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Iterative Development and Reverse Engineering for Optimized College Support Operations

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Abstract

In the college management system, the JNEC Support System appears as a vital solution, streamlining assistance for students, faculty, and staff of Jigme Namgyel Engineering College (JNEC). Recognizing a centralized platform, the proposed system aims to ease the challenges associated with navigating various departments and queues, fostering a unified and supportive experience for students. Concurrently, it eases the workload of faculty, allowing them to concentrate on their main responsibilities. Critical limitations have been identified in the existing "JNEC Helpdesk," such as lack of notification upon issue submission, unassigned tasks, and an inability to track issue resolutions. Reverse engineering played a crucial role, involving a careful analysis of the current system to loosen its underlying structure, functionalities, and processes. This method allowed us to gain a comprehensive understanding, even in the absence of complete design documentation or source code. The proposed system incorporates significant enhancements, including an academic-related support feature, eradicating the need for in-person meetings, and facilitating visual context through picture uploads. Monthly reports now provide comprehensive insights into both unresolved and resolved issues, empowering informed decision-making. Task assignment notifications via email ensure swift and efficient issue resolution by designated staff members. The key outcome is an enhanced JNEC Support System, featuring an intuitive interface for unified issue filing, accurate record-keeping, and transparent progress tracking. Addressing academic, infrastructure, and administrative concerns, the system establishes a transparent and efficient mechanism for complaint resolution. This system also fosters improved communication and collaboration across the JNEC community. The significance lies in enhancing user experience, ultimately creating a supportive and transparent college environment.

Keywords— College Management Support, Helpdesk, Issue Resolution, Support System, Iterative Development, Reverse Engineering

1 Introduction

In academic institutions, the provision of effective support systems plays an essential role in shaping a positive and efficient educational experience. Jigme Namgyel Engineering College (JNEC) recognizes this need and endeavors to enhance its support infrastructure through the implementation of the JNEC Support System. The existing scenario highlights the challenges students, faculty, and staff experience in navigating various departments and queues, impacting the overall efficiency and user experience. This work builds upon the foundational principles of academic support and draws inspiration from core-related activities, aiming to create a centralized platform for seamless assistance.

A specific and pressing issue identified in the current context revolves around the limitations of the obvious "JNEC Helpdesk" system. Notably, there is a lack of timely notifications upon issue submission, unassigned tasks, and an inability to systematically track issue resolutions. This deficiency highlights the critical need for a more efficient and transparent mechanism to address academic, infrastructure, and administrative concerns within the JNEC community.

To tackle these challenges, our methodology incorporated a strategic mixture of reverse engineering and an iterative approach. Reverse engineering played a crucial role in dividing the existing system, unscrambling its details, and identifying areas for improvement where original design documentation or source code was incomplete or unavailable. This comprehensive analysis informed the development strategies, placing the groundwork for the subsequent enhancements.

The implementation of the JNEC Support System resulted in considerable improvements. This includes the introduction of an academic-related support feature, eliminating the need for in-person meetings, and empowering users to convey issues through picture uploads. Monthly reports now provide comprehensive insights into both unresolved and resolved issues, facilitating informed decision-making. Task assignment notifications via email ensure the instant and efficient resolution of issues by designated staff members.

The significance of this work lies in its contribution to the optimization of academic support at JNEC, fostering improved communication, collaboration, and overall user experience. By addressing the identified limitations and enhancing the existing system, this research makes a valuable contribution to the broader research community, offering insights into the effective development and implementation of centralized support systems in educational institutions.

2 Literature Review

In educational institutes like JNEC, which has a large number of staff and students, it is inevitable to have some issues and these issues may not be properly handled if there is a lack of proper management system. In their paper [1], they discussed the lack of an integrated support system for students using a teaching and learning platform, resulting in issues such as communication gaps, prolonged issue resolution times, and suboptimal learning experiences for students and faculties in the university. According to [2], support systems provide a centralized platform for students to seek assistance, report issues, and receive prompt support ensuring a seamless learning experience thereby eliminating the need for multiple communication channels and streamlining support services. Additionally, in [1], it is known that the role of online help desk systems is vital in monitoring and analyzing student feedback and concerns which allows universities to identify prevalent trends and address systemic issues effectively. These help desk systems can also assist the universities in making continuous improvements.

The combination of reverse-engineering and iterative approach was used for the development of the JNEC Support system. According to [3], reverse engineering aims to provide design models from existing software thereby facilitating program comprehension, maintenance, and evolution of systems. This approach was helpful for developers in identifying the system's components and their

interoperability, and to create a representation of the system in another form or at a higher level of abstraction. In [4], a similar approach to reverse-engineering was also used by the developers to identify the limitations of the old system upon which the new system will be developed. The Rapid Application Development (RAD) approach was used to break down the design into iterations, implement and test the features, deploy the completed feature, gather feedback, and refine the design with each cycle.

As discussed in [5], the implementation of a helpdesk system using an information technology infrastructure library framework in software companies shows that it effectively manages IT infrastructure and provides optimal IT services. It includes processes such as service desk and problem management, integrating IT management, and supporting services for overall operational efficiency. Thus, the existing system, "JNEC Helpdesk", system is set to undergo improvements to address its limitations and enhance functionality. New system enhancements include an academic-related support feature and generating monthly reports summarizing both unresolved and solved issues, providing valuable insights for decision-making and improving the overall user experience. Furthermore, task assignment notifications via email would ensure that designated staff members receive all necessary details to address assigned tasks promptly and efficiently. These improvements aim to enhance the JNEC Support System's usability and provide comprehensive support for various concerns, leading to increased system usage and improved user experience.

3 Methodology

As represented in Figure 1, the development of the JNEC Support System incorporated a methodology that combined reverse engineering and an iterative approach. Reverse engineering played a crucial role in the development of the JNEC Support System as the process involved precisely analyzing the existing system to gain a deep understanding of its underlying structure, functionalities, and processes. Reverse engineering helped to uncover the system's details, even if the original design documentation or source code was incomplete or unavailable. This in-depth examination of the system provided valuable insights into its inner workings, enabling and identifying areas for improvement and formulating effective development strategies. During the reverse engineering process, the system's components and modules were separated where mapping out their relationships and dependencies. The data flow, algorithms, and interfaces of the system's logic and functionality were examined. This reverse engineering effort served as a foundation for making informed decisions on how to enhance and optimize the system.

The iterative approach was employed in the enhancement of the JNEC Support System. This approach involved breaking down the development process into smaller, manageable iterations. During each iteration, in each iterative phase, user feedback was gathered, requirements were analyzed, and evolving needs were assessed to drive system improvements. Based on the feedback received, the areas were identified for enhancement, and the necessary changes were made to address user expectations and organizational goals. This iterative cycle was repeated throughout the development process, allowing for continuous refinement and expansion of the system. Each iteration provided an opportunity to incorporate user feedback and make iterative adjustments, resulting in an improved system that aligned more closely with user needs and expectations. According to the [6], the project integrating the System Development Life Cycle (SDLC) with the Rapid Application Development (RAD) model benefits from a structured development approach while allowing flexibility for user feedback and iterative improvements. Thus, iterative methodology allowed for responding to changing requirements and emerging challenges effectively, ensuring that the system's development was responsive and adaptable to evolving circumstances.

The development included creating a Use Case diagram to outline system interactions, followed by database design to manage data effectively as mentioned in [7]. The use case diagram as shown in Figure 2 provides a visual representation of the interactions between actors and the JNEC Support

System. It highlights key use cases such as lodging complaints, checking status, assigning issues, sending notifications, and generating reports. Users, such as students and faculty, can lodge complaints through the system, track the status of their reported issues, and receive timely notifications regarding progress updates. The system assigns the issues to the appropriate staff or technicians for resolution, ensuring efficient and prompt handling. Additionally, the system generates reports that offer insights into the overall performance and key metrics of the helpdesk system.

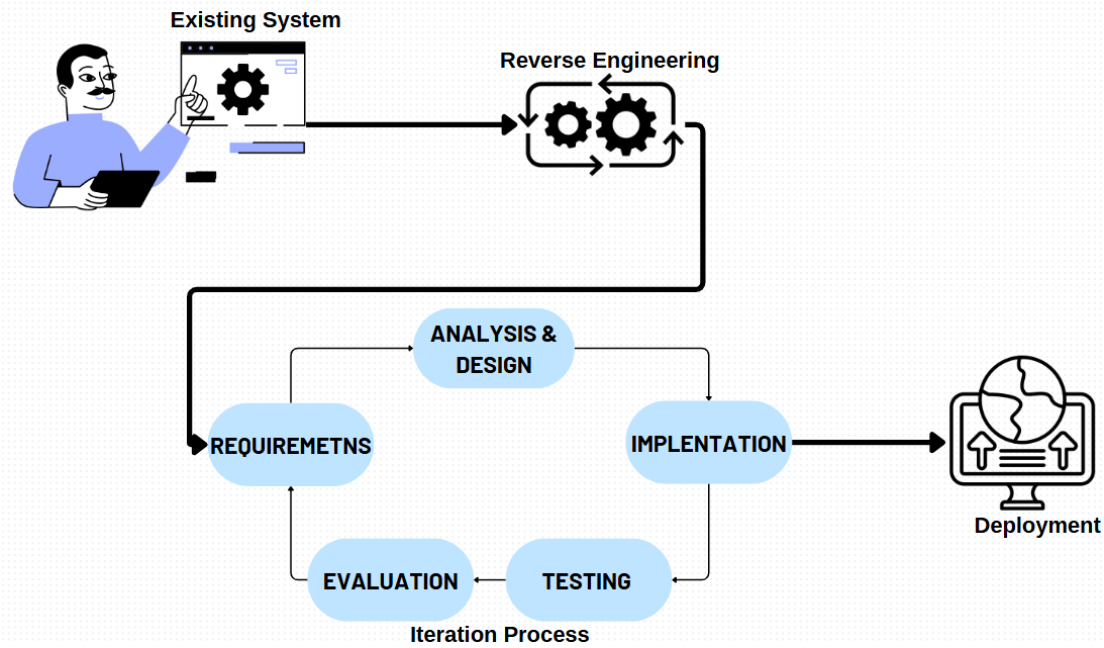


Figure 1: Combination of reverse engineering and iterative approach

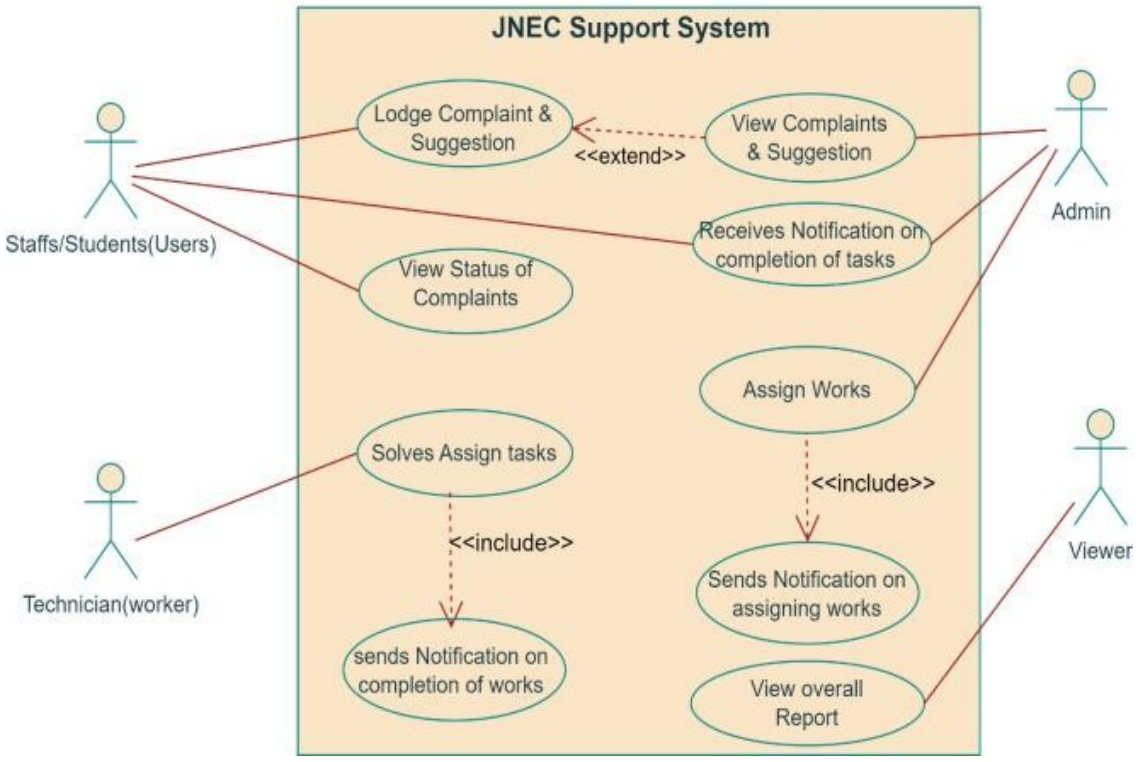


Figure 2: Use Case Diagram

Figure 3 shows the ER diagram to provide a clearer image of database design. Through the requirements analysis and Use Case diagram, the database design was completed earlier and could reduce the time taken during the iterative cycles of implementation and testing phase.

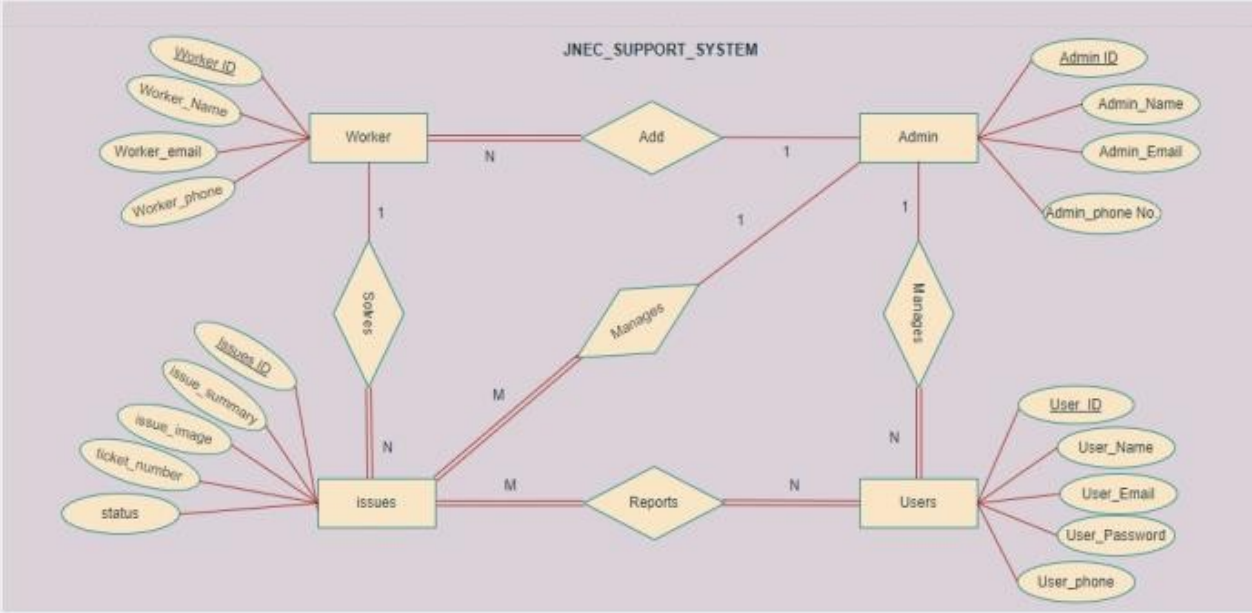


Figure 3: ER-Diagram

4 Results

The JNEC Support System working process of Admin is shown in Figure 4 where admins will be able to log in and be redirected to their respective dashboards. Each admin can manage their staff, assign work to their staff, check the work status, and send email notifications.

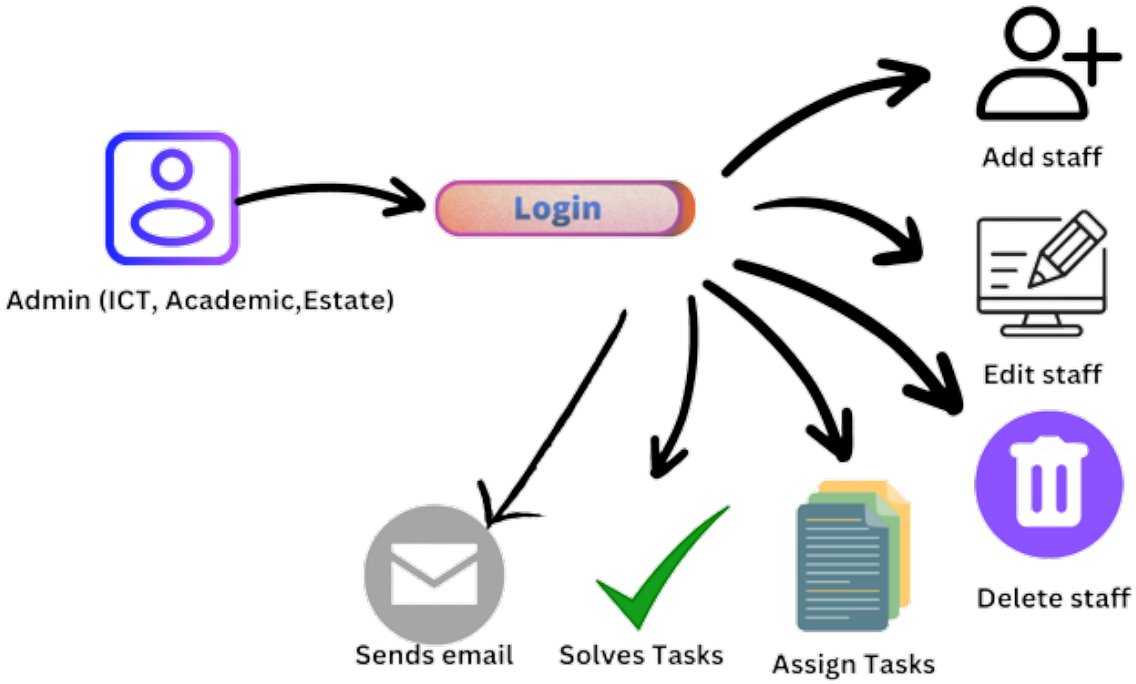


Figure 4: System Functionality of Admin

The system could generate reports for viewers as represented in Figure 5 on a monthly basis to see the number of issues received in the institution. The report will contain information on solved issues and unsolved issues, and also search for specific issues to generate the report.

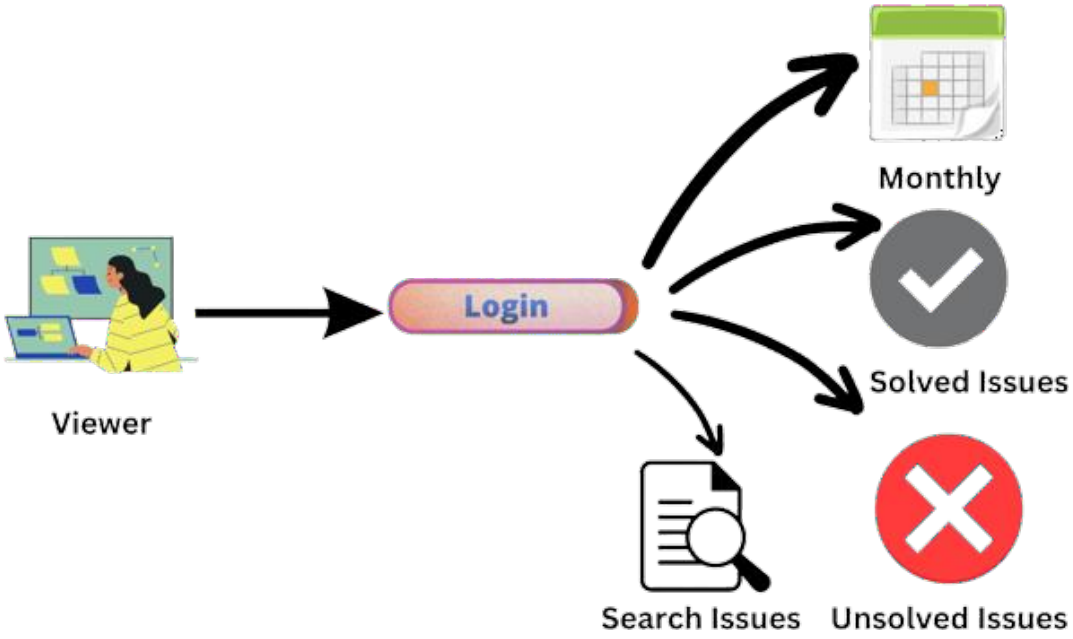


Figure 5: System Functionality of Viewer

The successful deployment of the JNEC Support System not only addresses the challenges regarding the existing system but also brings several benefits to the college. Figure 6 shows the landing page of the system where students can lodge issues with a brief description of the issue and an image if available.

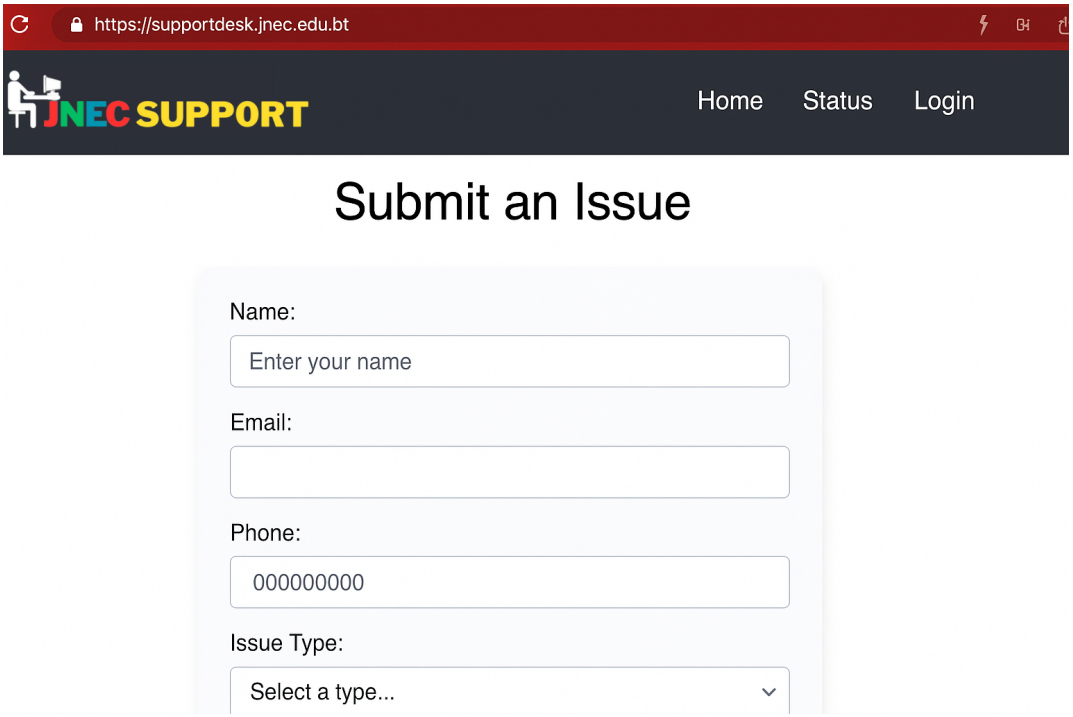


Figure 6: Landing Page

The issues lodged by the users are received at the respective admin dashboard. Figure 7 shows the admin dashboard of the system where the admin can view the issues lodged by the users and can assign staff to work on the particular issue.

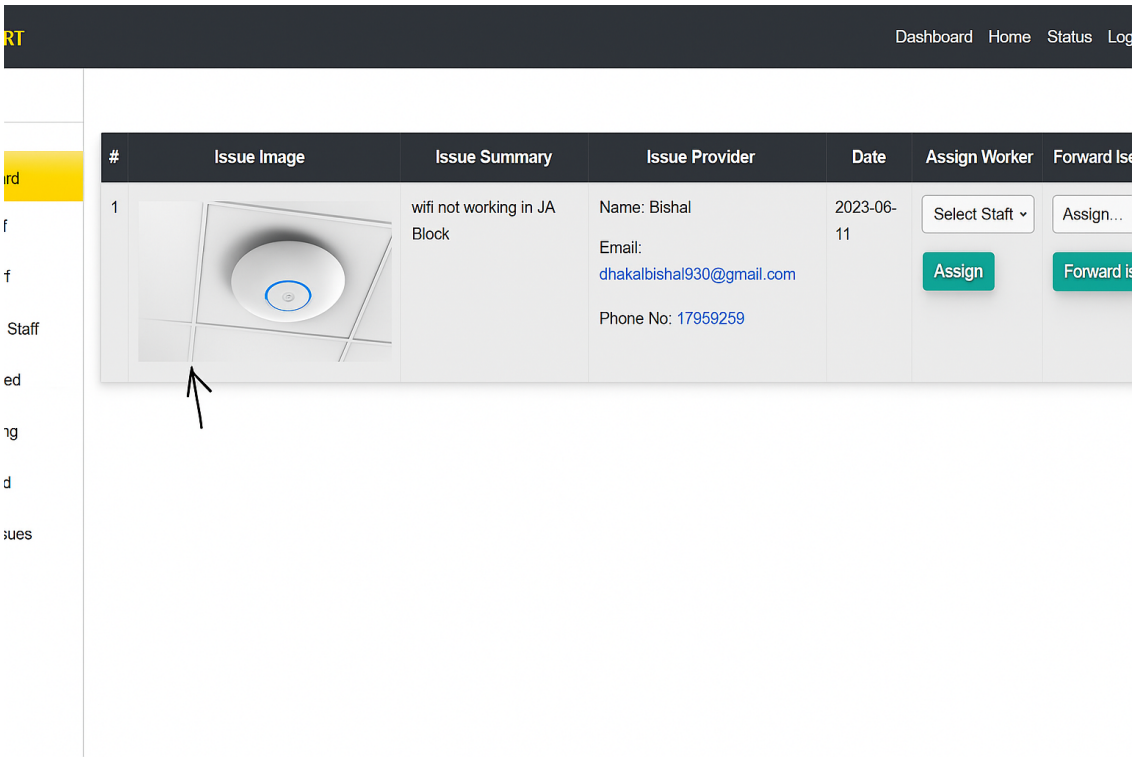


Figure 7: Admin Dashboard

JNEC Support System checks the workload of staff as the admin can view the status of the issue that the staff is currently working on shown in the staff dashboard in Figure 8.

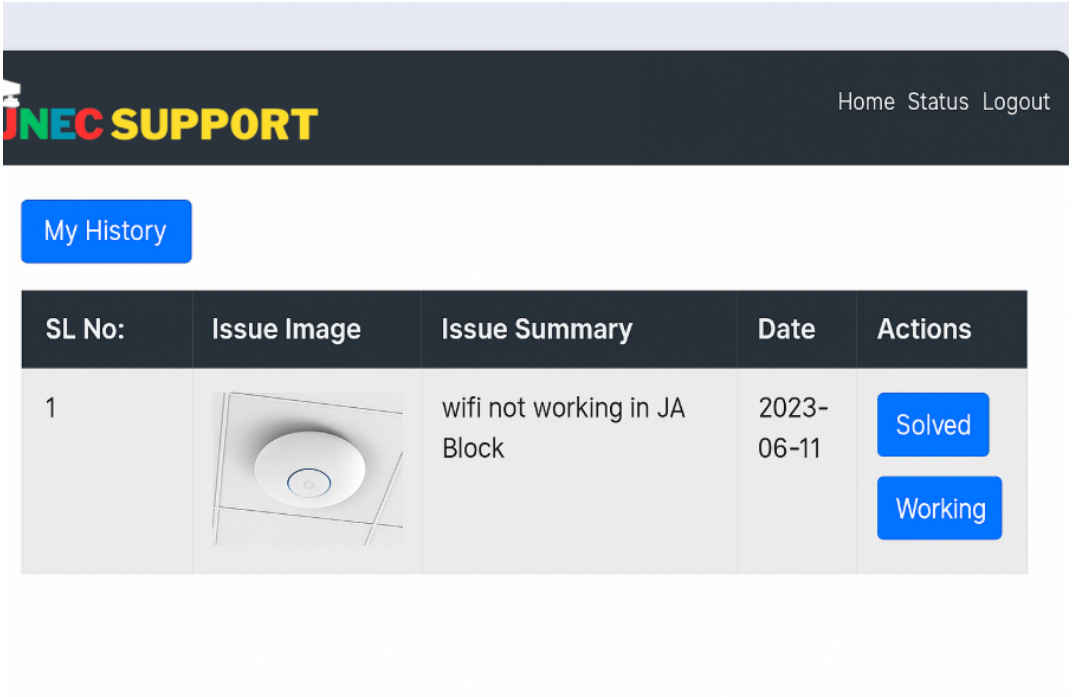


Figure 8: Staff Dashboard

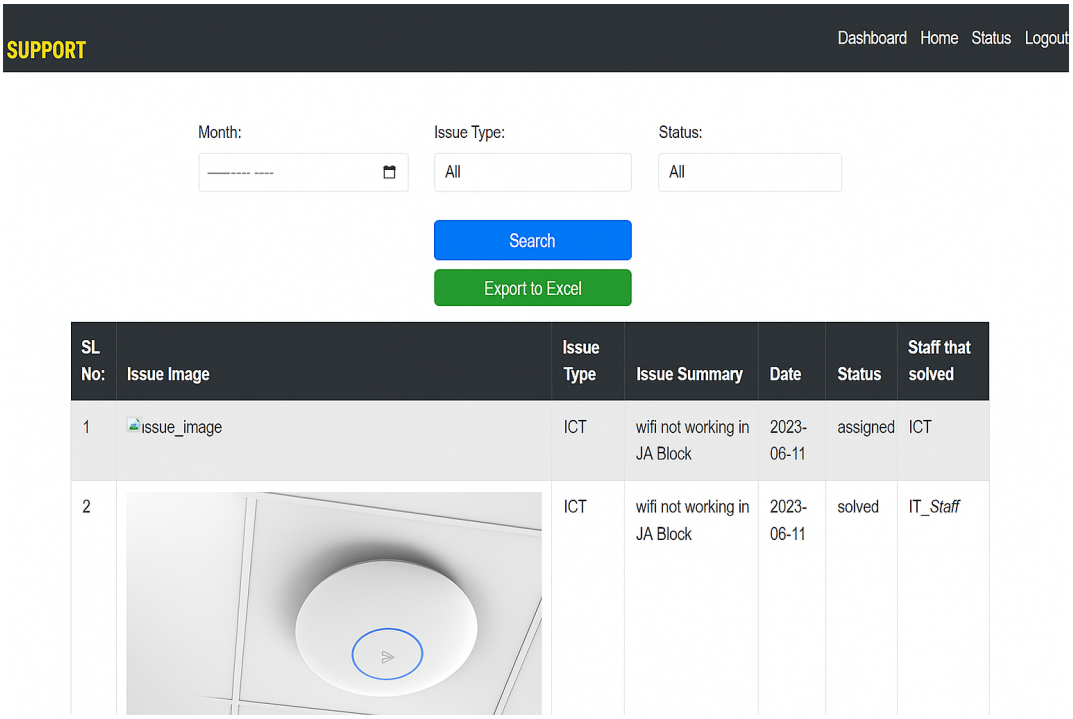


Figure 9: Viewer Dashboard

The support system generates valuable data on student inquiries, allowing administrators to identify common challenges and areas for improvement as shown in Figure 9. By analyzing the data collected through the support system, administrators can optimize support services, enhance system performance, and better align resources with student needs.

5 Conclusion

JNEC support system ensures numerous advantages to both students and staff users. It provides a centralized platform for students to seek help with academic, administrative, and technical issues, eliminating the need to navigate multiple departments or endure long queues. This modernized access to assistance reduces frustration and enhances students' sense of support and engagement, ultimately improving their overall experience at the college.

Moreover, the support system eases the work of college management by offering a reliable source of assistance for staff and students. With a dedicated avenue for help, staff can focus on their core responsibilities, knowing that students have a centralized platform to address their concerns. JNEC support system is an integrated and comprehensive platform that provides students with a one-stop solution for any academic, administrative, or technical issues they may encounter. The system ensures that all submissions are recorded accurately, enabling efficient tracking and resolution of issues. This platform promotes transparency, as users can stay updated on the progress of their complaints.

Acknowledgement

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References

[1] S. Kusasira, A. Arinaitwe, and J. Nuwagaba, "Online Help Desk System Guide to Enhance Learning," 2023. [Online]. Available: http://www.cavendish.ac.ug

[2] S. Alexander and T. Golja, "Using Students' Experiences to Derive Quality in an e-Learning System: An Institution's Perspective," 2007. [Online]. Available: https://www.researchgate.net/publication/220374227

[3] M. H. Aabidi, B. el Mahi, C. Baidada, A. Jakimi, and H. Ammar, "Benefits of Reverse Engineering Technologies in Software Development Makerspace," *ITM Web of Conferences*, vol. 13, p. 01028, 2017, doi: 10.1051/itmconf/20171301028.

[4] Y. Tshering, S. P. Kamishetty, and H. Sarwarzadah, "Event Management for Social Service Website Using Ruby on Rails: BTO Event View Application Developed Implementing Collaborative Technique," *World Journal of Research and Review*, vol. 13, no. 6, Dec. 2021, doi: 10.31871/wjrr.13.6.5.

[5] S. Mehravani, N. Hajiheydari, and M. Haghighinasab, "ITIL Adoption Model Based on TAM." [Online]. Available: *[link not provided]*

[6] T. Thongley and Y. Tshering, "Digital Landslide Risk Mapping and Landslide Database for Bhutan Through Mobile App for Bhutan," in *Proc. Geoinformatics for Spatial-Infrastructure Development in Earth and Allied Sciences (GIS-IDEAS)*, Dec. 2024, doi: 10.1109/GIS-IDEAS63212.2024.10991118.

[7] Y. Tshering, T. Yangchen, K. J. Wangchuk, W. Dorji, S. Pelzang, and T. Wangchuk, "Innovative Solutions for Democratic Processes: A Case Study on Secure JNEC Voting System," *Journal of Applied Engineering Technology and Management*, vol. 4, no. 1, 2024, doi: 10.54417/jaetm.v4i1.123.

[8] A. Yadav, "React JS JWT Authentication | React JS Laravel Auth | React JS Login Authentication Routes," YouTube, Feb. 11, 2024. [Online]. Available: https://www.youtube.com/watch?v=9tlute6epkk

[9] Node.js Documentation, "Index | Node.js v21.6.1 Documentation," Accessed: Feb. 11, 2024. [Online]. Available: https://nodejs.org/docs/latest/api/

[10] W3Schools, "JavaScript Tutorial," Accessed: Feb. 11, 2024. [Online]. Available: https://www.w3schools.com/js/

[11] CodeWithVishal, "Build CRUD Application with ReactJS NodeJS ExpressJS & MySQL from Scratch," YouTube, Feb. 11, 2024. [Online]. Available: https://www.youtube.com/watch?v=8ly39na3LLM