated Android and iOS mobile applications to enhance accessibility. Additionally, dietary filters such as vegetarian, vegan, and allergen-based options will be introduced to cater to diverse user preferences and requirements, along with the integration of a customized menu request feature to allow users to suggest or personalize meal options.

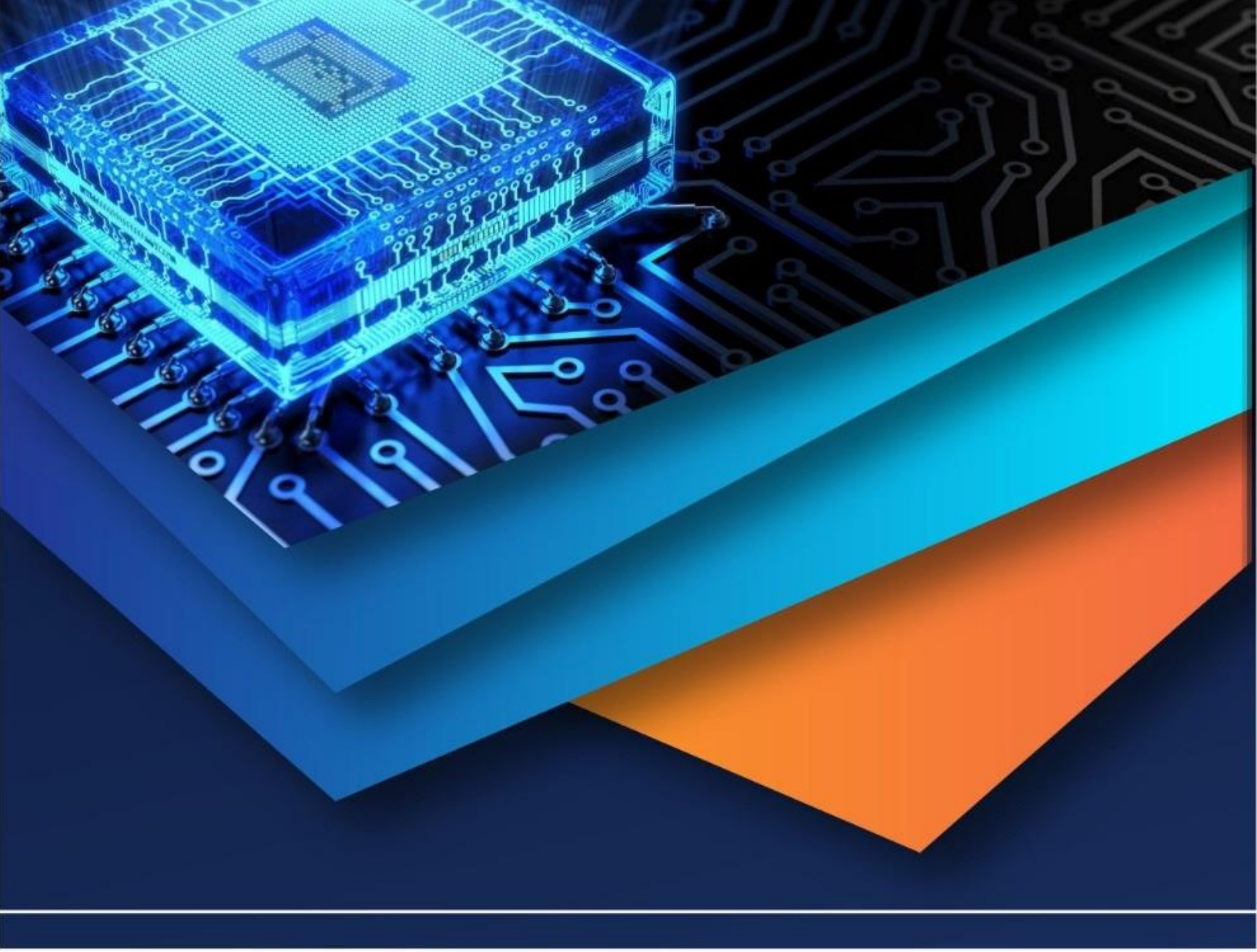
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