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Design and Development of a Workflow-Driven Online Student Clearance System for Seamless Multi-Departmental Integration

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Abstract **Original Research Article**

This paper provides an overview of the design and development of a web-based Student Clearance Management System to automate multi-departmental clearance workflows in higher education institutions. The system is developed by using Django framework and MySQL database, and includes role-based access control, department-wise document submission, automated email notification and QR code enabled clearance certificate verification. A workflow driven architecture allows for independent review and authorization by administrative units such as the library, bursary and academic affairs using a unified web interface while tracking clearance progress in real time. The proposed system overcomes some of the limitations of manual clearance processes, such as the delays, data inconsistency, and poor interdepartmental coordination. With the enforcement of structured workflows, audit trails and secure access controls, the operational efficiency, transparency and data integrity of the system is improved. The implementation is a showcase of how modern web technologies and workflow management can be used to support the scalable and secure digital transformation of academic administrative processes.

Keywords: students' clearance, workflow-driven, manual clearance, automated, QR-Code, email notification, Django framework, MySQL database, online clearance.

1. Introduction

Student clearance is a compulsory procedure which is done at the conclusion of an academic programme in most institutions of higher learning. Conventionally, this process entails physical visits to different departments by the students to the library, bursary, faculty and hostels to obtain signatures and document verification. This is an inefficient manual practice that is likely to cause delays, loss of data, and administrative bottlenecks (Eweoya et al., 2025). Academic management is going online, and now institutions are considering the use of web-based applications to automate and streamline their clearance processes.

An online clearance system that functions under a workflow will offer a centralized online digital system that integrates all the relevant departments by having an online database and clearance processes.

The system is interacted with by each department in accordance with its roles and clearance requirements. The system ensures transparency and accountability by automatically producing a clearance certificate after all the departments had passed a student (Reijers, 2003).

This study aims to design and develop a web-based clearance management system using Python Django framework and MySQL database to improve the efficiency, security, and reliability of clearance processes. The objective of the system is to overcome the shortcomings of the traditional manual clearance methods by introducing automated and intelligent features such as QR-code validation for clearance certificates, automated email notifications, and role-based access control (RBAC). These features allow a real-time monitoring of the clearance status, improve data integrity and secure the record management. Overall, the system is designed to be a scalable, easy-to-use and secure solution that can streamline administrative workflows, reduce delays, errors and the risk of unauthorized access.

Problem Statement

The institutions that use manual or semi-automated clearance processes in the universities often face the following issues: long queues with students, loss or misplaced physical forms, inability to monitor the clearance status within the departments and inability to have centralized control. Eweoya et al. (2025) claim that clearance using manual paper is time-consuming, prone to error, inefficient, and causes administrative bottlenecks. Lack of a cohesive system makes students and administrators unable to know which departments are not yet cleared. In addition, various departments might need various document types (i.e. library: no overdue books; bursary: no outstanding payments; hostel: keys returned) and workflow between departments is not always tracked cross-departmentally.

Therefore, the necessity to have a system that will allow: (1) each department to review documents uploaded by students independently based on their needs; (2) role-based access (students, departmental officers, super-admin) so that only authorized users can operate within their jurisdiction; (3) to track the status of student clearance at all departments; (4) to be notified once full clearance is reached; and (5) to issue a clearance certificate/report with a QR code, to verify its authenticity. The system described suits these requirements.

2. Literature Review

The clearance process in higher education institutions is a very important administrative process that ensures graduating students have satisfied all academic, financial, and institutional obligations before being certified. Traditionally, this process has been carried out in a manual manner with paper-based workflows which are often inefficient, prone to mistakes and vulnerable to delays. Recent research has increasingly been directed towards the digitisation of clearance systems for students, in order to overcome these difficulties and to make the administrative process more efficient.

Early research into online clearance systems focused on the shift from using a manual system to a web-based system. Adamu (2022) showed that online clearance system has a significant impact in terms of processing time and minimises data redundancy compared to conventional clearance procedures. However, the study was mainly concerned with digitisation without thoroughly addressing the coordination of workflow among several departments, which still remains one of the biggest operational challenges at large institutions.

A number of studies have investigated data integration at the enterprise level in clearance processes. Alade et al (2018) investigated enterprise data integration of graduating student for clearance in Lagos State University wherein the integration of databases is emphasized in order to ensure that the information on clearance can be accessed in real-time across departments. While their results did confirm improvements in consistency and accuracy of data, the system was heavily centralised in handling of data with little focus on role-based clearance workflows, which are critical for accountability and departmental autonomy.

Document management has also been identified as one of the key elements of clearance automation. Estrera (2017) in her electronic document

management system for higher education institutions, she has proven that the digital handling of documents brings about improvement in record security and retrieval efficiency. However, the study did not include workflow automation or clearance sequencing, which are required in the handling of multi-departmental approvals. Similarly, Mangubat et al (2023) created an online student clearance management system, but identified some limitations in terms of scalability and verification mechanisms.

More modern research has centered on all-inclusive web-based clearance solutions. Jonathan et al. (2019) presented the development of an online clearance system that supports departmental approvals using a central web application. Their work proved to show better transparency and fewer processing delays; however, the system did not offer advanced workflow tracking and verification features such as QR code validation and automated notifications. Essel et al. (2023) further strengthened the case for the benefits of digitisation to report sizeable decreases in administrative bottlenecks after the introduction of an online clearance system, but their model did not explicitly account for department specific document requirements.

Workflow-driven systems have become prominent to address the coordination and accountability. Reijers (2003) established that workflow automation increases efficiency of the organization by imposing structured task execution and thereby reducing ambiguity within the process. Based on this foundation, Eweoya et al. (2025) proposed a web-based solution for clearance incorporating workflow management to facilitate independent departmental approvals. Their results demonstrated there were measurable improvements to turnaround time and auditability; one of the strengths of this study is the relevance of workflow engines to clearance systems.

Digital transformation in university administration has also established a stronger need for integrated and scalable platforms. Kumar and Singh (2023) performed a systematic review and concluded that workflow-enabled systems are highly beneficial in academic administration in terms of service delivery, transparency, and user satisfaction. Hasan et al. (2023) similarly illustrated the benefit of the digital transformation of a student clearance system to enhance operational efficiency at Soran University, although their study was more focused on the deployment of such a system rather than extensible workflow design.

Notification and communication mechanism is another important part of modern clearance systems. Nnadi, Eze and Okafor (2023) noted that web based notification systems promote better academic communication as they provide timely feedback and minimize the occurrence of uncertainty on the part of users. Automated email notifications, therefore, have a vital role in keeping students in the loop of clearance status updates and outstanding requirements.

Verification and security of clearance documents have become an area of scholars attention too. Okafor and Daniel (2024) showed that the integration of QR codes can improve the authenticity of the document and help in the verification of academic records in a very fast way. Similarly, Suteja, Imbar and Johan (2020) demonstrated the effectiveness of QR codes in securing electronic certificates to ensure integrity as well as to prevent forgery. These approaches are especially applicable for clearance certificates that are official institutional documents.

Emerging technologies like artificial intelligence have been studied in relation to academic record verification. Ogunyemi and Ojo (2024) proposed AI-based verification system to validate academic documents, which can be used in automated clearance validation. Current clearance systems while promising are still underutilised in such approaches.

Framework selection has been also discussed in recent literatures. Olaniyan and Musa (2024) compared both Laravel and Django framework and concluded that Django's inbuilt security, scalability and rapid development features make it suitable for data driven academic systems. This is in favor of using Django to create secure and extensible clearance platforms.

Despite these improvements, current research generally does not have a cohesive approach that incorporates workflow-based clearance, role-based departmental approval, document-specific

validation, QR-code verification and automated notifications within a single system. Taiwo and Faboya (2025) highlighted the existence of this gap and emphasise the need for integrated solutions that are specific to institutional workflows and not generic clearance automation.

As such, this study extends and augments research findings by designing and developing a workflow-driven online student clearance system that allows seamless multi-departmental integration, role-based approvals, secure document verification with the use of QR codes, and automated email notifications to address critical limitations identified in previous studies.

3. System Design and Architecture

The system is based on three-tier MVC (Model-View-Template) architecture that consists of the presentation layer (frontend), application logic layer, and data storage layer. The MTV architecture of Django helps in boosting modularity, reuse, and scalability (Olaniyan and Musa, 2024). The frontend interface has been created based on the HTML5, CSS3, JavaScript and Bootstrap to be responsive to different devices. Application layer is used to deal with workflow logic, clearance check and interaction between the user and database. The database layer was implemented with MySQL, which will store the information of the users, faculty, departments, clearance progress, documents, and notifications. The workflow model stipulates a chain of approval system according to which each department should approve the status of a student regarding his or her clearance procedure. The system generates automatic clearance when all the departments have been satisfied. This is to guarantee that there is clearance when all the departmental conditions are fulfilled (Kumar & Singh, 2023).

The role-based access control (RBAC) system distinguishes users into three categories:

- **Students**: upload required documents and view clearance progress.
- **Departmental/Unit Officers**: verify and approve submissions.
- **Administrators**: manage departments, configure clearance items, and monitor system activity.

The generation module of the QR-code was done by embedding a verification code in the clearance certificate using *qrcode* Python library and Pillow Python library. Upon scanning, the code reroutes to Django endpoint of checking the certificate validity. The email notification service was developed based on the EmailMessage class of Django with SMTP and auto-sending of updates in case of a change of clearance status (Nnadi et al., 2023).

System design was done using Use Case diagram, Data Flow Diagram (DFD) and Entity Relationship Diagram (ERD).

The Use Case Diagram visually represents interactions between the actors (Admin, Faculty Unit, Department Unit and Other Units) and the system as shown in ***Fig 1***.

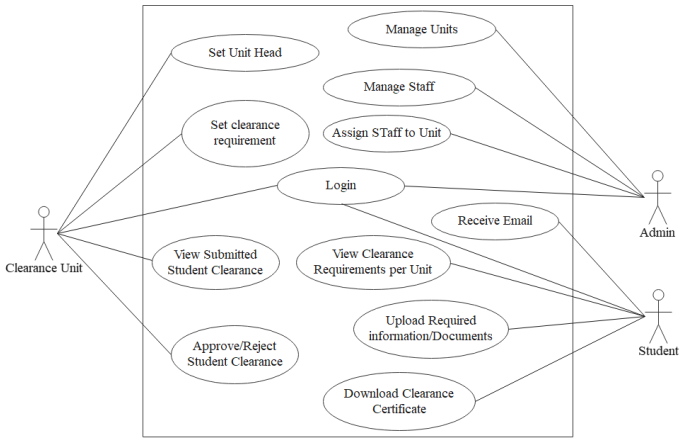

Fig 1: Online Clearance System Use Case Diagram

All units inherit common use cases for clearance. The students interact with all Units for document submission and approval tracking while the system generates the final clearance certificate.

Data Flow Diagram (DFD) shows how student data, unit requirements, and approval status move within the system.

Level 0 DFD (Context Diagram) shows how the system interacts with external entities - Admin, Units (Faculty, Department, and Other Units like Library or Bursary), Students and Email Service through the exchange of data and information as shown in ***Fig 2***.

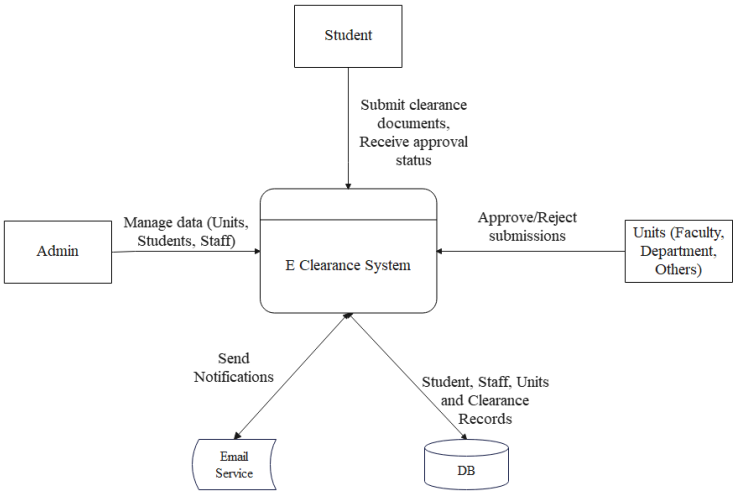

Fig 2: Online Clearance Level 0 DFD

The Level 1 DFD provides a detailed breakdown of the single high-level process ("E-Clearance System") as shown in ***Fig 2***. It decomposes the system into its main functional processes, data stores, and data flows among the Admin, Units, Students, and the Email Service as shown in ***Fig 3***.

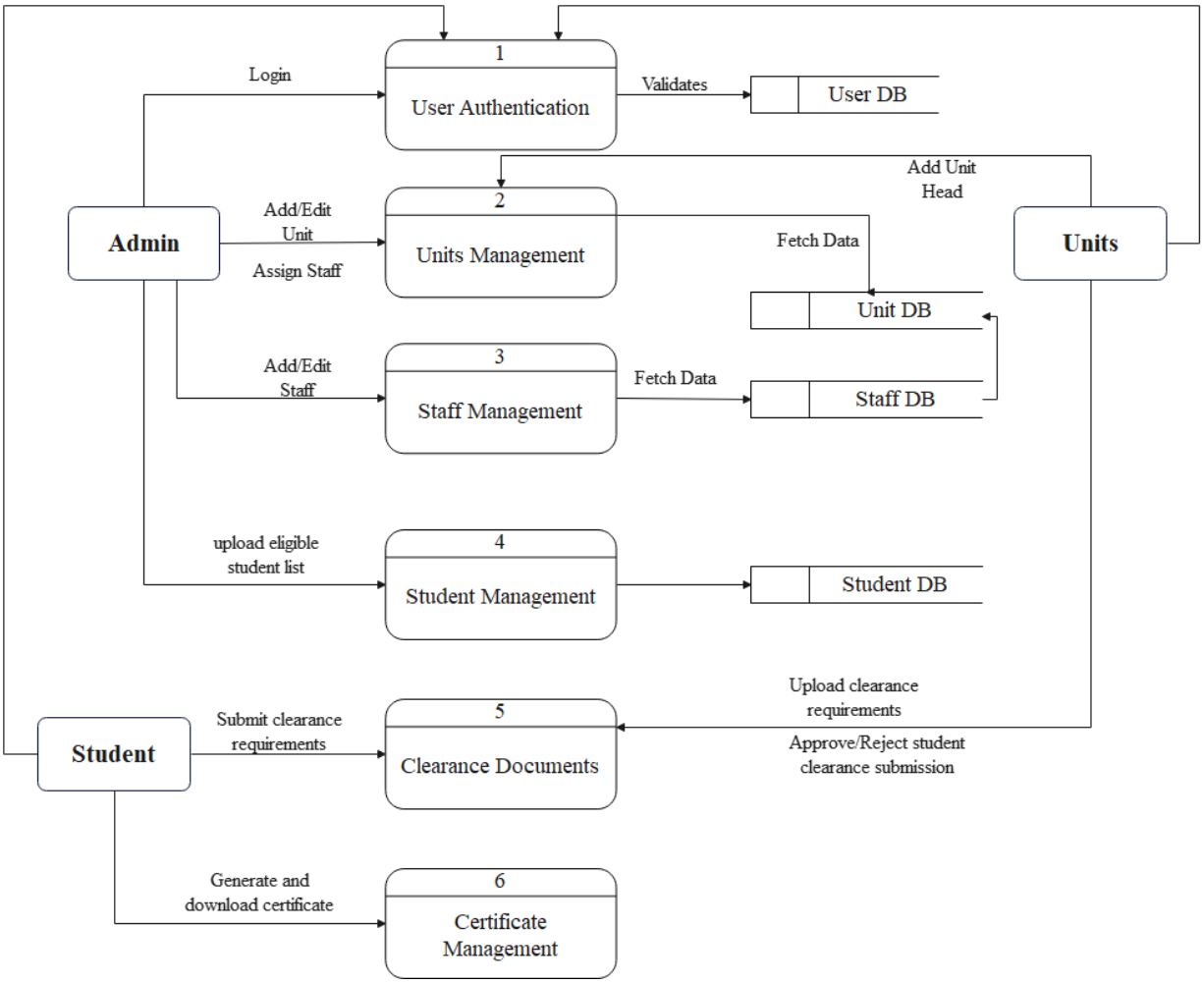

Fig 3: Online Clearance Level 1 DFD

The Entity–Relationship Diagram (ERD) represents the data structure of the E-Clearance System. It shows the entities (major data objects), their attributes, and the relationships between them in the system's database as shown in ***Fig 4***.

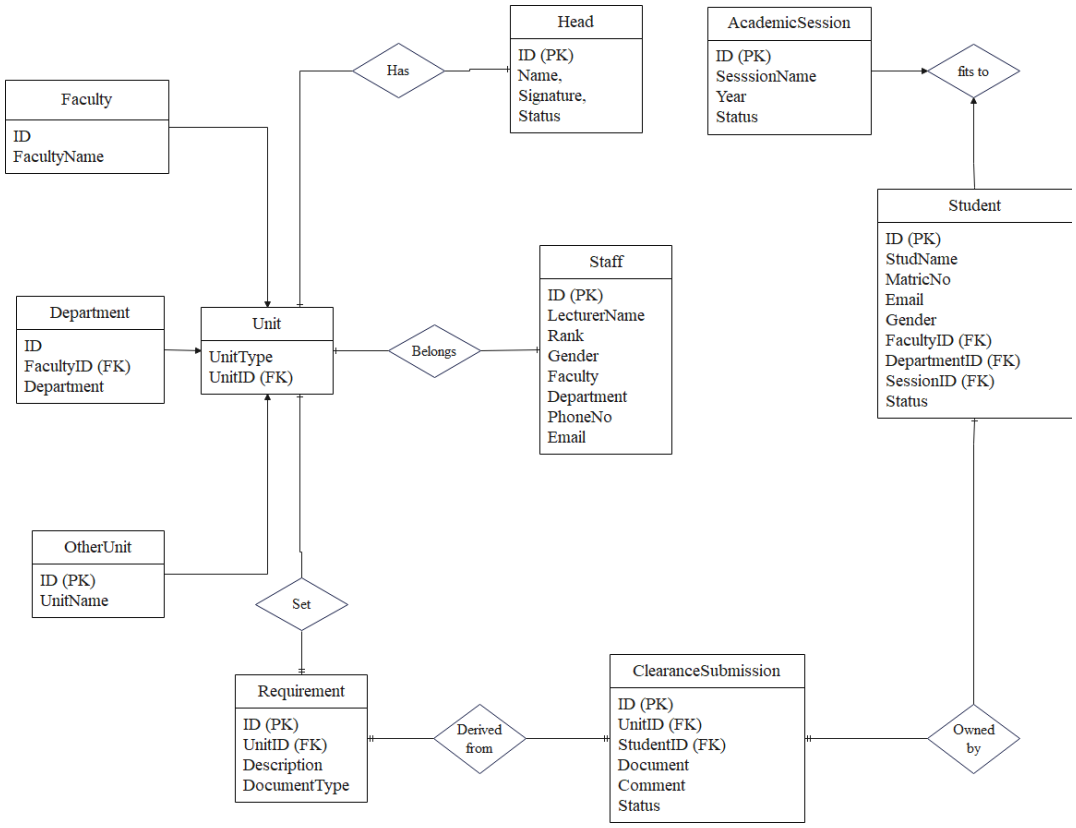

Fig 4: Online Clearance ER Diagram

3. System Development and Results

3.1 Development Process

The system has been built and locally tested in Python 3.12, Django 5, and MySQL 8.0. The MySQL was used to manage relational data, and the integrity of data was ensured by well-defined foreign keys. Some of the important tables were *users, roles, departments, uploads, clearance status, and notifications.*

The workflow of clearance was implemented with the help of Django views and models to control the validation of the submissions, departmental approvals and certificates generation. After a student was administered as cleared by all the departments, the system sent the *ReportLab* library to produce a PDF clearance report with a QR code embedded in it.

SMTP configuration was used to integrate the email notification system which was used to dispatch updates automatically at every milestone of the workflow. Such automation gets rid of delays in communication and encourages the feedback that is timely (Okafor and Daniel, 2024).

3.2 Interface and Functionality

The system interface was designed to be intuitive and accessible.

- **Students** view departmental clearance progress, upload documents, and receive automated email updates.
- **Officers** review and approve submissions or request resubmissions.
- **Administrators** manage users, monitor activity logs, and generate clearance analytics.

Admin dashboard contains graphical metrics of the number of cleared students and pending approvals

and the department performance to contribute to the data-based decision-making (Eweoya et al., 2025).

Upon login, the system automatically detects the type of user based on their login credentials and redirects them to their respective dashboard.

The Admin user is responsible for managing all Faculties, Departments, and other Clearance Units, as well as Staff accounts. The Admin also uploads the list of students eligible for clearance for each academic session.

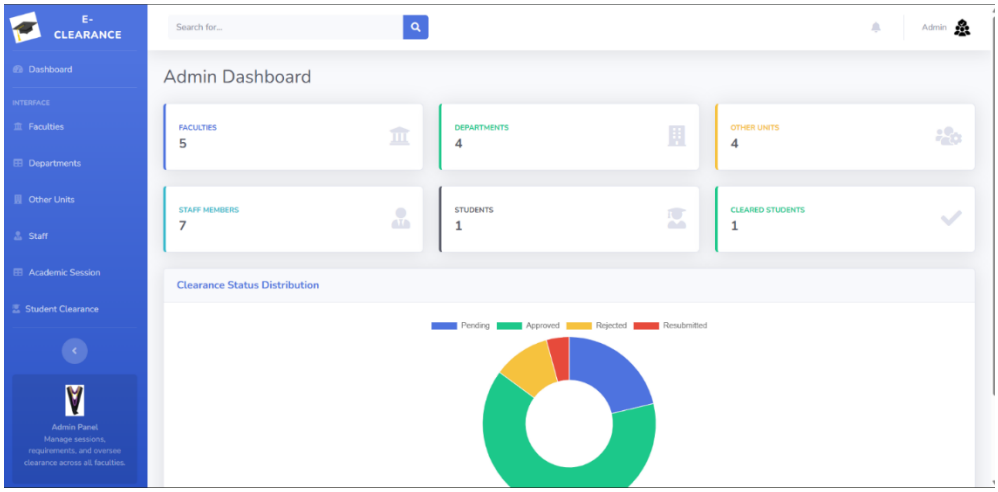

Fig 5: Online Clearance Admin Dashboard

Each Clearance Unit (such as a Faculty, Department, Library, or Bursary) can designate a Unit Head (for example, a Dean for a Faculty or Head of Department for a Department). The assigned officer (Staff) enters the Unit Head's name and either uploads the Head's signature file or enables the Head to sign digitally using the provided web signature pad. The officer then selects the Unit Head as the current (active) one to be used for students' approved clearances.

Fig 6: Online Clearance Unit Head form with signature pad

Every Clearance Unit can also upload its clearance requirements for a specific academic session. These requirements specify the information and documents that students must provide to be cleared by that Unit.

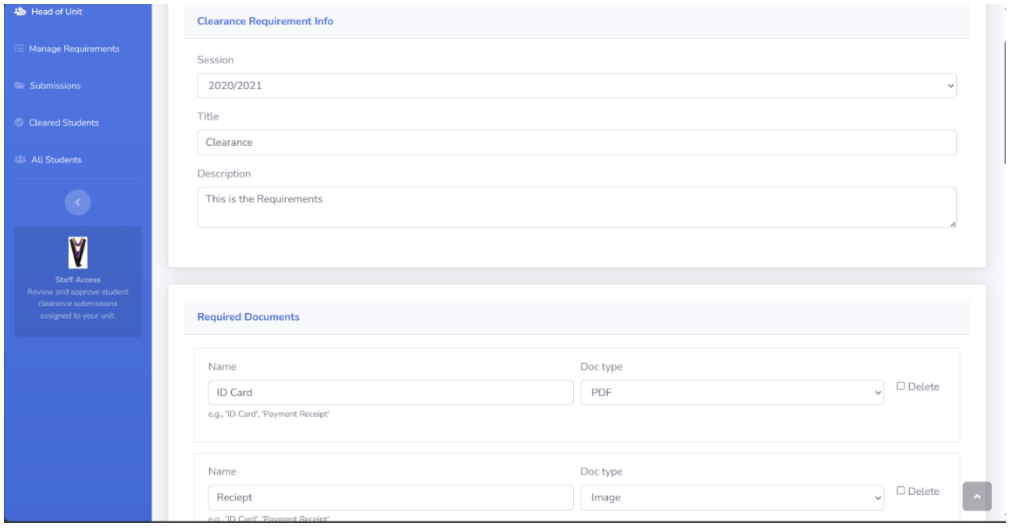

Fig 7: Online Clearance Unit requirement form

Students can view all clearance requirements from the various Units involved in their clearance process, fill in the necessary information, upload the required documents, and submit their clearance forms through the system.

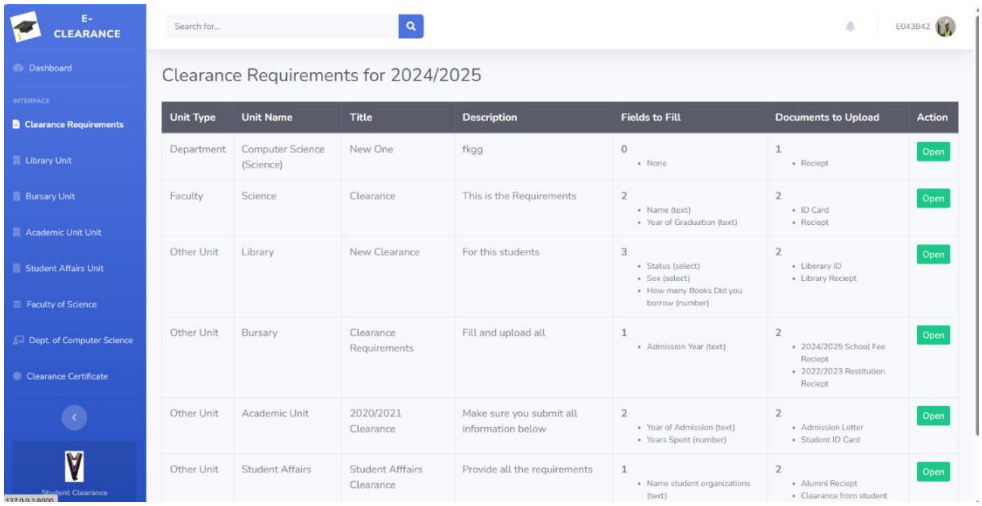

Fig 8: Online Clearance all unit requirements on student dashboard

Unit Staff members can access the list of student submissions for their respective Units. They can review each submission and either approve, reject, or request resubmission, providing relevant comments to clarify the reason for rejection or resubmission.

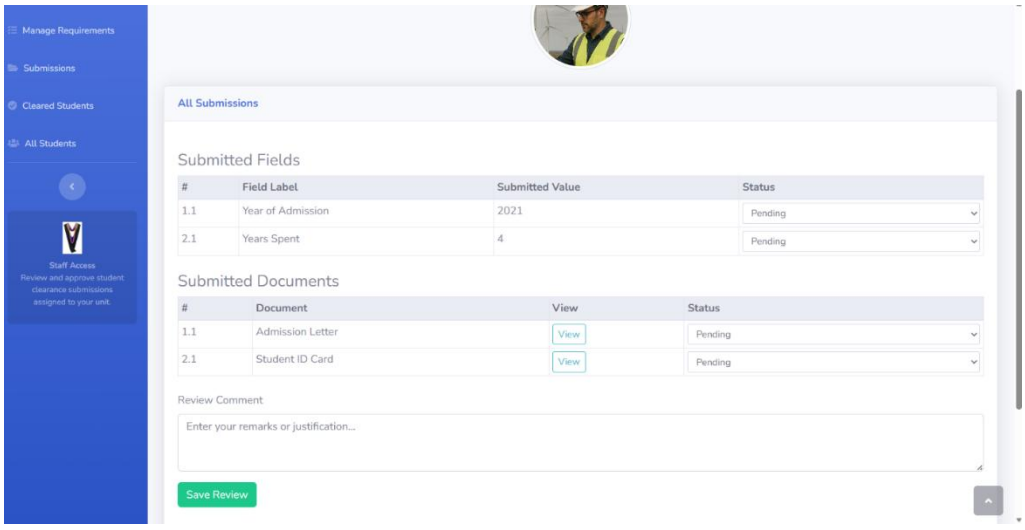

Fig 9: Online Clearance Unit student approval/rejection page

If a student's submission is approved, the system automatically sends an email notification, and the clearance status for that Unit is updated to Approved. In cases of rejection or resubmission requests, the system also notifies the student via email, including the comments provided by the staff, allowing the student to make the necessary corrections and resubmit.

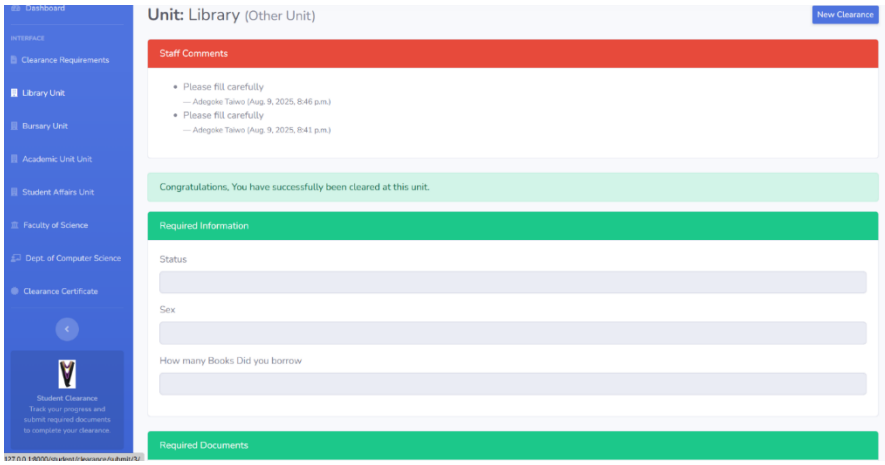

Fig 10: Online Clearance Student Comment/Status page

When a student has received approval from all the required Units, the system generates a Clearance Certificate. This certificate contains the student's personal information, the clearance details from all Units, the Unit Heads' names and signatures, and a QR code for verification.

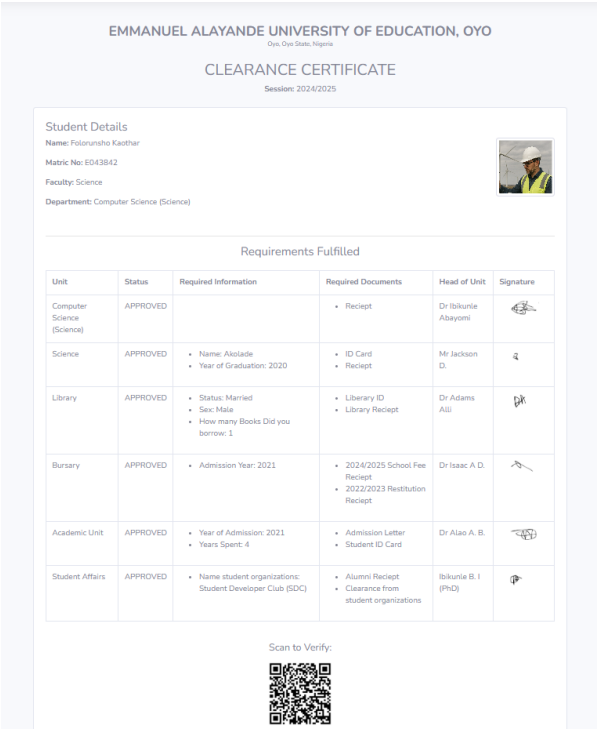

Fig 11: Clearance Certificate

3.3 Benefits and features

Key benefits and features of the developed system include:

1. **Reduced Processing Time:** Automation eliminated inter-departmental paperwork delays.

2. **Transparency:** Real-time tracking ensured accountability.
3. **Data Integrity:** Centralized MySQL storage maintained consistent and secure records.
4. **Security:** QR-code verification prevented certificate forgery.
5. **Communication Efficiency:** Email notifications improved user awareness and responsiveness.

4. Conclusion and Recommendations

4.1 Conclusion

The online student clearance system, which is workflow based, is practical in eliminating the old manual system of student clearance and moving forward to an automated, transparent and secure student clearance system. The modular architecture of the system, which is developed on the basis of Django and MySQL, provides the smooth cooperation of the departments and controlled access provided by role-based authentication.

QR-code verification allowed increasing document authenticity, whereas email notifications helped to enhance the efficiency of communication. The results of tests indicated that the amount of time saved, and the administrative overhead is significantly lower, and these findings are in line with results showing that workflow-based solutions facilitate institutional efficiency (Reijers, 2003).

Generally, the system provides a scalable and viable system to digitize administrative operation in institutions of higher learning.

4.2 Recommendations

1. **Integration with Existing Systems:** Make a clearance system connected with institutional databases like SIS or LMS to verify them in real-time.
2. **Cloud Hosting:** Run on cloud computing (AWS or Azure) to be able to scale more extensively and reliably (Okafor and Daniel, 2024).
3. **Mobile Application:** Build a mobile app with Flutter or React Native so that more people can access it.
4. **AI-Powered Validation:** AI and OCR can be used to check the documents uploaded automatically (Ogunyemi and Ojo, 2024).
5. **Enhanced Security:** Implement 2FA, SSSL encryption, and role-based logging to improve the security of data.
6. **Training and Support:** Frequent workshops are to be conducted to promote appropriate system adoption and utilisation.

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