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eHostel Hub - A Smart Hostel Management System

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Abstract: This paper presents eHostel Hub, a web-based hostel management system designed to integrate administrative and security operations within institutional hostels. The system integrates role- based access for students, parents, wardens and security personnel using Firebase-backed authentication and real-time data synchronization. Key functionalities include automated attendance generation using gate logs, multi-level outpass approval with parent validation, OTP-based visitor authentication and intelligent room allocation based on academic parameters. The proposed system reduces manual intervention in administrative workflows and ensures real-time monitoring of student movement. Experimental usage demonstrates improved transparency, faster communication and enhanced hostel security compared to traditional methods.

Keywords: Student Activity Tracking, Centralized Records, Gate Monitoring, Digital Attendance, Outpass Approval, Institutional Security.

I. INTRODUCTION

In many educational institutions, hostel administration operates through disconnected processes where attendance, gate logs, and approvals are handled independently. This lack of integration results in inconsistencies in student tracking and delays in administrative decision- making. For instance, attendance records often do not reflect actual student movement recorded at security gates, leading to inaccurate monitoring. With increasing student populations and growing security concerns, institutions require a centralized digital platform capable of managing attendance monitoring, fee monitoring, complaint resolution, OTP visitor verification, digital mess preference tracking, multi- level outpass approval and priority-based room allocation suggestion within a structured workflow environment. The smart hostel management system addresses these challenges by implementing a multi-role authenticated architecture with real-time synchronization and automated workflow logic. The system ensures structured communication among stakeholders, including students, parents, wardens and security staff. Through intelligent automation and centralized monitoring, the platform enhances safety, accountability and administrative control while reducing manual intervention.

II. LITERATURE REVIEW

Diyaolu et al. (2024) developed an e-based hostel management system focusing on digitizing student records and administrative processes. However, the system lacks real-time synchronization between modules such as attendance and security logs. Yadav et al. (2025) proposed a smart hostel booking system incorporating automated room allocation and online booking features. While effective for accommodation selection, it does not address internal hostel monitoring or security validation mechanisms. Agrawal and Rastogi (2023) introduced a cloud-based hostel automation system that improves data accessibility and scalability. However, the system does not include multi-level authentication or parent involvement in decision workflows. SharmikhaSree et al. (2023) designed a dormitory management system for handling student registration and room allocation. The system primarily focuses on administrative efficiency and lacks intelligent automation features such as predictive allocation or real-time alerts. From the analysis of existing systems, it is evident that most solutions address individual modules but fail to provide an integrated platform combining security, automation and parent interaction.

III. EXISTING METHODOLOGY

In the current hostel management setup observed in our institution, attendance is recorded manually while gate entry and exit are maintained separately by security personnel. These systems operate independently without synchronization, leading to inconsistencies in student status tracking. Outpass approvals are processed offline, making real-time validation at entry/exit points difficult. Additionally, fee tracking and complaint handling are not integrated into a unified system, increasing administrative workload and response time.

IV. PROPOSED SOLUTION

The proposed system, eHostel Hub is designed as a centralized web application that integrates hostel administration, security monitoring and parent interaction into a single platform. The system is implemented using Firebase Firestore for real- time database management and supports four user roles with controlled access.

1) Attendance Monitoring: The attendance module automates daily tracking by synchronizing with security gate records. Wardens can select a date to generate attendance reports and students who fail to check in within the permitted time are automatically marked absent. This reduces manual errors and ensures accurate monitoring.
2) Security Tracking: The system records and uploads student check-in and check-out activities using register number verification. Approved outpass details are validated before exit and all movement logs are maintained in real-time. These records can be securely accessed by both parents and wardens for monitoring purposes. The module ensures accountability by tracking the entry and exit history of each student. It helps in preventing unauthorized movements within the hostel premises. Overall, the system enhances transparency, supervision and student safety
3) Smart Room Suggestion: The smart room suggestion provides priority- based room suggestion based on vacancy, academic year and department. The system automatically recommends the most suitable room, minimizing manual effort and ensuring efficient space utilization.
4) Multi-Level Outpass Approval: The outpass implements a structured digital approval workflow. Students submit outing request, which require parent approval followed by warden verification. The final status is updated in real-time and reflected in the security dashboard.
5) OTP-Based Verification: The visitor module enhances security by generating an OTP sent to the parent's registered mobile number. Access is granted only after successful OTP validation, eliminating manual visitor entries and strengthening hostel security.
6) Fee Management: The fee management enables digital recording of hostel fee payments and monitoring due dates. Automatic reminders and overdue alerts are generated to notify parents, ensuring financial transparency and timely payments tracking.
7) Complaint Monitoring and Escalation: The complaint management allows students to raise complaints digitally. The system tracks complaint status and applies escalation logic if unresolved within a specific time frame, ensuring systematic issue resolution.
8) Mess Preference Management:The mess module allows student to select weekly meal preferences (vegetarian and non-vegetarian) through a digital interface. Food count is calculated based on In/Out status of the student and outing meal preference.

V. SYSTEM ARCHITECTURE

The eHostel Hub system is designed using a layered architecture consisting of four main layers:

1) User Layer: This layer includes students, parents, wardens, and security personnel. Each user interacts with the system through role-specific dashboards to perform authorized operations.
2) Presentation Layer: The presentation layer is implemented as a web application using HTML, CSS, and JavaScript. It provides an interactive interface for users to access system features and submit requests.
3) Authentication Layer: This layer ensures secure system access. Students, wardens, and security staff use credential-based login, while parents authenticate using OTP verification followed by a secure PIN.
4) Application Logic Layer: This layer handles core functionalities such as attendance tracking, outpass approval, room allocation, fee management, complaint handling, visitor verification, and mess management.
5) Data Layer: The data layer uses Firebase Firestore, a cloud- based NoSQL database, to store student records, attendance logs, fee details, complaints, and visitor OTP data. It supports real-time synchronization across all modules.

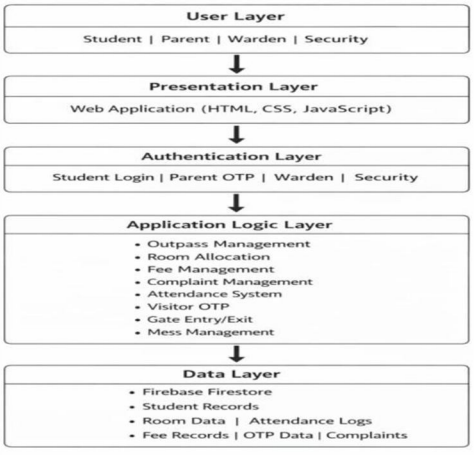

Fig 1. Hostel Room Configuration flow

VI. BLOCK DIAGRAM

A. *Hostel Room configuration.*

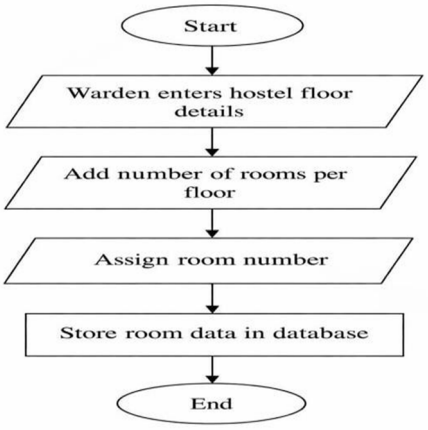

Fig 2. Hostel Room Configuration flow

The hostel room configuration process allows the warden to enter hostel floor details and the number of rooms available per floor. The system assigns room numbers accordingly. All room configuration details are stored in the database for efficient room allocation and management.

B. *Attendance Monitoring*

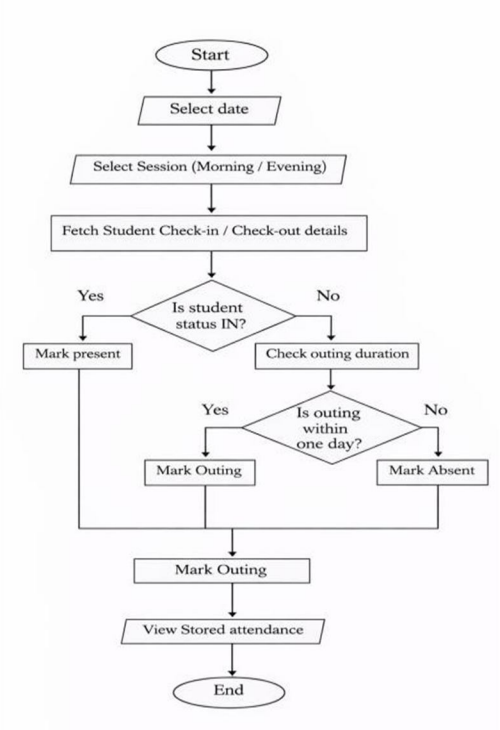

Fig 3. Attendance Monitoring flow

Attendance is automatically generated using security gate check-in and check-out timestamps. Students are marked as present, absent or outing based on movement and outpass status. This eliminates manual attendance errors and ensures real-time accuracy.

C. Fee Management

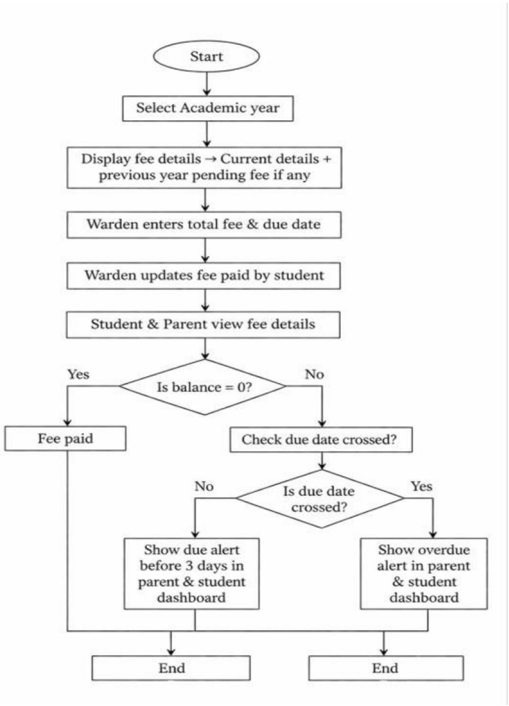

Fig 4. Fee Management flow

The updated fee module generates automated alerts before and after due dates. Notifications are displayed on both student and parent dashboards.
This ensures timely fee payment and financial transparency.

D. Outpass Approval

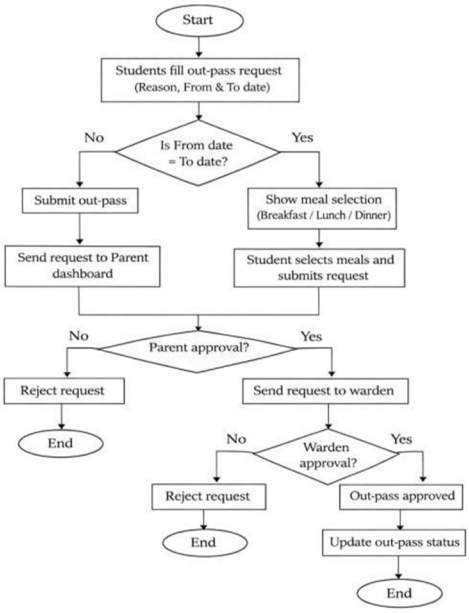

Fig 5. Outpass Approval Flow

The outpass approval follows a structured three- level workflow involving students, parents and wardens. Parent approval is mandatory before warden verification. Approved outpasses are synchronized with security gate verification and attendance updates.

E. Add and view student detail

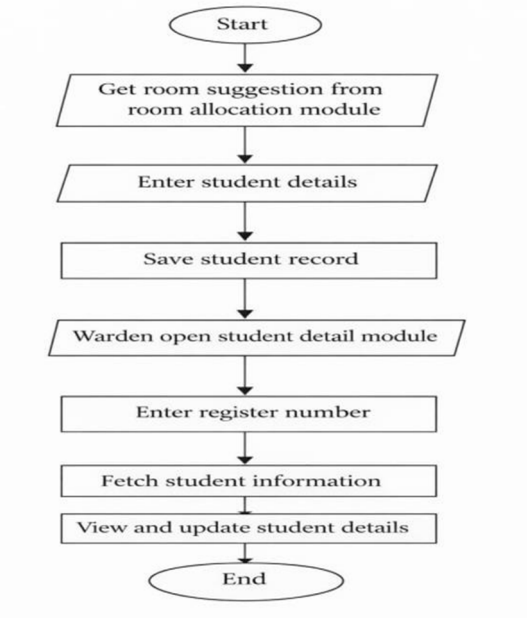

Fig 6. Add and View Student Details flow

The student management module enables the entry and storage of student details along with suggested room allocation. The system saves the student record in the database for future reference. The warden can retrieve student information using the registration number to view or update the details when required.

F. Complaint Management

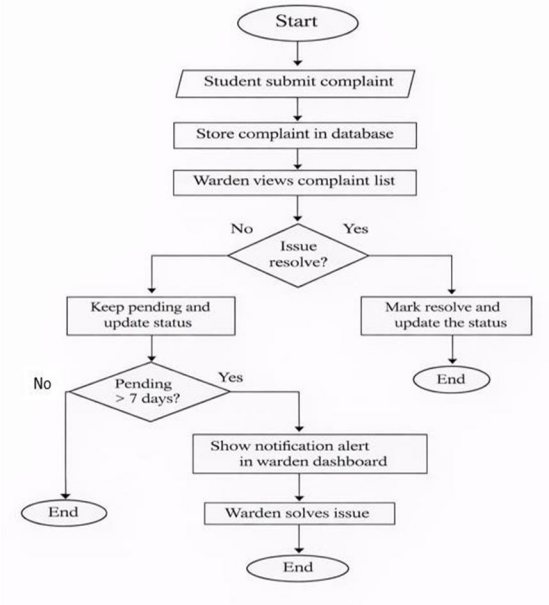

Fig 7. Complaint Management flow

The complaint management process starts when a student submits a complaint through the system. The complaint is stored in the database and reviewed by the warden. If the issue remains unresolved for a specific period, the system generates a notification alert until the complaint is resolved.

G. Mess Management

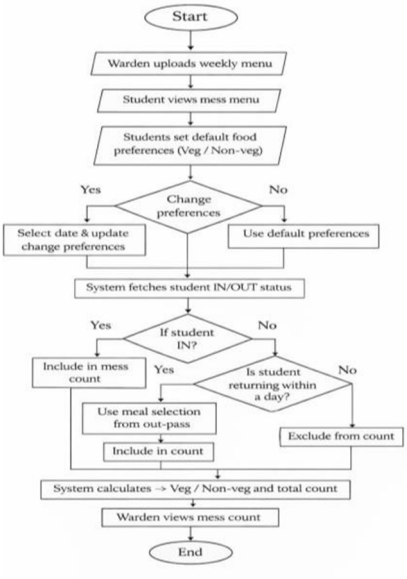

Fig 8. Mess Management flow

The warden uploads the weekly mess menu and students view it and set their default food preference (veg/non-veg). Students may optionally modify their preference for specific dates. The system calculates veg and non-veg counts and displays the total to the warden.

H. Visitor OTP

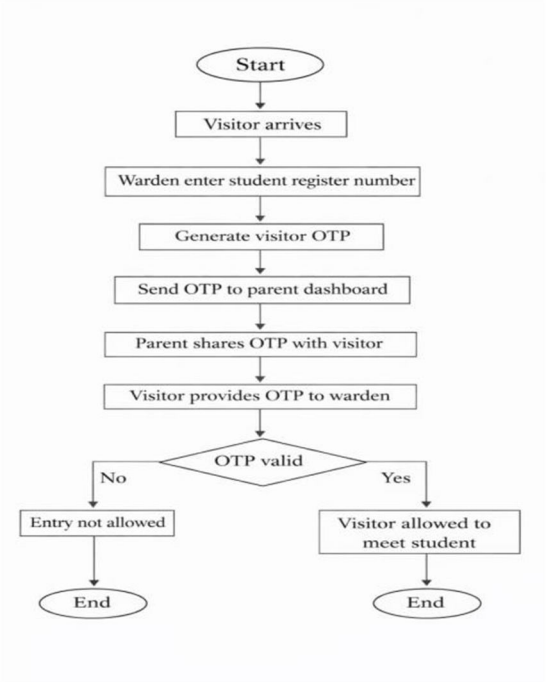

Fig 9. Visitor OTP flow

When a visitor arrives, the warden enters the student registration number to generate an OTP. The OTP is sent to the parent dashboard and shared with the visitor for verification. If the OTP is valid, the visitor is allowed to meet the student; otherwise, entry is denied.

I. Room Allocation

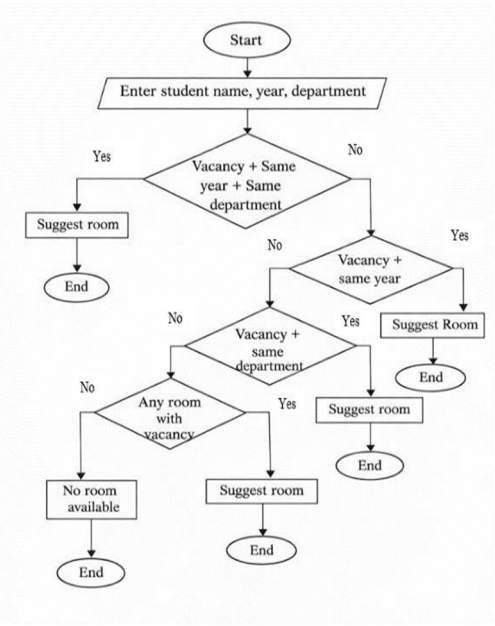

Fig 10. Room Allocation Flowchart

The room allocation process begins by collecting the student's name, year, and department. The system checks room availability and prioritizes rooms with the same year and department to maintain compatibility among students. If such rooms are unavailable, the system searches for rooms with partial matches or any available vacancy before concluding that no rooms are available.

J. Security Gate IN/OUT

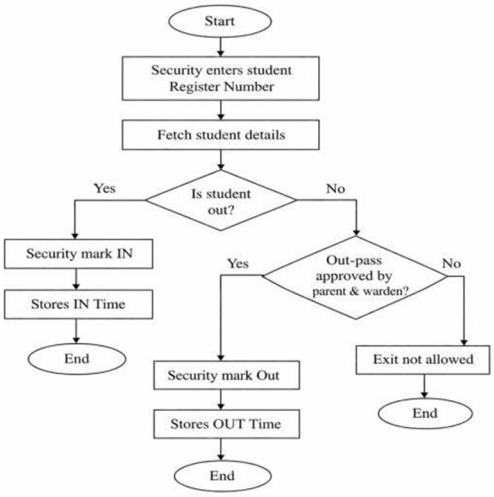

Fig 11. Security Gate In/Out Flowchart

The security gate process starts when the security personnel enter the student registration number to retrieve student details. The system verifies whether the student is entering or exiting and checks for an approved out-pass if the student attempts to leave. Based on validation, the system records the in/out time and automatically updates the student's attendance status.

K. Login

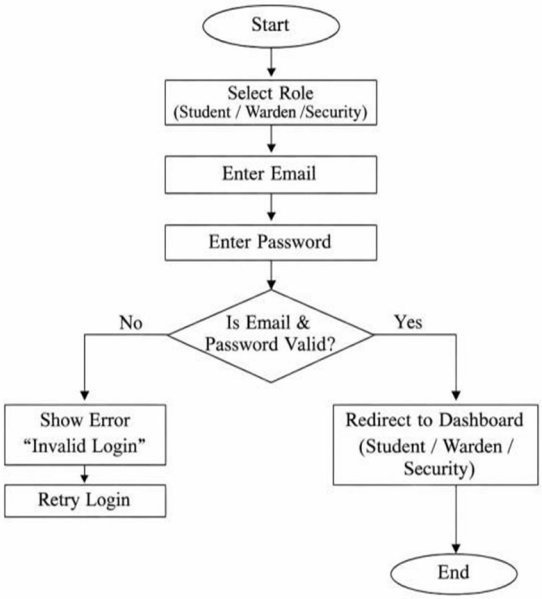

Fig 12. Login

The user begins by selecting their role and entering their email and password. The system verifies the entered credentials for authentication. If the login details are invalid, an error message is shown and the user retries. If valid, the user is redirected to their respective dashboard, ensuring secure access.

L. Parent Login

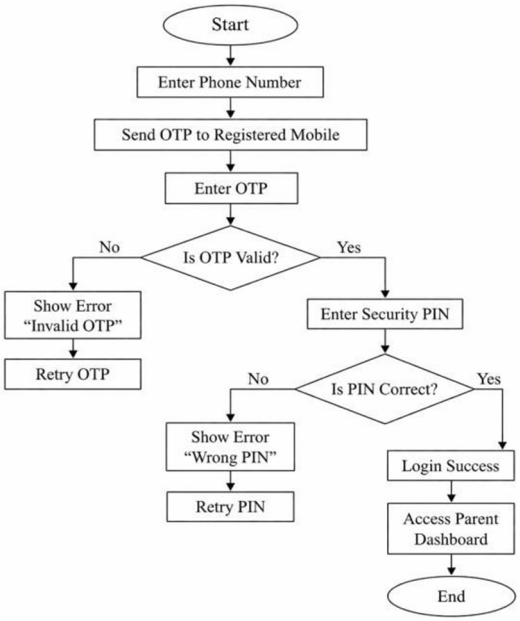

Fig 13. Parent Login

The user enters their phone number and receives an OTP. After entering the OTP, the system validates it. If correct, the user enters a security PIN for additional verification. Once validated, the user gains access to the parent dashboard.

VII. MODULE WISE IMPLEMENTATION

The system follows a modular architecture, where each module functions independently while sharing centralized database connectivity.

1) Multi-Role Authentication:

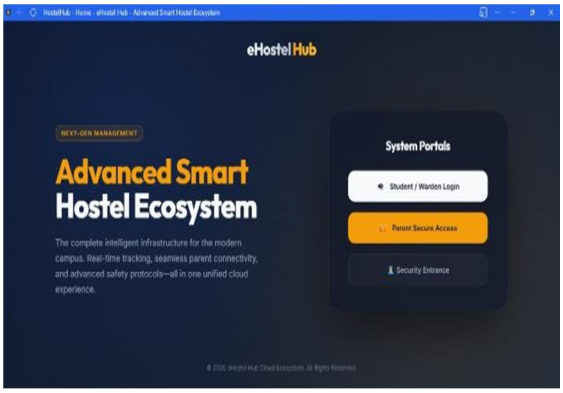

Fig 14. Multi-Role access

This module supports four login portals: Student, Parent, Warden, and Security. Authentication mechanisms include password-based login for students, wardens and security personnel and OTP-based login for parents. RBAC (Role- Based Access Control) ensures secure access control and strict data isolation.

2) Security Dashboard - Gate Management:

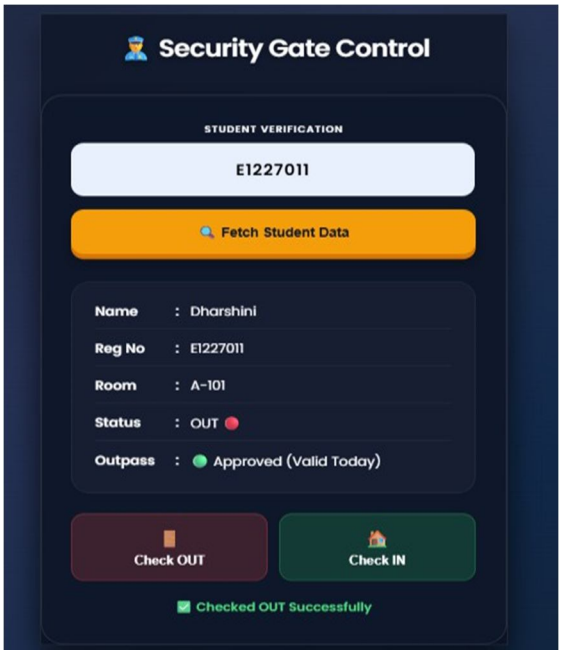

Fig 15. Security Gate Control

This module is used by security staff to record student Check-In and Check-Out activities. The security user enters the student register number, fetching the student details and do corresponding actions. A timestamp is automatically stored in the database. The movement status is synchronized with parent, warden dashboard and attendance module.

3) Warden Dashboard

The Warden Dashboard acts as the administrative core.

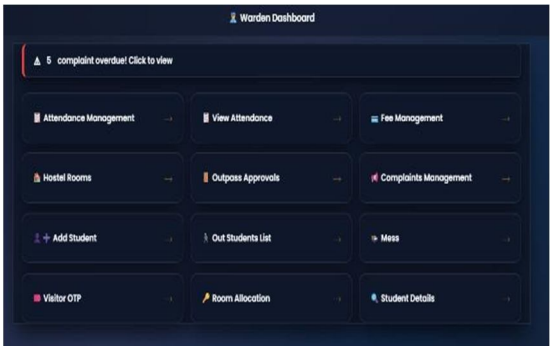

Fig 16. Warden Dashboard

4) Attendance Management - Wardens can mark and view daily attendance. Absentee lists are automatically generated based on check-out records.

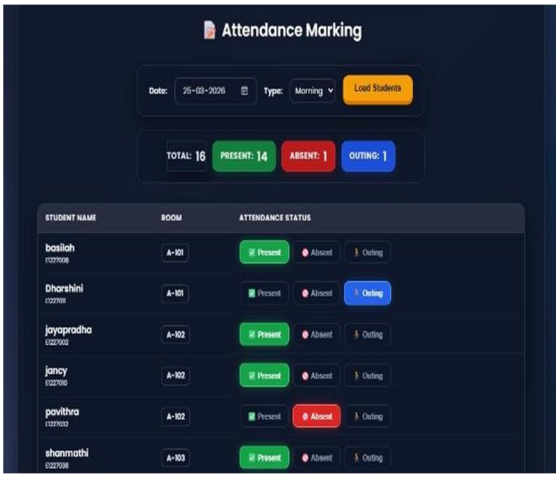

Fig 17. Attendance Marking

5) Fee Management System - Wardens update total hostel fees, paid amounts and outstanding balances. If balance remains greater than zero after the due date, automated alerts are displayed on both Student and Parent Dashboards.

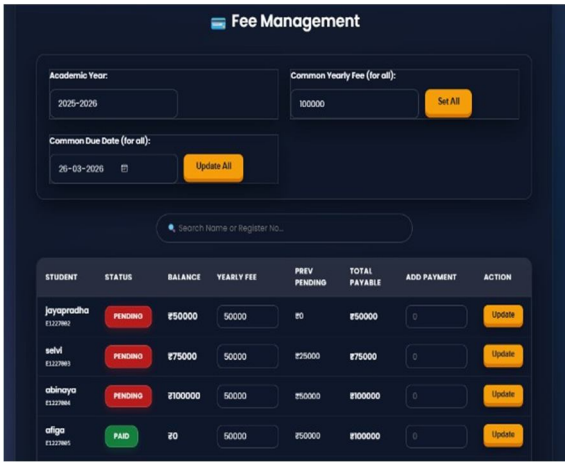

Fig 18. Fee Management

6) Outpass Approval Workflow -The system follows a three-level approval hierarchy. Student submits outpass request. Parent receives notification and approves or rejects. Warden provides final approval.

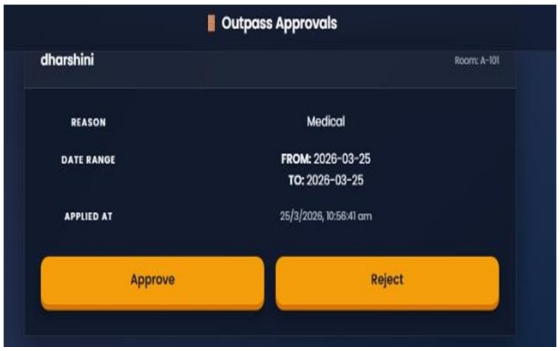

Fig 19. Outpass Approvals

7) Complaint Management system - Students raise complaints through their dashboard. Wardens update status as Pending or Resolved. If a complaint remains unresolved for more than seven days. An automated alert appears on the Warden Dashboard.

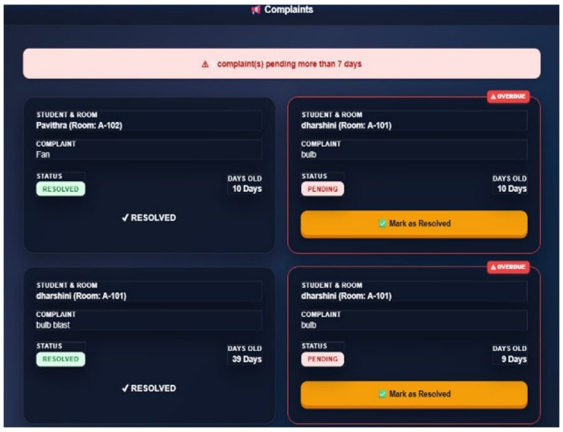

Fig 20. Complaints Management system

8) Student Management - Wardens can add new students, edit student details and view room-wise student lists.

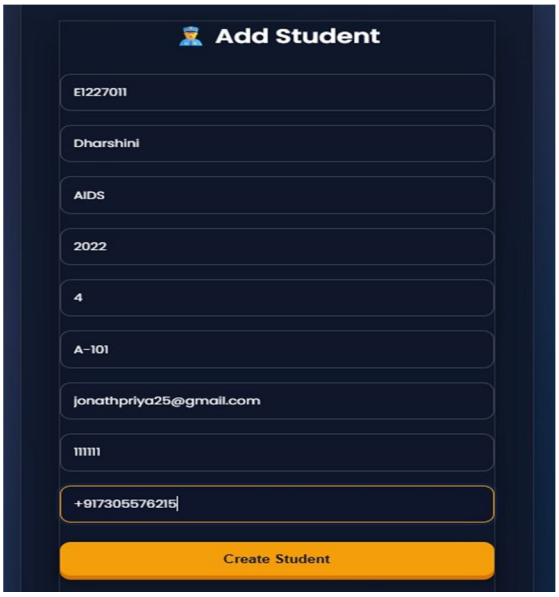

Fig 21. Adding Students

9) Mess Management - Wardens update weekly menu and monitor vegetarian and non-vegetarian preference counts collected digitally from students.

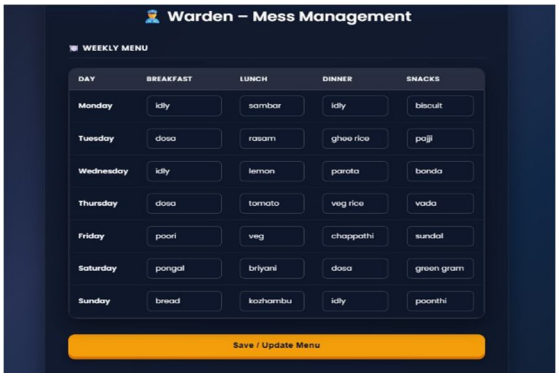

Fig 22. Mess Management

10) Room Allocation System - Room allocation is suggested automatically based on year, department, vacancy and total cots available. Room data includes total beds, occupied beds and available beds.

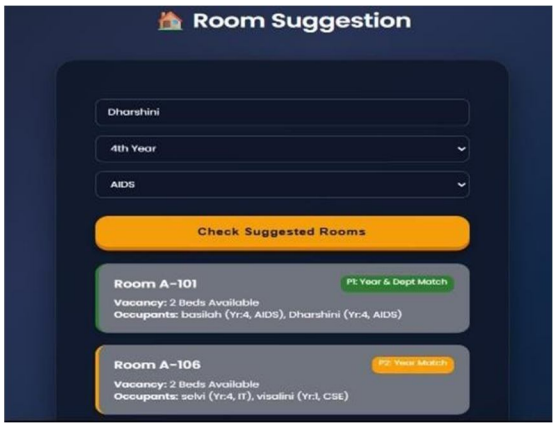

Fig 23. Room Wise Student List

11) Visitor OTP System - The warden generates a one-time password (OTP), which is sent to the parent. The visitor must provide this OTP at the security gate for verification. This ensures parent- controlled visitor access and secure hostel entry.

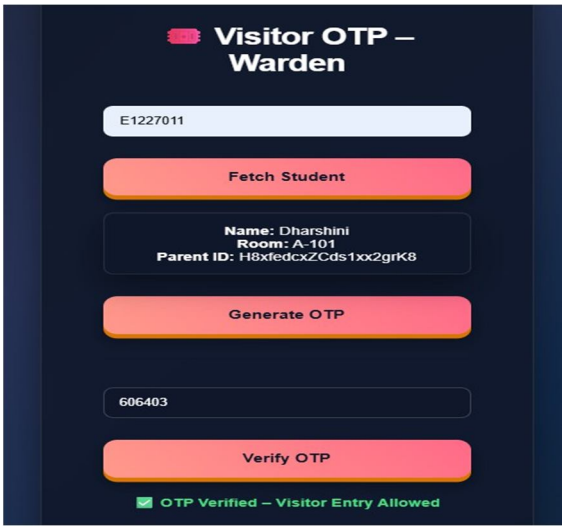

Fig 24. Visitor OTP

12) Security History - The system records and uploads student check-in and check-out activities with register number for verification. Validated outpass details and real-time movement logs can be viewed by warden to ensure transparency and safety.

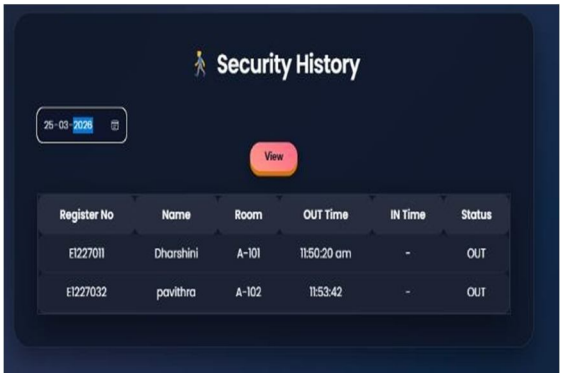

Fig 25. Viewing Security History

13) Student Dashboard: Displays the student's personal and academic information such as register number and year. It acts as a centralized identity view for hostel-related activities.

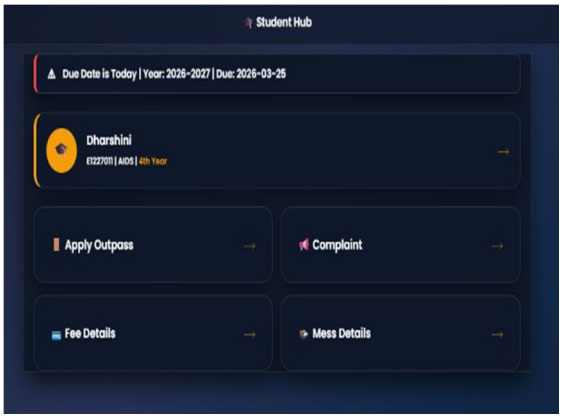

Fig 26. Student Dashboard

14) Fee Status - Shows hostel fee details including pending amount and due date. Students can track payment status and avoid overdue penalties.

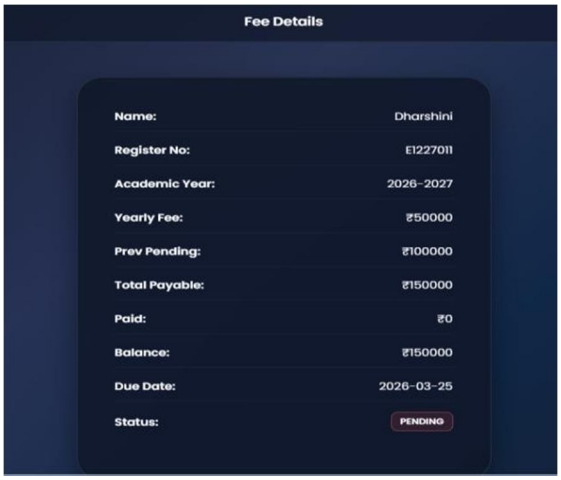

Fig 27. Fee Status

15) Apply Outpass - Allows students to submit outpass requests by specifying date, time, and reason. Requests are digitally forwarded for approval.

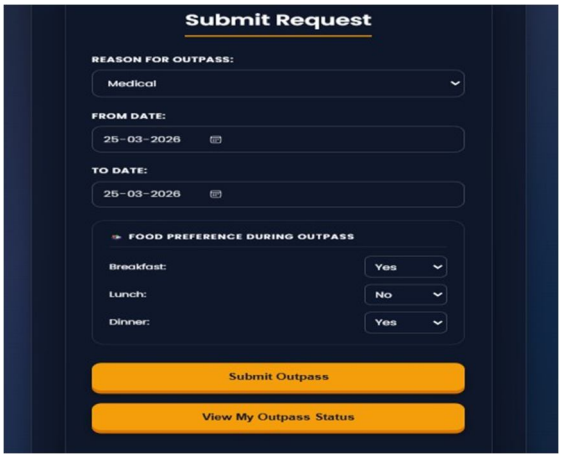

Fig 28. Outing Outpass Request

16) Complaint Module - Enables students to register complaints regarding hostel facilities or services. The system tracks complaint status until resolution.

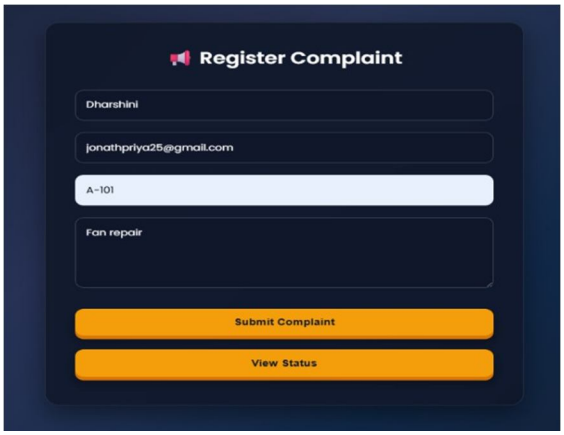

Fig 29. Registering Complaint

17) Mess Details - Provides information about daily or weekly mess menu, menu preference and meal schedules. It helps students plan their meals efficiently.

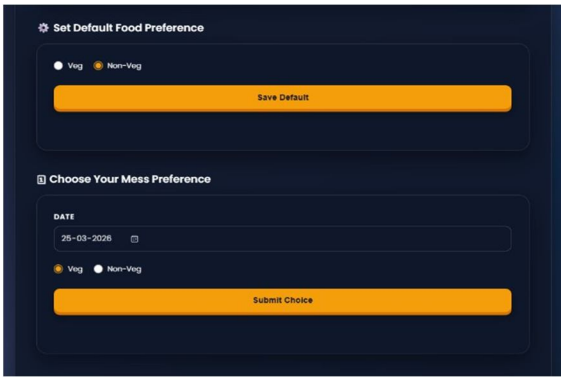

Fig 30. Food Preferences

18) Parent Dashboard: Displays student profile details and current hostel status. Parents can easily monitor academic year and hostel-related information.

Fig 31. Parent Dashboard

19) Outpass Approval - Allows parents to view, approve or reject outpass requests submitted by students. This ensures controlled movement with parental consent.

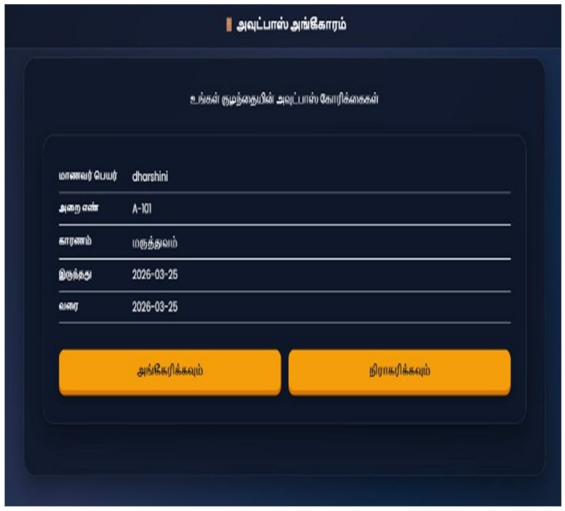

Fig 32. Outpass Approval

20) Student In / Out History - Maintains a detailed log of student entry and exit activities recorded by the security system. Parents can review historical movement data to ensure safety and accountability.

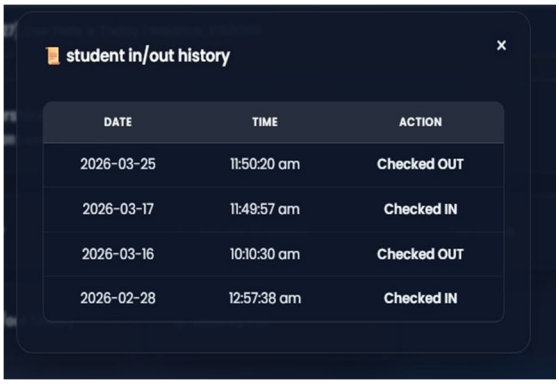

Fig 33. Student In / Out History

21) Fee Monitoring - Provides access to hostel fee details, payment history and pending dues. Parents can track payments and ensure timely settlement.

Fig 34. Fee Monitoring

22) Visitor OTP Verification - Generates a one-time password (OTP) for visitor entry verification. This ensures that only authorized visitors are allowed to meet students, enhancing hostel security.

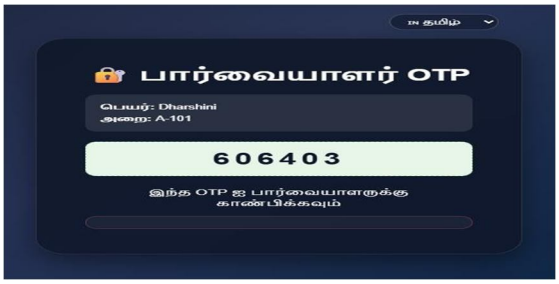

Fig 35. Visitor OTP

23) Security PIN - Provides an additional authentication layer for sensitive actions such as outpass approval. This enhances security by preventing unauthorized access to parental controls.

Fig 36. Security PIN

24) Data Storage: All system records are stored in a cloud-based database using Firebase Cloud Firestore. It provides a scalable and real-time NoSQL data storage solution that supports secure data synchronization across multiple user roles. Student records, attendance logs, outpass details, fee information and movement history are stored and retrieved efficiently. Role-based access control and authentication ensure data privacy and securit**.**

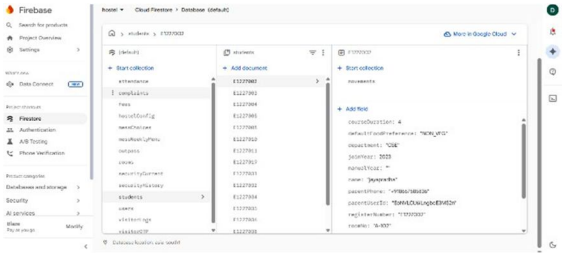

Fig 37. Data Storage

VIII. RESULTS AND PERFORMANCE ANALYSIS

The proposed eHostel Hub system was tested using a dataset of approximately 150 student records under simulated hostel conditions to evaluate its efficiency and performance. The automated attendance module, which is integrated with security gate logs, significantly improved accuracy. These results demonstrate that the proposed system enhances operational efficiency, accuracy, transparency and security when compared to existing manual or semi-digital hostel management approaches. The system performance confirms its suitability for real-time deployment in institutional environments.

IX. CONCLUSION

The eHostel Hub system successfully integrates hostel administration, security monitoring, and parent interaction into a unified platform. By combining real-time attendance tracking, multi- level approval workflows, and OTP-based verification, the system reduces manual effort and improves operational accuracy. The implementation demonstrates that centralized digital solutions can significantly enhance transparency, responsiveness, and student safety in hostel environments.

X. FUTURE ENHANCEMENTS

Future enhancements may include mobile application integration for Android and iOS platforms, biometric authentication for gate entry, AI-based analytics for occupancy prediction, cloud- based scalability, ERP integration and facial recognition systems for advanced security. Integration of predictive maintenance models and intelligent reporting dashboards may further enhance administrative efficiency. Continuous system updates based on user feedback will ensure adaptability to evolving institutional requirements.

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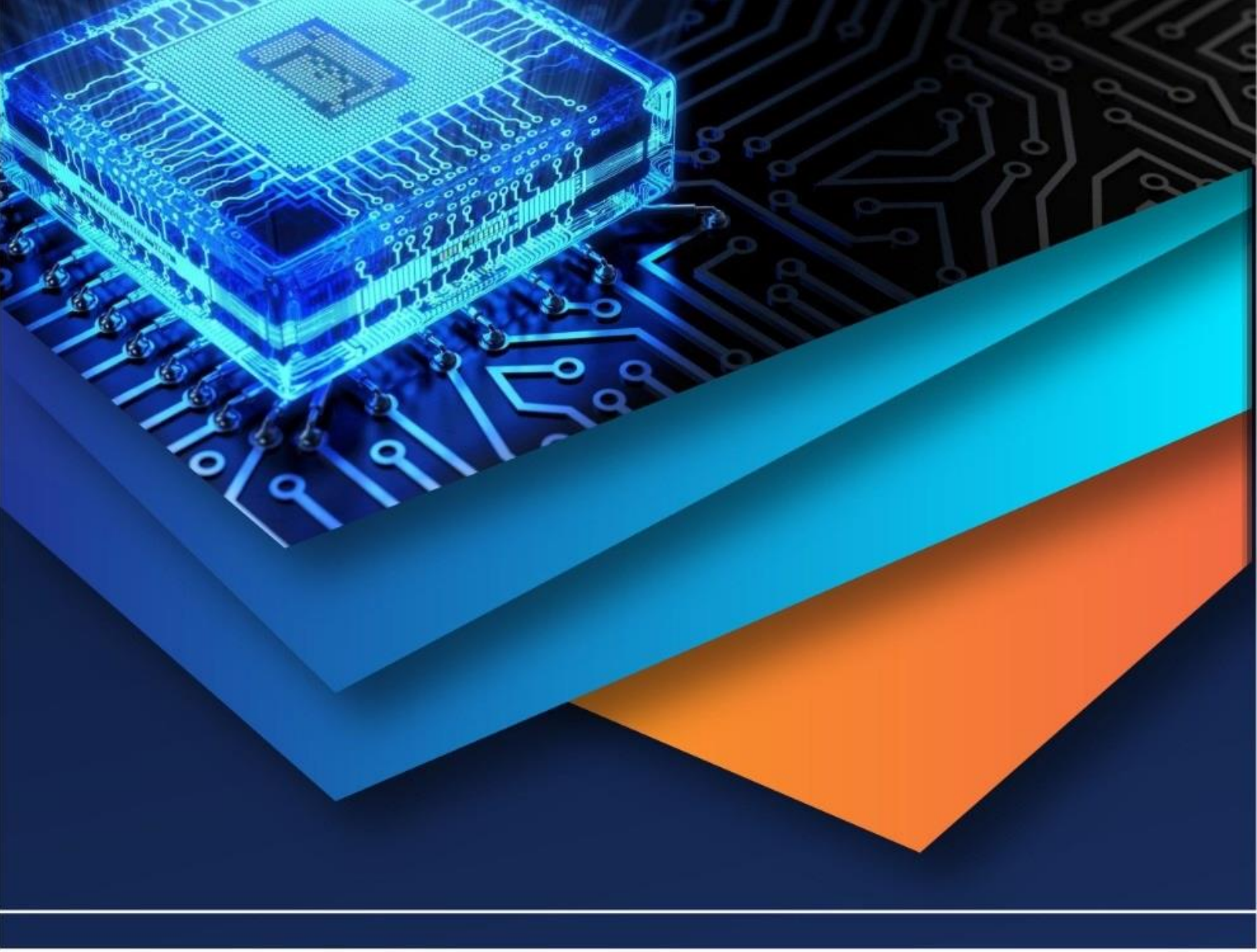

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