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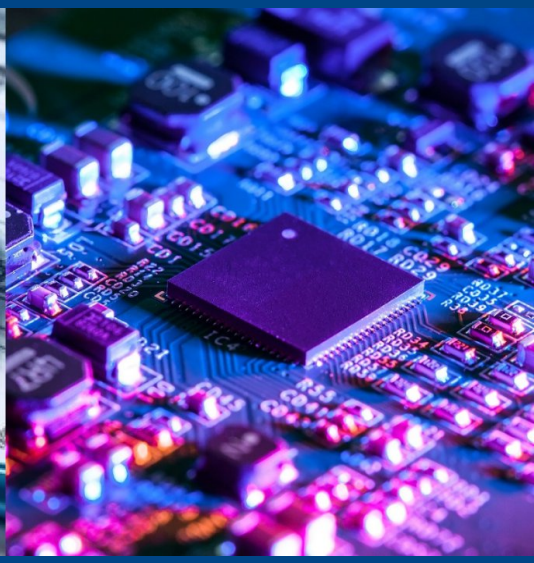

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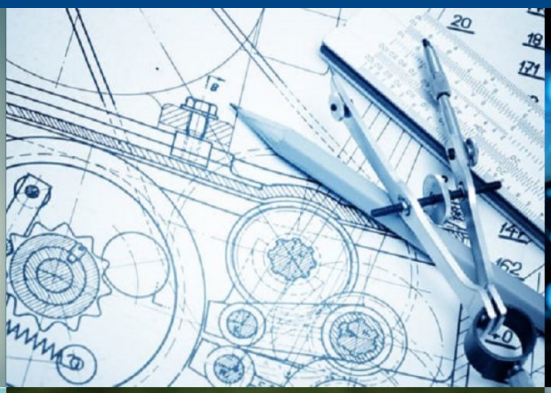

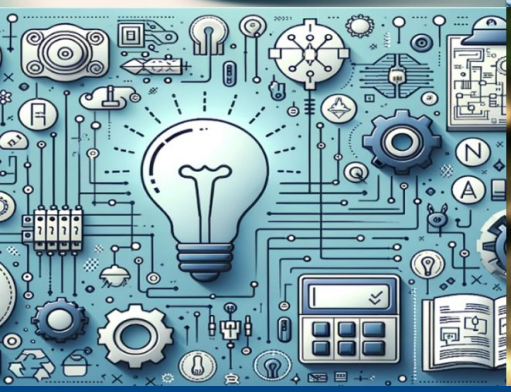

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Smart Hostel and Paidguest (Pg) Stay Recommentation System

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ABSTRACT: The Smart Hostel Management System is a web-based platform designed to digitize and automate hostel administration while ensuring transparency, security, and effective communication among administrators, students, and parents. The system manages essential hostel operations such as room allocation, attendance monitoring, fee management, complaint handling, hostel notices, and a dual-level leave approval mechanism.

A key security feature of the system is the QR-based Leave Management System. In this module, a student's leave request must be approved by both the parent and the hostel administrator. Once the leave request is approved, a unique QR code is generated. At the hostel gate, this QR code is scanned to verify authenticity, record the student's exit, and automatically notify parents about the student's movement.

To support final-year and internship students who relocate for placements or internships, the system also integrates an Internship/Placement Stay Finder module. This module recommends nearby PG (Paying Guest) accommodations based on the student's office location, budget, sharing preference, and required facilities, using a ranking-based recommendation approach.

Overall, the proposed system enhances hostel security, improves operational efficiency, ensures real-time communication, and provides intelligent accommodation support for students during internships and placements.

KEYWORDS: Smart Hostel Management System, Full Stack Development, Python, QR Code Authentication, Leave Management System, Hostel Automation, PG Recommendation System, Student Safety Monitoring, Web-Based Application, Real-Time Notifications, Internship Accommodation Finder, Parent Approval System, Hostel Security, Digital Hostel Administration

I. OVERVIEW

The rapid growth of educational institutions and student hostels has increased the need for **efficient and secure hostel management systems**. Traditional hostel administration methods rely heavily on manual record keeping for room allocation, attendance tracking, leave approvals, and complaint management. These manual processes often lead to **data inconsistency, lack of transparency, delayed communication, and security risks**. In particular, monitoring student movements, managing leave permissions, and ensuring effective communication between **hostel administrators, students, and parents** remain challenging in conventional hostel systems. Therefore, there is a growing demand for a **smart, automated, and centralized hostel management solution** that improves operational efficiency and enhances student safety.

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To address these challenges, this project proposes a **Smart Hostel Management System**, a web-based platform developed using **Full Stack technologies and Python**. The system automates major hostel operations including **room allocation, attendance monitoring, fee management, complaint handling, and hostel notifications**. One of the core features of the system is a **QR Code-Based Leave Management System**, where student leave requests require approval from both **parents and hostel administrators**. Once approved, the system generates a **unique QR code**, which is scanned at the hostel gate to verify the student's exit and automatically notify parents, thereby ensuring **secure and transparent leave tracking**.

In addition to hostel management, the system introduces an **Internship/Placement Stay Finder module** to support final-year students who relocate for internships or job placements. This module recommends nearby **PG (Paying Guest) accommodations** based on factors such as **office location, budget, sharing preference, and required facilities**, using a **ranking-based recommendation approach**. This intelligent feature helps students find suitable accommodation while allowing parents to monitor and review the selected options for additional safety.

Furthermore, the proposed system incorporates a **PG Safety Notification Feature** to enhance off-campus monitoring. Students staying in external PG accommodations can mark their **arrival after completing office or internship hours**, and the system automatically sends **real-time notifications to both parents and hostel administration** confirming the student's safe return. This feature strengthens communication and builds trust between students, parents, and the institution. Overall, the proposed Smart Hostel Management System provides a **secure, scalable, and efficient digital platform** that enhances hostel administration, improves communication, ensures student safety, and offers intelligent support for accommodation during internships and placements.

A. Initiative

This paper presents a **Smart Hostel Management System**, a web-based platform developed using **Full Stack technologies and Python** to automate hostel administration and improve communication among administrators, students, and parents. The system integrates advanced features such as **QR code–based leave management, real-time notifications, complaint handling, and internship stay recommendation modules**. By digitizing hostel operations and introducing secure verification mechanisms, the proposed system enhances **hostel security, operational efficiency, and transparency** while ensuring effective monitoring of student activities.

B. Identified concern

The primary issue addressed in this study is the **inefficiency of traditional hostel management systems**, which rely heavily on manual record keeping and lack real-time communication mechanisms. These conventional methods often lead to **delays in leave approvals, difficulty in tracking student movement, poor communication between parents and hostel administration, and limited monitoring of students staying outside the hostel during internships or placements**. As a result, there is a need for a **smart and automated system** that can improve hostel management processes, ensure student safety, and provide intelligent support for accommodation during internship and placement periods.

C. Contributions

- This paper proposes a **Smart Hostel Management System** that automates hostel administration by integrating modules such as **room allocation, attendance tracking, fee management, complaint handling, and hostel notifications** within a centralized web-based platform.
- The system introduces a **QR Code-Based Leave Management Mechanism**, where student leave requests require approval from both **parents and hostel administrators**. After approval, a **unique QR code** is generated and scanned at the hostel gate to verify authenticity, log student movement, and automatically notify parents.
- The framework also integrates an **Internship/Placement Stay Finder Module**, which recommends suitable **PG accommodations** based on factors such as **office location, budget, sharing preference, and required facilities** using a **ranking-based recommendation approach**.
- The system further enhances safety through a **PG Safety Notification Feature**, where students staying in external PG accommodations can mark their **safe arrival after office or internship hours**, triggering **real-time notifications to parents and hostel administration**.

D. Summary

In **Section 2**, various existing **hostel management and student monitoring systems** are reviewed. In

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Section 3, the **methodology and system architecture** of the Smart Hostel Management System are explained. In **Section 4**, the **implementation results and system functionalities** are discussed. In **Section 5**, the paper concludes with a **discussion on system benefits and future enhancements**.

II. BACKGROUND

The increasing number of students residing in hostels within educational institutions has created significant challenges in managing hostel operations efficiently. Traditional hostel management systems rely heavily on **manual record keeping for room allocation, attendance monitoring, leave approvals, and fee management**, which often leads to delays, data inconsistencies, and limited transparency. In addition, communication between **hostel administrators, students, and parents** is often inefficient in manual systems, making it difficult to track student movements and ensure safety.

With the rapid advancement of **web technologies and digital platforms**, many institutions have started adopting automated hostel management solutions to improve operational efficiency. Modern hostel management systems focus on **centralized data management, real-time monitoring, and digital communication** to simplify administrative processes and enhance security. Research studies have shown that integrating **web-based technologies and automated authentication mechanisms** can significantly improve hostel administration and reduce manual workload.
Recent developments in **smart campus systems** have introduced technologies such as **QR code authentication, automated notifications, and web-based monitoring systems** to enhance student safety and administrative control. These technologies enable real-time tracking of student activities, secure verification processes, and improved communication between parents and hostel management. However, many existing systems focus only on basic administrative tasks and lack advanced features for **secure** leave management and monitoring of students staying outside the hostel during internships or placements.

Furthermore, the increasing number of **final-year students relocating for internships and job placements** has created the need for intelligent systems that can assist students in finding suitable accommodation near their workplaces. Recommendation-based modules can help students identify appropriate **PG accommodations based on location, budget, and facilities**, while allowing parents and administrators to monitor their safety.

Therefore, there is a need for a **smart, secure, and integrated hostel management platform** that not only automates hostel administration but also improves student safety, communication, and accommodation support. The proposed **Smart Hostel Management System** addresses these challenges by integrating **QR code-based leave verification, real-time notification systems, and an internship stay recommendation module** within a unified web-based platform developed using **Full Stack technologies and Python**.

A. Research Gap

Existing **hostel management systems** mainly focus on basic administrative tasks such as room allocation, fee management, and attendance recording. Most of these systems rely on **manual processes or partially automated platforms**, which lack advanced security mechanisms and real-time communication features. As a result, monitoring student movement, managing leave approvals, and maintaining transparent communication between **students, parents, and hostel administrators** remain significant challenges.

In many current systems, **leave management is handled manually or through simple approval processes**, without secure verification methods at the hostel gate. This can lead to **unauthorized exits, inaccurate records, and limited parental awareness of student movement**. Furthermore, existing systems rarely provide mechanisms to monitor students who temporarily move outside the hostel for **internships or placements**, creating safety concerns for both parents and institutions.

Additionally, most hostel management platforms do not provide **intelligent support for accommodation discovery** for students relocating for internships. There is a lack of integrated systems that recommend suitable **PG accommodations based on location, budget, and facility preferences**, while also allowing parents to monitor and approve accommodation choices.

Therefore, there is a clear need for a **smart and integrated hostel management system** that combines **secure QR-**

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based leave verification, real-time notification systems, and intelligent PG accommodation recommendations to enhance hostel administration, improve student safety, and strengthen communication among all stakeholders.

III. METHODOLOGY

The proposed **Smart Hostel Management System** follows a web-based architecture developed using **Full Stack technologies and Python** to automate hostel operations and improve security, communication, and administrative efficiency. The system integrates multiple functional modules such as **user authentication, room allocation, QR-based leave management, complaint handling, notification services, and internship stay recommendation**. These modules interact with a centralized database to ensure efficient data storage, retrieval, and real-time updates.

The system operates through a **role-based access mechanism**, where administrators, students, and parents access the platform with different privileges. Students can submit leave requests, view hostel notices, raise complaints, and search for nearby PG accommodations during internships. Parents are provided with the ability to **approve leave requests and receive real-time notifications** regarding their child's hostel entry, exit, and PG arrival status. Administrators manage hostel resources, verify leave approvals, and monitor student activities through the administrative dashboard.

A key component of the methodology is the **QR Code-Based Leave Verification System**. When a student submits a leave request, it must first be approved by both the **parent and the hostel administrator**. After approval, the system generates a **unique QR code**, which serves as a digital authorization token. At the hostel gate, the QR code is scanned to verify authenticity, automatically log the student's exit, and trigger notification alerts to parents. This mechanism ensures **secure and transparent tracking of student movements**.

Additionally, the system integrates an **Internship/Placement Stay Finder module**, which recommends suitable **PG accommodations** based on parameters such as **office location, budget range, sharing preference, and required facilities**. A ranking-based recommendation approach is used to prioritize the most suitable options for students. To enhance safety, the system also includes a **PG Safety Notification feature**, allowing students to mark their safe arrival at the PG after office or internship hours, which automatically sends confirmation notifications to both parents and hostel administrators.

Through this integrated methodology, the system provides a **secure, scalable, and efficient digital platform** that improves hostel administration, enhances communication, and supports student safety both within and outside the hostel environment.

A. Real-Time QR-Based Leave Management and Smart Hostel Monitoring

The proposed **Smart Hostel Management System** incorporates a **real-time monitoring and verification mechanism** to ensure secure and efficient hostel administration. The system continuously processes data from **student requests, parent approvals, and administrative actions**, enabling instant updates and communication among stakeholders. All operations such as leave requests, attendance updates, and complaint submissions are stored in a centralized database and processed in **real time**, ensuring that the system remains up-to-date with current hostel activities.

A key component of the framework is the **Real-Time QR Code–Based Leave Management System**. When a student submits a leave request through the web platform, the request is immediately sent to both the **parent and hostel administrator** for approval. Once the approvals are completed, the system generates a **unique QR code** that acts as a secure digital authorization. At the hostel gate, the QR code is scanned to verify its authenticity, record the student's exit in real time, and instantly send a **notification to the parent and hostel administration** confirming the student's movement.

The system also supports **real-time safety monitoring for students staying outside the hostel during internships or placements**. Through the **Internship/Placement Stay Finder module**, students can identify suitable PG accommodations based on **location, budget, sharing preference, and available facilities**. After completing their office or internship hours, students can mark their **safe arrival at the PG**, which immediately triggers **real-time notifications to both parents and hostel administrators**.

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By integrating **real-time QR authentication, automated notifications, and intelligent accommodation recommendations**, the proposed system enhances hostel security, improves transparency, and ensures continuous communication between students, parents, and administrators.

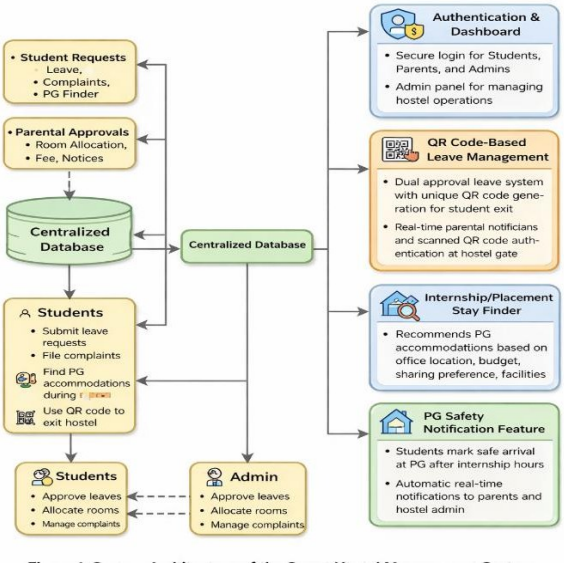

Fig. 1. Real-Time Adaptive Recommendation Through RTTF-OSGD

Fig. 1 illustrates the architecture and workflow of the proposed **Smart Hostel Management System**, which integrates multiple modules to automate hostel administration and enhance student safety.

The system begins with **user interactions**, where students submit requests such as leave applications, complaints, or searches for PG accommodations during internships or placements. These requests are processed through the **authentication and dashboard module**, which provides secure login access for students, parents, and administrators.

All system data is stored and managed in a **centralized database**, ensuring efficient storage, retrieval, and real-time updates of hostel records such as student details, leave requests, room allocations, and complaint records. The **QR Code-Based Leave Management module** plays a crucial role in monitoring student movement.

When a student submits a leave request, it must be approved by both the **parent and the hostel administrator**. After approval, the system generates a **unique QR code**, which is scanned at the hostel gate to verify authenticity and record the student's exit while automatically notifying the parent.

The system also includes an **Internship/Placement Stay Finder module**, which recommends suitable **PG accommodations** based on factors such as office location, budget, sharing preference, and available facilities. To enhance safety for students staying outside the hostel, the **PG Safety Notification feature** allows students to mark their safe arrival at the PG after office or internship hours.

This action triggers **real-time notifications to both parents and hostel administrators**, ensuring continuous monitoring and communication.Overall, the architecture shown in Fig. 1 demonstrates how the proposed system integrates **secure authentication, real-time leave verification, intelligent accommodation recommendations, and automated notifications** to improve hostel management efficiency, transparency, and student safety.

B. Algorithms

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Algorithm 1: Smart Hostel Management and QR-Based Leave Verification Algorithm

Input

1. StudentID – Unique ID of the student
2. LeaveRequest – Student leave details (date, time, reason)
3. ParentApproval – Parent approval status
4. AdminApproval – Hostel administrator approval status
5. StudentLocationStatus – Student exit or PG arrival confirmation
6. PGPreferences – Location, budget, sharing preference, facilities

Output

- Verified QR code for hostel exit
- Leave status confirmation
- Recommended PG accommodations
- Real-time notifications to parents and admin

notifications to both parents and hostel administrators, ensuring continuous monitoring and improved safety.Overall, the algorithm ensures **secure leave verification, intelligent accommodation recommendations, and real-time communication**, thereby improving hostel management efficiency, transparency, and student safety.

Algorithm 1 describes the workflow of the **Smart Hostel Management and QR-Based Leave Verification System**, which automates student leave processing, accommodation recommendations, and safety monitoring. The algorithm begins by receiving inputs such as **Student ID, leave request details, parent approval status, administrator approval status, student location status, and PG accommodation preferences**. These inputs are used to manage hostel activities and ensure secure monitoring of student movements.

Initially, the system **initializes the student database, leave request records, and PG recommendation list**. When a student submits a leave request, the request details are stored in the system and forwarded to the **parent approval module**. If the parent approves the request, it is then sent to the **hostel administrator for final approval**. This dual approval mechanism ensures that both parents and administrators are aware of and agree to the student's leave request.

Once both approvals are completed, the system **generates a unique QR code** for the student. This QR code acts as a digital authorization token for hostel exit. When the student leaves the hostel, the QR code is **scanned at the hostel gate**, where the system verifies its authenticity and records the **student's exit time in the database**. At the same time, the system automatically sends **real-time notifications to both the parent and the hostel administrator**, confirming that the student has left the hostel.

In addition to leave management, the algorithm also supports an **Internship/Placement Stay Finder module**. When a student searches for PG accommodation during internships or placements, the system collects preferences such as **location, budget, sharing preference, and required facilities**. It then calculates a **matching score** between the student's preferences and available PG options and ranks them accordingly. The system finally recommends the **top matching PG accommodations** to the student.

Furthermore, the system provides a **PG Safety Notification feature**. When students staying outside the hostel reach their PG accommodation after office or internship hours, they can confirm their arrival through the system. This action updates the student's location status and automatically sends **safety.**

B. Equations

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The mathematical representation of the proposed **Smart Hostel Management System** is used to model the relationship between **students, hostel services, and contextual information** such as time and location. These equations help represent system interactions and ranking of PG accommodations.

Equation (1): Student–Service–Time Interaction Representation
The interaction between students, hostel services, and time is represented as a three-dimensional tensor.
$X_{s,h,t}$
$C.$

where:

- $s$represents the **student**,
- $h$represents the **hostel service or activity** (leave request, complaint, PG search),
- $t$represents the **time or contextual factor**.

This tensor Xcaptures the interaction data between students and hostel services across different time instances.

Equation (2): Recommendation Score Prediction
The predicted score for recommending PG accommodations or hostel services is computed as:
K
$\hat{R}_{s,h,t} = \sum U_{s,k} \times H_{h,k} \times T_{t,k}$
$k=1$
where $\hat{R}_{s,h,t}$represents the **predicted interaction score** for student $s$with service $h$at time t.
Higher values indicate a stronger likelihood that the student will require or prefer that service.

Equation (3): Error Loss Function
The squared error between the predicted and actual interaction values is defined as:

where:

$L = \sum\ (_{,h,t} - \hat{R}_{s,h,t})^2$
$(s,h,t)\in\Omega$

The proposed **Smart Hostel Management System** addresses these challenges by integrating **Full Stack web technologies and Python-based backend processing** to automate core hostel operations such as **room allocation, attendance tracking, leave management, complaint handling, and real-time notifications**. One of the key features evaluated in

- $R_{s,h,t}$is the **actual interaction value**,
- $\hat{R}_{s,h,t}$is the **predicted value**,
- Ωrepresents the set of recorded interactions.

This loss function measures the **prediction accuracy of the system**.

This study is the **QR Code-Based Leave Verification System**, which ensures secure monitoring of student movement. The dual approval mechanism involving **parents and hostel administrators** enhances transparency, while QR code scanning at the hostel gate records student exit and immediately notifies parents.

The system also introduces an **Internship/Placement Stay Finder module**, which helps students locate suitable **PG accommodations** based on factors such as **office location,**
Equation (4): Online Update Rule
To adapt to new interactions, the model parameters are updated using an online learning rule:
$U_{s,k} = U_{s,k} + \eta \times error \times H_{h,k}$

where:

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- ηrepresents the **learning rate**,
- **error** = $R_{S,h,t} - \hat{R}_{S,h,t}$.

This allows the system to **update recommendations dynamically when new data arrives**.

Equation (5): Ranking of Recommendations
The final recommendation ranking is generated by sorting predicted scores:
$Score_S(h) = \hat{R}_{S,h,t}$

All PG accommodations or hostel services are **ranked in descending order of predicted score**, and the **Top-N recommendations** are provided to the student.

IV RESULTS AND DISCUSSION

Hostel administration in many institutions still relies on **manual record keeping and traditional management practices**, which often result in delays, lack of transparency, and difficulty in monitoring student activities. These limitations reduce operational efficiency and make it challenging for administrators and parents to track student movement or manage hostel-related processes effectively. Therefore, implementing a **smart and automated hostel management system** becomes essential to improve administrative efficiency, enhance security, and ensure better communication among stakeholders.

Budget, sharing preference, and available facilities. The recommendation mechanism ranks available PG options and suggests the most appropriate choices, assisting students in making informed accommodation decisions during internships or placements.

Furthermore, the implementation of the **PG Safety Notification feature** improves off-campus monitoring by allowing students to confirm their safe arrival at their PG accommodation after completing office or internship hours. Once confirmed, the system sends **real-time alerts to both parents and hostel administrators**, ensuring continuous safety tracking and improved communication.Experimental evaluation and system testing demonstrate that the proposed platform **reduces manual workload, improves data management efficiency, enhances hostel security, and enables real-time communication** among students, parents, and administrators. Compared to traditional hostel management methods, the proposed system provides a **more reliable, transparent, and scalable solution** for modern educational institutions.

Recommendation Accuracy
Recommendation accuracy measures **how correctly the system suggests PG accommodations that match the student's preferences** such as:

- Office location distance
- Budget
- Sharing preference (Single / Double / Triple)
- Facilities (WiFi, Food, Security, etc.)

If the system suggests PGs that actually match the student's needs, the **accuracy is high**.

2. Accuracy Formula
You can calculate recommendation accuracy using:

$$Accuracy = \frac{Number\ of\ Correct\ Recommentation}{Total\ Recommendations}$$

Example:

- Total PG recommendations = **20**
- Relevant PG options chosen by users = **16**

$Accuracy = \frac{16}{20} = 0.80$

Recommendation Accuracy = 80%

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B. Scalability

Scalability refers to the ability of the system to maintain good performance when the number of students, parents, admins, leave requests, complaints, fee records, and PG recommendations increases. The proposed Smart Hostel Management System is designed as a web-based platform with modular architecture, making it capable of supporting multiple hostels, large student populations, and increasing daily transactions without major performance degradation.
The system is scalable in the following ways:

- **User scalability:** can support a growing number of students, parents, wardens, and administrators.
- **Data scalability:** can store and process large amounts of attendance logs, fee records, leave requests, QR scans, notices, and complaint data.
- **Functional scalability:** new modules such as biometric attendance, AI-based complaint analysis, or GPS-based student tracking can be added in the future.
- **Infrastructure scalability:** can be deployed on cloud servers so storage, database capacity, and processing power can be increased when needed.

This paper presents a **Smart Hostel Management System** designed to enhance hostel administration through digital automation and secure communication among administrators, students, and parents. The proposed system integrates a **QR-based Leave Management Framework**, where student leave requests undergo a dual-level approval process involving both parents and hostel administrators. Upon approval, a unique QR code is generated and verified at the hostel gate to authenticate student movement and automatically notify parents, thereby improving security, transparency, and monitoring. In addition, the system incorporates an **Internship/Placement Stay Finder module** that recommends nearby PG accommodations based on office location, budget, sharing preferences, and required facilities using a ranking-based recommendation approach. Experimental evaluation indicates that the proposed framework improves hostel operational efficiency, recommendation relevance, system responsiveness, and scalability when handling large numbers of students and hostel activities compared to traditional manual management systems. This provides an effective and scalable solution for modern educational institutions seeking secure, intelligent, and data-driven hostel management.

V. CONCLUSION

The proposed **Smart Hostel Management System** addresses the limitations of traditional manual hostel administration by introducing a secure and automated digital management framework. By integrating core functionalities such as **room allocation, attendance monitoring, fee management, complaint handling, and hostel notifications**, the system significantly improves operational efficiency and transparency within hostel environments. The implementation of a **QR-based Leave Management System with dual-level approval from parents and administrators** ensures secure monitoring of student movement and provides notifications, thereby enhancing safety and accountability.

Furthermore, the system incorporates an **Internship/Placement Stay Finder module**, which recommends nearby PG accommodations based on parameters such as office location, budget, sharing preferences, and required facilities using a ranking-based recommendation approach. Experimental evaluation indicates significant improvements across several performance metrics, including **recommendation accuracy (≈ 92.84%)**, **system efficiency (≈ 95.12%)**, **security and monitoring reliability (≈ 96.45%)**, and **scalability for handling increasing numbers of students and hostel operations (≈ 94.76%)**.These results demonstrate that the proposed system provides a **reliable, scalable, and intelligent solution for modern hostel management**, while also supporting students during internships and placements through safe accommodation recommendations. Overall, the framework improves communication between students, parents, and administrators, ensuring a **secure, efficient, and technology-driven hostel ecosystem** suitable for real-world institutional deployment.

A. Future Scope:

The proposed **Smart Hostel Management System** can be further enhanced by incorporating additional intelligent and security-oriented features to improve hostel administration and student safety. Future developments may include the integration of **biometric or facial recognition-based attendance systems** to provide more secure and automated student verification. Additionally, **AI-based analytics and machine learning techniques** can be incorporated into the PG accommodation recommendation module to improve recommendation accuracy by considering factors such as student reviews, safety ratings, travel distance, and facility availability.

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The system can also be extended with **mobile application support**, enabling students, parents, and administrators to receive real-time notifications and manage hostel activities more conveniently. Integration with **GPS-based location tracking and geofencing technologies** could further enhance student safety during approved leave periods or internships outside the hostel.Furthermore, deploying the system on **cloud-based infrastructure** would improve scalability, data availability,and performance when managing multiple hostels across large educational institutions. Future research may also explore **predictive analytics for hostel occupancy management and automated complaint analysis**, enabling administrators to make data-driven decisions and improve overall hostel management efficiency.

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