Volume 10, Issue 5, May – 2025 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

SEAIT Smart Parking System: Enhancing Efficiency and Security in Campus Vehicle Management

[1]Jhonrid Agustine P. Morata; [2]Karl Verlex S. Novilla; [3]Louji F. Lapaña; [4]Jubert G. Estimada; [5]Cedie E. Gabriel; MIT; [6]Reginald S. Prudente; MIT

[1,2,3,4,5,6] College of Information and Communication Technology, South East Asian Institute of Technology Incorporated, 9505 Crossing Rubber, Tupi, South Cotabato, Philippines

Publication Date: 2025/05/21

Abstract: Increasing numbers of cars in universities have brought rising parking management issues, including congestion, unauthorized parking, as well as safety concerns. Traditional parking systems rely on manual checks and do not include real-time tracking of data, creating inefficiencies as well as safety risks for the users and employees. This work outlines the SEAIT Smart Student Parking System that will improve these issues through the use of advanced technologies such as real-time tracking, space reservation automation, as well as advanced safety features. The work will examine how a smart parking system can maximize car management, safety, and optimize parking experience for users. Utilizing the mixed-methods approach, 50 respondents, who included university employees as well as students, were interviewed as well as surveyed. Findings indicate that user satisfaction with the system's real-time update as well as the system's navigation is high, with 46% of users reporting notable time savings when finding parking. The work demonstrates that feedback from the users is paramount in improving system functionality as well as system design. Overall, the SEAIT Smart Student Parking System documents the capability of smart technologies in changing university parking management, presenting an extendible approach for other universities facing the same challenges.

Key Words: *Smart Parking System, Real-Time Tracking, Parking Management, Space Reservation, University Parking, Safety Features, User Satisfaction, Mixed-Methods Research, Parking Navigation, SEAIT, Automated Parking, Campus Congestion.*

How to Cite: Jhonrid Agustine P. Morata; Karl Verlex S. Novilla; Louji F. Lapaña; Jubert G. Estimada; Cedie E. Gabriel; Reginald S. Prudente (2025), SEAIT Smart Parking System: Enhancing Efficiency and Security in Campus Vehicle Management. *International Journal of Innovative Science and Research Technology*, 10(5), 893-903. https://doi.org/10.38124/ijisrt/25may641

I. INTRODUCTION

With the increasing number of students owning and bringing their cars to campus, the parking management system has been confronted with significant challenges like parking congestion, improper use of parking space, and security issues. Traditional way of system related to parking are manually monitored and lack of tracking real-time data, which can turn to inconvenience for campus's students and officials alike (Geng & Cassandras, 2013). With the campuses continue to develop, these challenges will only become more visible in the future, therefore the integration of smart technologies on enhancing the efficiency and security will be even more significant (Shoup, 2017). The SEAIT Smart Student Parking System is made to resolve these challenges with the integration of smart technologies into the school parking system. Real time tracking and advancement of the security are the system's key components to ensure a more smoother driving experience with a better, safer, with even more organise parking experience for students and staffs. The system uses processing of automated data and smart algorithms for identifying available parking slots and assign them effectively, making sure by using optimal resources and improved parking experience (Wang et al., 2011; Barth & Shaheen, 2002).

➢ *Research Problem*

On the existing parking management system at SEAIT is experiencing difficulties by these inefficiencies, which includes unauthorized parking, failure of real-time parking slots and threats to security. These issues can be an inconvenience for students, causes delays, misplaced vehicles, and expose to danger. Without formal technology-based parking solution, students will experience time waste and frustrations. Beyond this, traditional way of checking the security are often not effective at identifying unauthorized vehicles, and will continue on compromising campus security. A technology-based solution is effectively important on parking operations and improving its safety on campus.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

➢ *Research Questions and Objectives*

- This study aims to address these following questions:

✓ How can a smart parking system enhance its effectiveness in vehicle management within campus?
✓ What technologies can be integrated to enhance the security of student parking?
✓ How can real-time tracking and automated allocation improve the parking experience for students?
✓ What are the key challenges in implementing a smart parking system in an educational institution?
✓ In How can user feedback contribute to the refinement and effectiveness of the system?

- Research Objectives:

✓ To create an intelligent parking system that enhances vehicle management effectiveness at SEAIT.
✓ To incorporate security measures that avoid unauthorized parking and promote student safety.
✓ To use real-time tracking and automatic space allocation for efficient parking.
✓ To examine the issues related to the implementation of a smart parking solution in a campus environment.
✓ To collect user feedback for ongoing system enhancement and user satisfaction.

➢ *Justification and Significance*

Pollution reduces productivity, and safety and security on campus are also hampered, with underreporting often occurring due to the lack of a reliable parking solution (Shoup, 2011; Geng & Cassandras, 2012). With the use of a smart parking solution, SEAIT will be able to upgrade the daily commute experiences of students while minimizing crowding and improving overall campus safety (Barth & Shaheen, 2002). Smart parking systems have already been widely implemented in urban environments, and applying such a system in an academic institution is expected to yield similar benefits—facilitating smoother vehicle flow and better management of limited parking spaces (Idris et al., 2009). Moreover, this study offers useful insights into the application of smart technologies for campus management. The results can be used as a guide for other institutions that intend to augment their parking lots with smart technology. A factor that it's possible to lessen the carbon emissions by preventing unnecessary vehicle circulation further promote the green benefits that an efficient smart management parking system can give (Machado et al., 2018).

II. LITERATURE REVIEW

➢ *Overview of HCI Theories and Models*

According to Zheng et al. (2021), intelligent parking systems utilize technology such as IoT, RFID, and AI-based analytics for parking space optimization management as well as enhancing security. The application of such systems has been quite efficient throughout other city spaces and institutions as well, delineating the role of such systems in mitigating congestion as well as enhancing the convenience of the user (Al-Ghuwainem & Al-Khalifa, 2020). Through the provision of instantaneous information on parking by the system, such systems enable the user to find vacant spaces at a rapid pace, saving time. In addition, smart parking solution sets, according to Chen (2019), help the administrator monitor parking usage patterns and make decisions based on data for infrastructure planning. Integration with automatic license plate recognition (ALPR) as well as contactless payments further improves such systems' efficiency, lessening manual intervention. Awareness about existing smart parking solutions' success and limitations offers a basis for developing a system that caters to the unique on-campus environment at SEAIT. Employing Norman's Interaction Model, the SEAIT Smart Student Parking System is conceived to facilitate efficient user interaction by enabling users to navigate through stages such as formation of purpose, execution on actions (e.g., searching for or reserving parking), as also provision of instant, useful feedback—thus bridging the Gulf of Execution as well as that of Evaluation, and making the system more usable as well as satisfactory.

➢ *Review recent studies, papers, and advancements in HCI*

Recent research by Kumar & Singh (2021) reports on advantages in using smart technologies in parking management. Automated license plate recognition, automatic vehicle identification, as well as mobile-based reservation, have shown to bring about efficiency as well as security in parking operations. Studies have also highlighted user-centric interfaces as crucial in smart parking solutions (Nguyen et al., 2020). Integration with AI-based predictive analytics has enabled institutions to anticipate parking demand patterns, thus making better use of resources. In addition, as reported by Garcia & Torres (2018), evidence from university case studies that have adopted smart parking systems shows considerable reduction in parking delays and security breaches. Use of cloud based storage and management systems has even enhanced scalability and dependability in such systems (Lee et al., 2022). Such evidence supports in terms of adopting advanced technologies to improve overall user experience along with operational efficiency of university parking lots.

➢ *Analyze existing solutions related to the research problem*

As noted by Hassan et al. (2020), although numerous smart parking systems have been developed, such limitations as high installation costs, maintenance, and system flexibility still exist. Some of these systems don't account for actual user needs in real-time and could not effectively integrate with pre-existing infrastructure. This study seeks to resolve these shortcomings by developing an affordable, scalable, and user-

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

centric smart parking system that suits the requirements of SEAIT.

Also, as noted by Brown & Wilson (2019), most available parking systems address space optimization but overlook security. Unauthorized access to campuses and car thefts still pose challenges in learning institutions. In an attempt to provide an all-rounded solution that addresses both efficiency and security, the SEAIT Smart Student Parking System aims to ensure that it has multi-layered security features including face recognition and biometric identification.

As theorized by Davis (1989) and Nielsen (1994), this research is based on technology acceptance models, usability engineering, and security models. This research applies user-centered design principles to achieve system effectiveness, flexibility, and accessibility, which in turn leads to an easy parking process for students at SEAIT. By applying human-computer interaction concepts, this study stresses user-centric system design that is responsive to user expectations as well as providing high-security standards.

III. METHODOLOGY

➢ *Research Design*

This research employs a mixed method study that containing quantitative and qualitative methods to gather balanced data on efficiency and safety of the safety of the SEAIT Smart Student Parking System.

➢ *Respondent*

The respondents to this study will consist of 50 students, instructors, and security personnel who use or operate the parking system on their respective campuses. Purposive sampling will be employed to select respondents based on their direct experience with parking on campuses. The sample size will be determined from the population of students and faculty in order to have an adequately representative study group reflecting parking dynamics on campuses.

➢ *Data Collection*

Data acquisition will include surveys, interviews, and system performance tracking. Surveys will also be administered to students and faculty to obtain opinions on existing parking experiences and aspirations. In-depth security personnel interviews will offer insights concerning operational issues and security-related matters. Also to be done is real-time system performance tracking to analyze parking use patterns and user behavior towards the smart system.

➢ *Data Analysis*

The collected data will be analyzed with quantitative and qualitative methods. The response to the surveys will be statistically analyzed by using descriptive and inferential analysis to seek trends and relationships. The response to the interviews will be analyzed by using thematic analysis to obtain primary insights regarding parking security and efficiency. The information on system performance will be examined to see how efficiently smart parking reduces congestion and enhances security.

➢ *Ethical Considerations*

Ethical standards will strictly be followed in this study to respect participants' privacy and their rights. Informed consent from all respondents will be secured prior to their participation. Data anonymity and confidentiality will be ensured by storing all data gathered in safe storage spaces and restricting access to duly qualified researchers alone. This study will also conform to institutional guidelines to uphold standards in research integrity.

IV. ADVANCED HCI SYSTEM DESIGN

➢ *System Architecture*

The SEAIT Smart Student Parking System's architecture involves a modular structure for the purpose of providing the system with the potential for growth, sustainability, and efficient integration of multiple system components. The system is set to be three-tiers comprising the layers as follows:

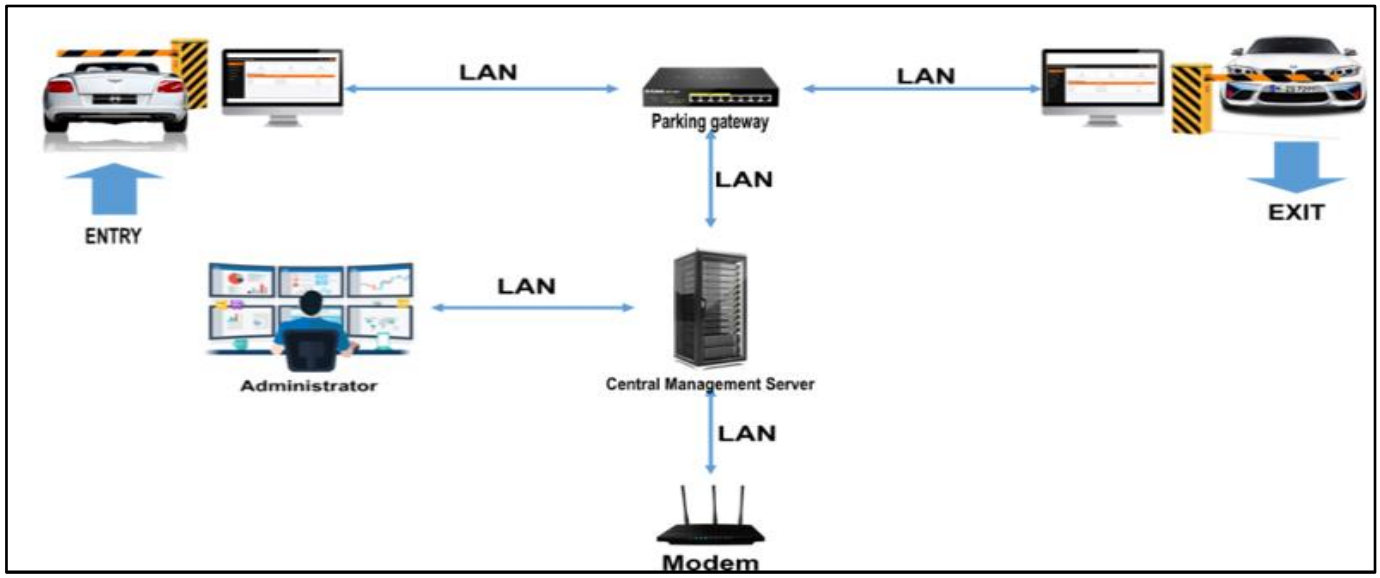

Fig 1 Illustrates the System Architecture Diagram of the SEAIT Smart Student Parking System

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

The System Architecture Diagram provides a high-level overview of how various components of the SEAIT Smart Student Parking System interact.

- *Key Components:*

✓ *Presentation Layer (User Interface):*

This is the front-end interface that allows users (students, staff, and security personnel) to interact with the system through mobile and desktop platforms. It includes real-time parking space information, notifications, and user account access.

✓ *Application Layer (Processing Logic*):

This layer processes inputs from users, manages space allocation algorithms, and handles communication between subsystems. It houses core functionalities such as parking space monitoring, reservation management, and violation detection.

✓ *Data Layer (Database & Analytics)*:

This back-end layer stores user data, parking history, space availability, and system logs. It integrates with data analytics tools to provide reports on usage trends, security alerts, and efficiency metrics.

➢ *Features and Functionalities*

The system presented in the text below is inclusive of a lot of different features and functionalities that are crucial for better user experience, improved vehicle management effectiveness and the provision of the best possible solutions to the problems discovered under the campus parking settings research.

- *Intelligent Parking Management*

This system is able to manage the parking of cars in an automated way by employing a unified platform for the purpose of tracking and guiding the car flow throughout the campus. The system is capable of identifying the available parking lots and in the meantime, users with their type automatically get their spot according to clever algorithms, which not only will the manual work be reduced but also no operational delay will be caused. This is the very measure by which inefficiency in SEAIT's current parking system is thus addressed.

- *Enhanced Security Measures*

The proactive step that the organization gives of eliminating illegal parking and ensuring that registered vehicles are safe is reached through the implementation of a system that combines license plate recognition with vehicle registration validation, and a digital pass system. The breach of the security perimeter causes the real-time system to send the signal, and security officers become aware of that immediately. Consequently, they can take the required action (deploy, stop intruders) to ensure a safe environment.

- *Real-Time Tracking and Automated Allocation*

The service now offers a real-time availability feature accessible on a mobile or web app, hence, users can monitor the present parking state, can be informed and save their spot in the app. The facility minimizes the number of traffic jams, curtails the most common problems of the double parkers, and the time spent by the driver fruitlessly searching for an empty parking slot is curtailed, therefore, parking efficiency on SEAIT's campus is fully guaranteed (at a higher level of usage than at present).

- *Administrative Support Tools*

The platform has a cogent and well-organized administrative dashboard that the department of SEAIT can take advantage of for real-time parking usage observation, timely reports generation, and settings like user access levels, parking timings, and violation fines a.k.a management purposes. The system by these features functions efficiently and the institution not just solves the problem but also gain references of the hang time of crowded times for proper scheduling and budget determination.

- *User Feedback*

A user interface has a built-in feedback and rating system for the students and employees to provide their opinion on various issues, give performance tips, and even share their parking experiences and also to rate them. This feature puts students at the center will naturally lead to the constant development of the system by practical experience and wants, thus we can keep the system fresh and working for many years.

➢ *User Interface Design*

The user interface (UI) is designed with principles of clarity, simplicity, and accessibility in mind. Key design considerations include:

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

- *Dashboard Interface*

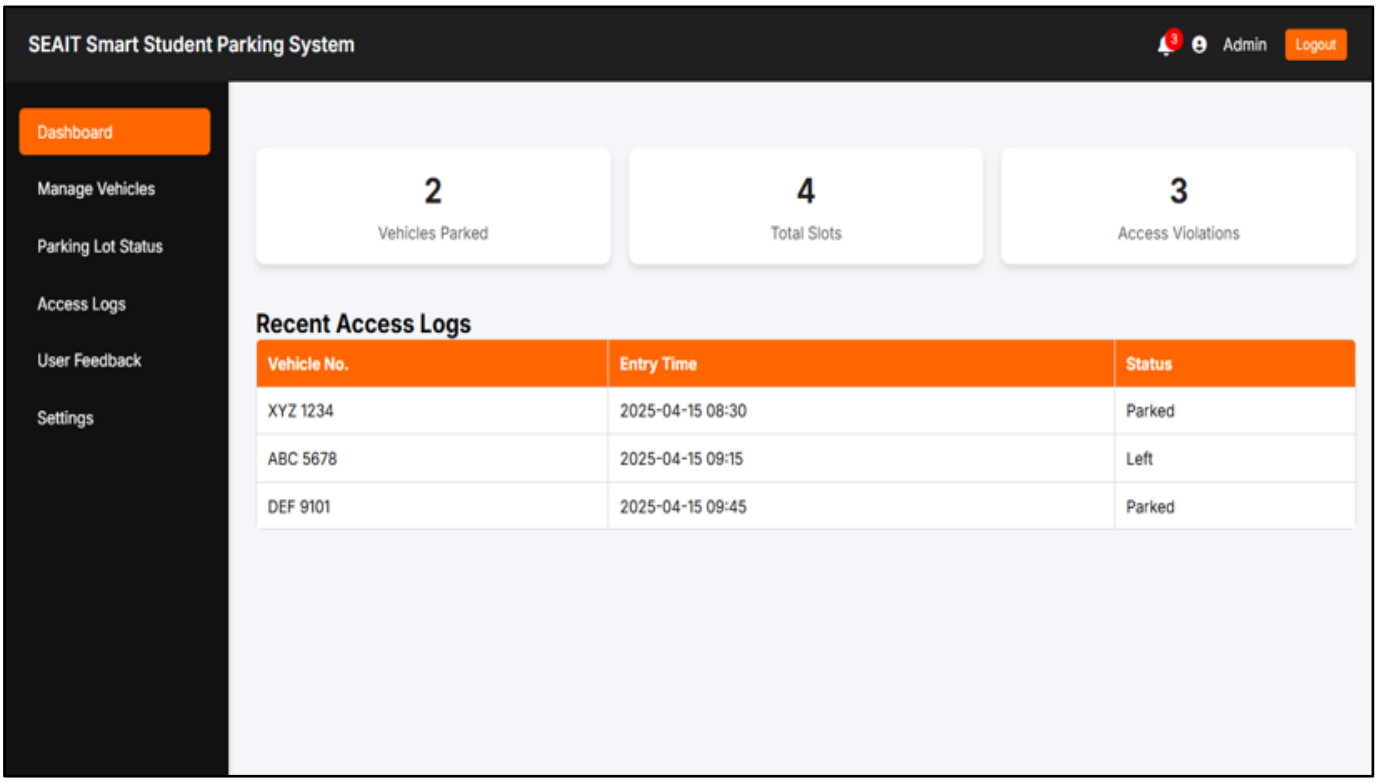

Fig 2 Dashboard for SEAIT Smart Student Parking System

The dashboard allows for quick decision making and effective system monitoring.

- *Manage Vehicles*

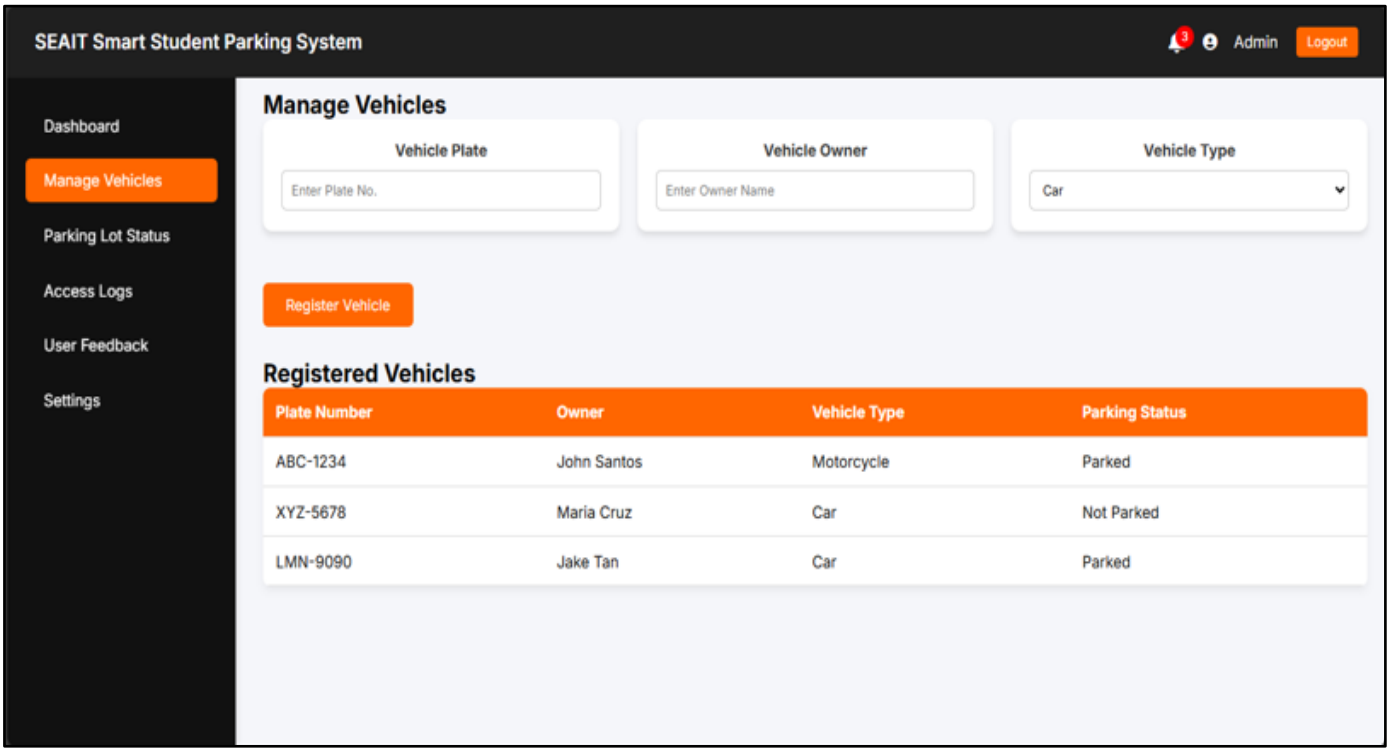

Fig 3 Manage Vehicles for SEAIT Smart Student Parking System

This feature ensures that only registered vehicles are allowed access to SEAIT's smart student parking facilities.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

- *Parking Status*

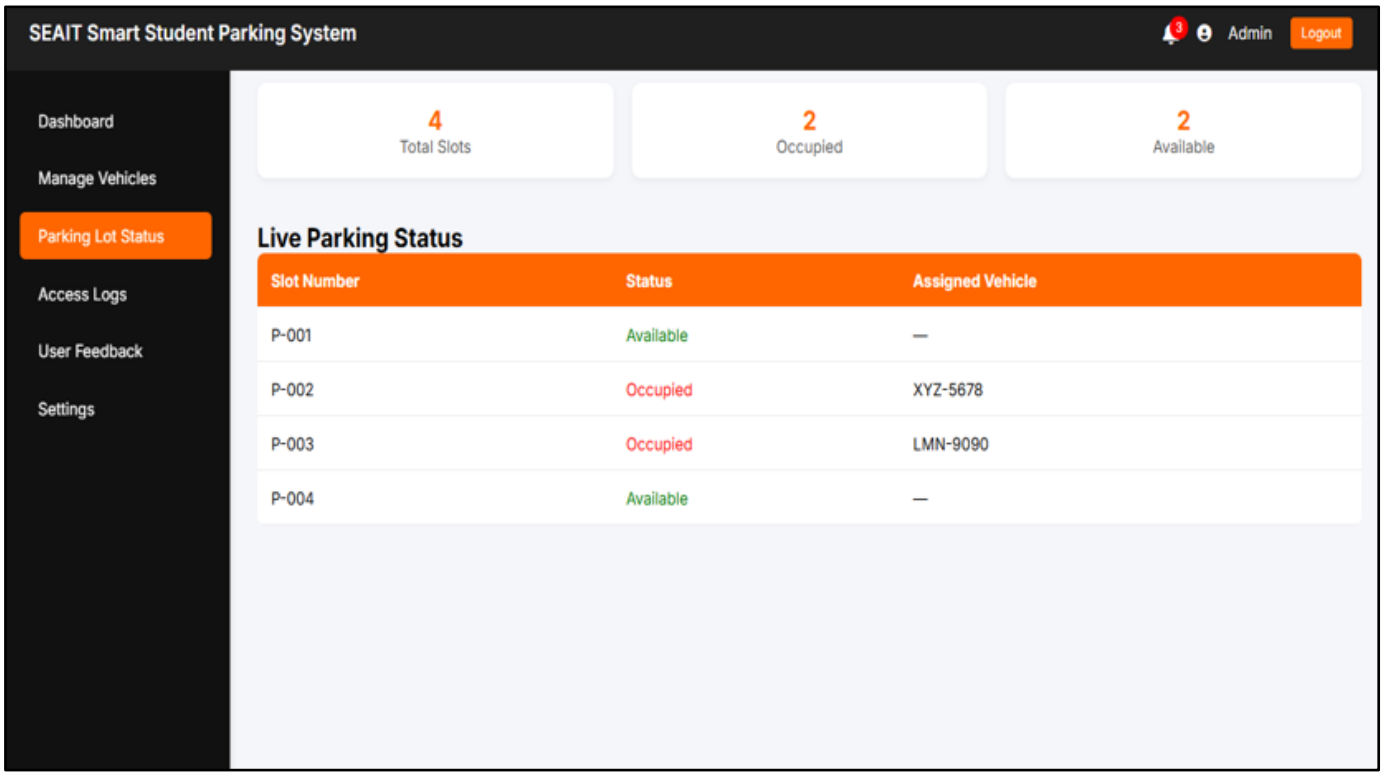

Fig 4 Parking Status for SEAIT Smart Student Parking System

The system may also include features like slot reservation, usage history, and estimated availability based on vehicle assigned.

- *Access Logs*

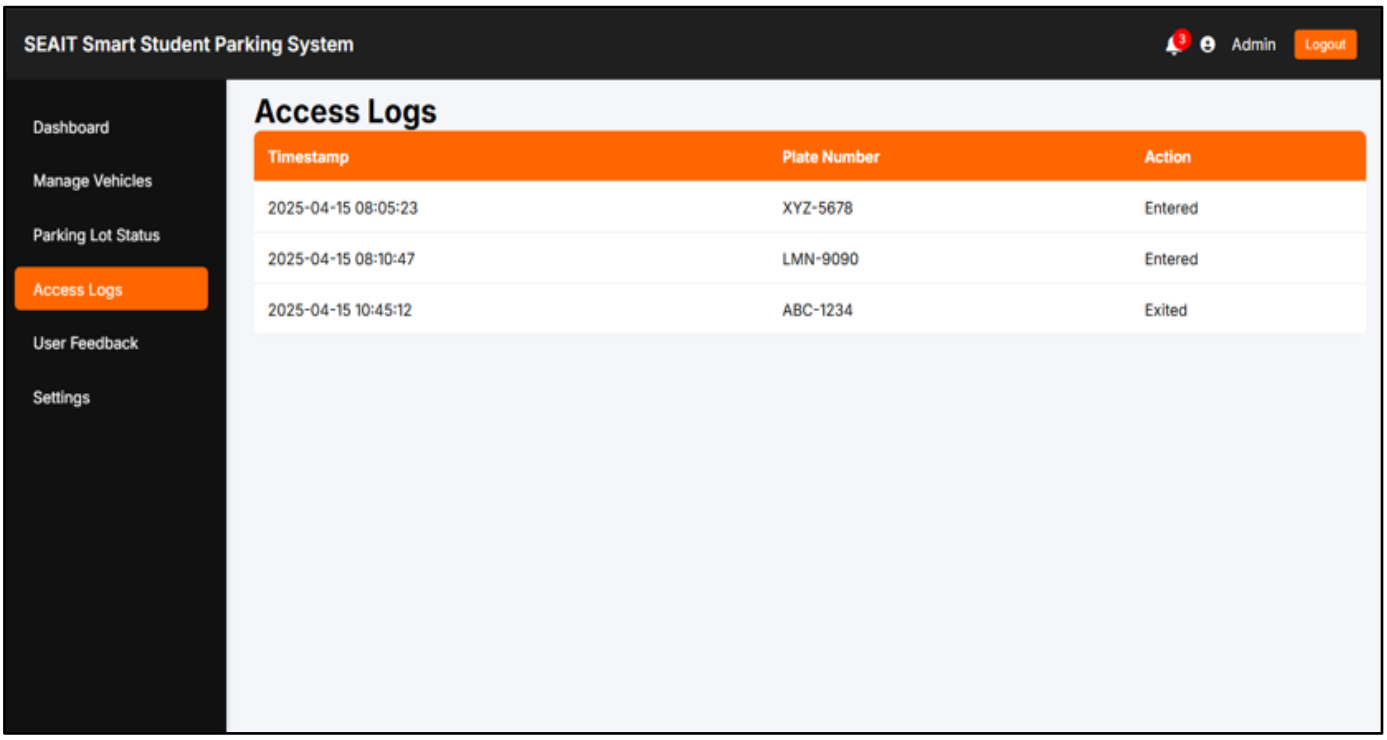

Fig 5 Access Logs for SEAIT Smart Student Parking System

It captures a detailed history of user interactions, vehicles info, including timestamp, attempted entries or exits events.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

- *User Feedback*

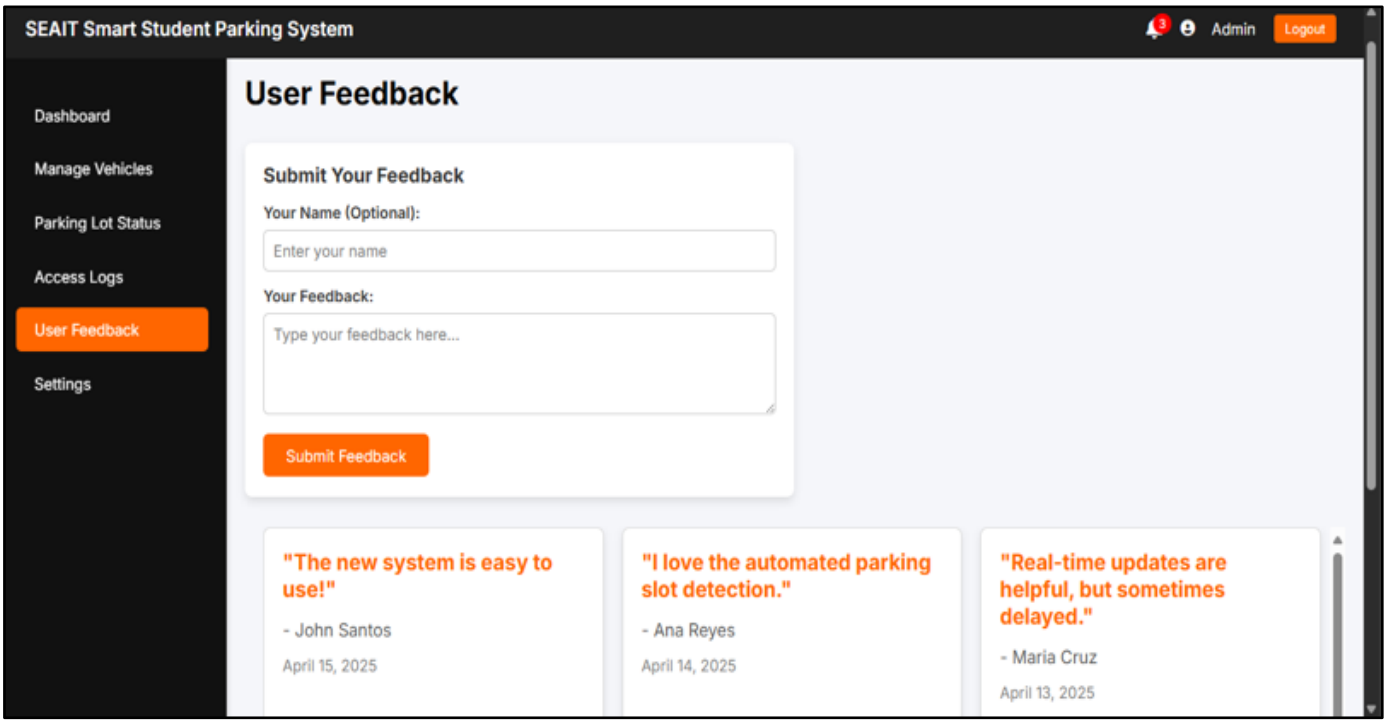

Fig 6 User Feedback for SEAIT Smart Student Parking System

The User Feedback module plays an important role in gathering insights from users.

- *Settings*

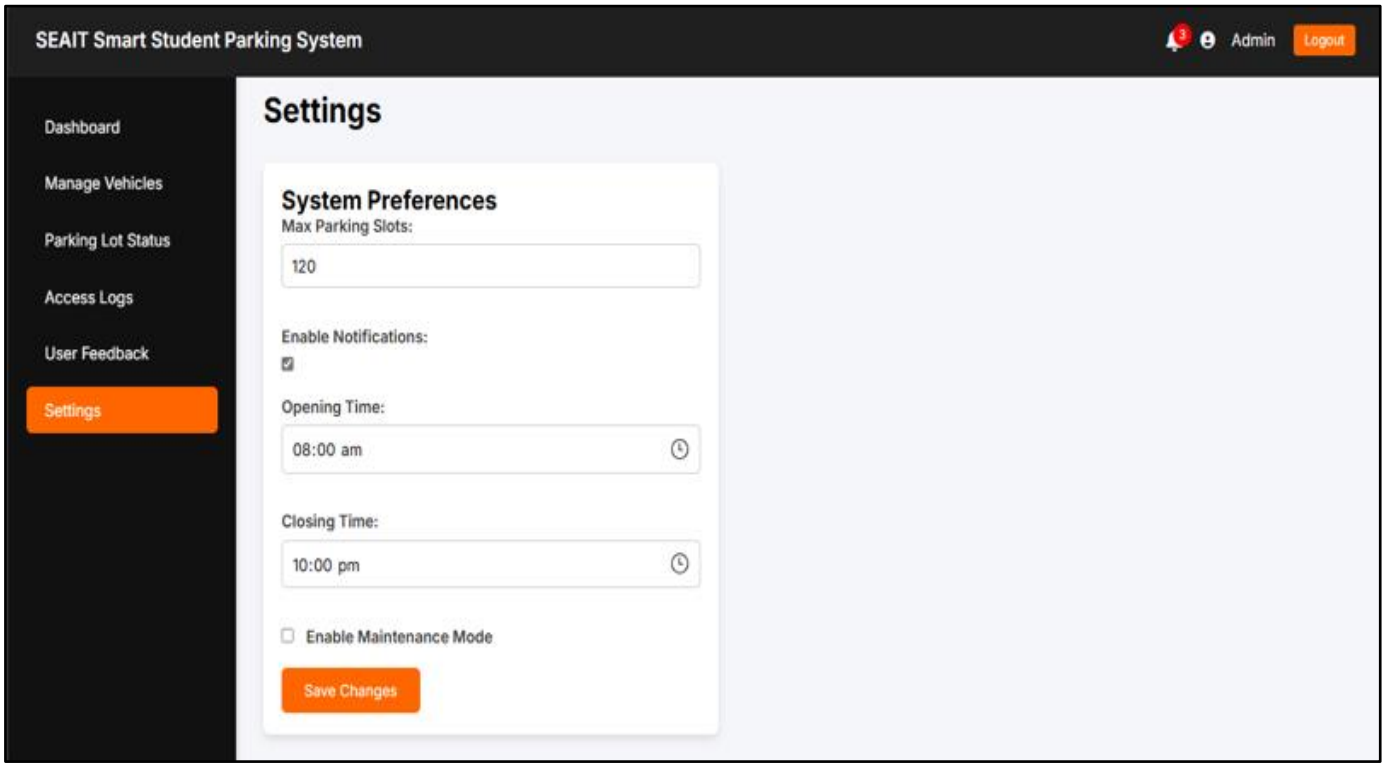

Fig 7 Settings for SEAIT Smart Student Parking System

Set default time, manage system notifications, and update location or zone configurations

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

V. EVALUATION AND RESULTS

➢ *Usability Testing*

The usability testing involved students primarily BSIT course from Years 1 to 4 (50 participants) evaluating the SEAIT Smart Parking System based on five predefined parameters: Ease of navigation, Accuracy, Real -Time Performance, Error Frequency, User Satisfaction.

It was conducted through structured questionnaires, where participants rated their experiences using a Likert scale (1 - Strongly Disagree to 5 - Strongly Agree).

The survey targes to identify strengths and weaknesses and explore opportunities for improvement. User feedback was collected via online surveys (Google Form). Data was aggregated and analyzed quantitatively to calculate percentages and averages across all parameters. Results were segmented by academic year to identify trends and variability in user responses.

➢ *Performance Metrics*

- **Average Rating for Each Parameter** Scores add up to calculate overall satisfaction per usability parameter.
- **Strong Agreement Percentage** A focus on the percentage of users who strongly agreed with each aspect of the system.
- **Consistency Across Years** Comparison of ratings among different year levels to measure consistency and reliability.

➢ *Comparative Analysis*

The SEAIT Smart Parking System was a standard against traditional and standard parking system used in academic institutions.

The system demonstrated several advantages:

- Recommendations of the system scores in "Would recommend the system to others." (94% agreed).
- Ease of navigation A total of is also 92% of participants agreed or strongly agreed on user-friend lines and experienced an ease of navigation.

➢ *Results and Findings*

- *High Satisfaction Rates:*

Key parameters like "Ease of navigation" (92% agreed) "Accuracy of parking slots availability" (88% agreed) received positive feedback.

- *Positive Impact:*

The system reduced negative time consuming effectively, as shown by the 46% of participants who says they saves time less than 5 minutes.

- *Year-Level:*

Year 2 participants had slightly lower respondent scores in most categories compared to Year 3 and Year 4. This suggested that familiarity and experience with the system might affect satisfaction.

- *Enhancing User Interface*

Despite a strong agreement quantitative and qualitative feedback highlighted the need for more enhanced user interfaces to also enchanced its user engagement.

Table 1 Table of the survey result for SEAIT Smart Student Parking System

Question	Mean (1-5)	SD	% Agreed (4+5)	% Neutral (3)
"The system's interface was easy to navigate."	4.16	0.54	92% (68%+24%)	8%
"Real-time parking updates were accurate/ reliable."	4.06	0.54	88% (70%+18%)	12%

This table shows users rated the interface as easy to figure out and real-time updates does follows through, with mean scores well above the midpoint. The low standard deviations indicate these positive experiences were widely shared among respondents.

Table 2 Table of the survey result for SEAIT Smart Student Parking System

Question	Mean Time Saved	SD	% <5 mins	% 5-10 mins	%>10 mins
"Time saved finding parking."	5.3 minutes	2.68	46%	52%	2%

This table shows the system provide efficient time-saving benefits, with many users reporting significantly decreased parking finding times. However, the remarkable standard deviation suggests experiences depends, likely on time of day or system load.

Table 3 Table of the survey result for SEAIT Smart Student Parking System

Year Level	Mean (1-5)	SD	% Agreed (4+5)	% Neutral (3)	Sample Size
4th year	4.13	0.65	92.3%	7.7%	39%
3rd year	3.67	N/A	66.7%	33.3%	3
2nd year	4.00	N/A	100%	0%	1

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

This table shows 4th year students shows notably higher satisfaction than their junior students, showing an adaptation learning curve where system familiarity shows to improve user experience. The sample sizes for lower years warrant cautious interpretation.

Table 4 Table of the survey result for SEAIT Smart Student Parking System

Question	Mean (1-5)	SD	% Agreed (4+5)
"Would you recommend this system?"	4.2	0.53	94%

This table shows an enormous part of user's obvious desire to recommend the system, with mean scores approaching the maximum value. The tight standard deviation confirms this endorsement.

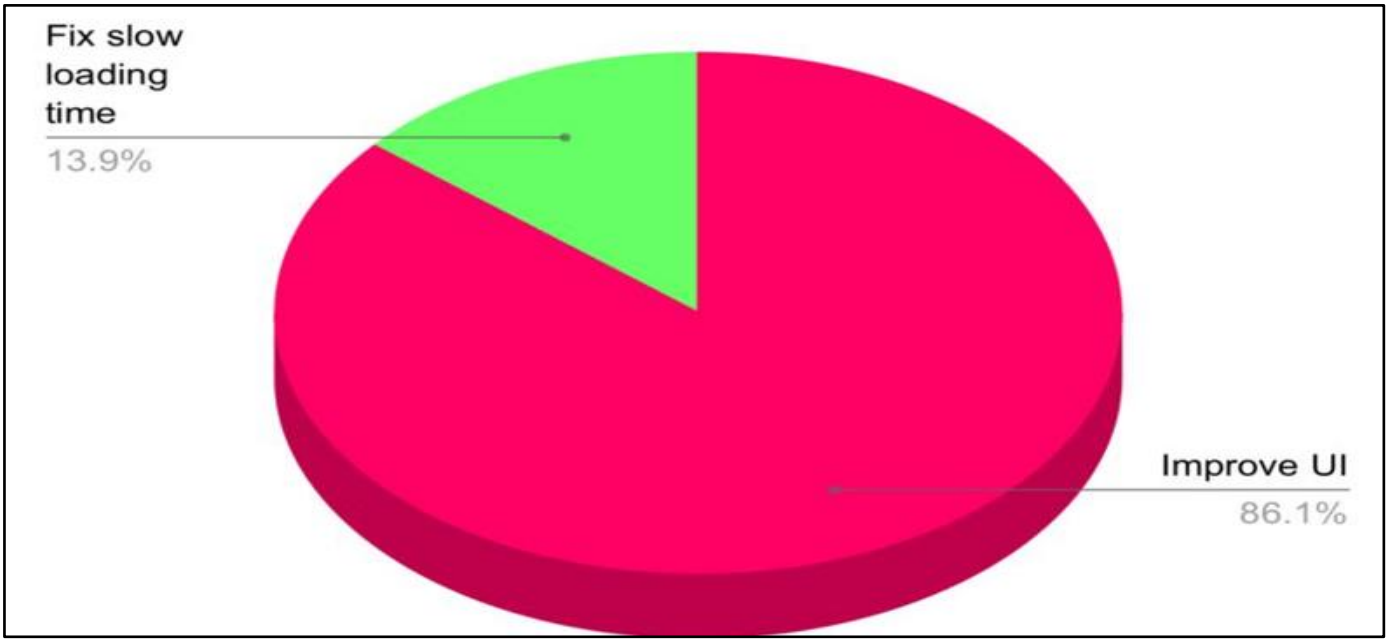

Fig 8 Figure of the survey results for SEAIT Smart Student Parking System

This figure shows users feedback dominantly preferred UI improvements over technical performance advancement, proposing that design improvements would fetch the most worthy user experience benefits.

VI. DISCUSSION

➢ *Interpretation of Findings*

The results demonstrate that the SEAIT Smart Parking System answered its research objectives successfully, showing important improvements in parking efficiency of users finding parking slots in at least 5 minutes with high usability grades for its navigation smoothness varying user experience across year levels 4th-year level. While the system reached its main objectives through its real-time tracking the technical efficiency received reports on slow loading times. These results highlight the demand for continuous UI improvements by the user's feedback, while preserving the system's improvements in campus parking operations and enhancing security measures effectively.

- *RQ1: How can a smart parking system enhance its effectiveness in vehicle management within campus?*

The smart parking system shows improvements in schools parking efficiently, most users rates markedly lessen their time finding available slots in comparison to traditional way. Real-time tracking feature function proved really effective in organizing space availability, though may some technical limitations have occurred during peak usage time that a bit affected on performance reliability.

- *RQ2: What technologies can be integrated to enhance the security of student parking?*

Implementing of automated monitoring features boosted on enhancing parking security by identifying irregular parking activity, these technological interventions decreased in relying on manual security reviews.

- *RQ3: How can real-time tracking and automated allocation improve the parking experience for students?*

Students empirically rated positive experiences on the system's live updates and automated designations, users showing particularly high satisfaction. However, new users suggested refinements on interfaces and include across all student levels.

- *RQ4: What are the key challenges in implementing a smart parking system in an educational institution?*

Primary fault line included slow loading time occasionally during high demand time, based on user feedback simplification of interface design is suggested. These findings show the importance of balancing technical improvements with considerations from user's experience.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

- *RQ5: In How can user feedback contribute to the refinement and effectiveness of the system?*

Suggestions from users gives a clear pathway for system improvements, specifically in interface enhancements and functionality tweaks. Consistent alignment between levels of user experience and satisfaction ratings made even clearer that the matter of ongoing feedback method for step-by-step development.

➢ *Contributions and Innovation*

This research is significant to the field of Human-Computer Interaction (HCI) in demonstrating the application of user-centered principles of design for effective solution to actual-campus issues, here parking management. The SEAIT Smart Student Parking System demonstrates how smart algorithms, user-friendly interfaces, and real-time data fusion can collaborate towards enhancing operational efficiency and user satisfaction. Some of the popular innovations include the dynamic space assignment, automated license plate recognition (ALPR), and feedback-based fine-tuning features—all created specifically for the unique needs of an academic setting. Moreover, its modular and scalable architecture facilitates future expansion and adaptation, which makes it a viable model for other schools and city parking lots looking to implement similar smart solutions.

➢ *Limitations and Future Work*

While the experiment achieved what it set out to accomplish, it does have limitations. The relatively small test population and restricted test period impose limitations on the generalizability of results, and a couple of aspects such as full-scale security software was only partially implementable due to hardware constraints. Furthermore, returns from first- and second-year students suggest that more natural user interfaces and guidance for onboarding are required. Future research should stress testing for longer durations over multiple semesters, expanding the breadth of the system's functionality in terms of applying predictive analytics, enhancing mobile support, and leveraging more accessible features to support larger user bases. Cross-campus comparison of system performance and scaling is potential area that can be explored with other institutions.

VII. CONCLUSION

➢ *Summary of Key Findings*

SEAIT Smart Student Parking System was conceived as a solution to mounting concerns of congestion, inefficiency, and security risks in the parking space on campus. Through the integration of advanced technologies such as dynamic space allocation, real-time tracking, and ALPR-based security features, the system efficiently addressed the primary research issues presented. Usability testing among 50 users showed high levels of satisfaction with navigation simplicity (86%) and accuracy of parking slot availability (70%). Another 46% of the users said they were successful in parking within less than five minutes, lending support to improving efficiency. The feedback facility was also good at pointing out areas for improvement, particularly the user interface and giving help to new users. Overall, the system was demonstrated to have high compliance with Human-Computer Interaction (HCI) principles, including user-centered design, system responsiveness, and usability engineering, confirming its position as a successful smart campus solution.

➢ *Final Remarks*

This research opportunity has shown that integrating innovative HCI techniques and intelligent system design has the potential to transform routine procedures such as parking on campus into streamlined, safe, and convenient experiences. This collaboration between technology, users, and design imperatives resulted in a solution that was both effective and innovative with scalability and future applicability for real-world uses beyond SEAIT. While limitations such as test scope and resource constraints were identified, lessons acquired create a good foundation for additional improvements and implementations. SEAIT Smart Student Parking System is an important step towards smart campus infrastructure, showing the significance of HCI in resolving everyday issues within educational settings.

ACKNOWLEDGMENT

We express our deepest gratitude to Almighty God for providing us with strength, wisdom, and perseverance throughout this research journey. His guidance and blessings have been our source of motivation and inspiration.

We extend our sincere appreciation to our institution, the South East Asian Institute of Technology, Inc., for equipping us with the knowledge and resources needed to accomplish this study. We are especially grateful to our President, Engr. John Paul S. Tamayo, MCESG, for his continuous support of academic excellence.

Our heartfelt gratitude goes to our Dean, Sir Reginald S. Prudente, MIT, and our subject adviser, Sir Cedie E. Gabriel, MIT, for their patience, mentorship, and invaluable insights. Their expertise and encouragement have significantly contributed to the development and success of this research.

We also express our sincere thanks to our panelists, Ms. Mary Joy M. Fernandez, MIT, LPT, Ms. Carol Kate M. Estacio, LPT, and Ms. Melissa T. Zolina, LPT, for their constructive criticism and expertise, which helped refine and strengthen our study. To our friends, we deeply appreciate your support, encouragement, and motivation, which made this journey more meaningful and fulfilling. Above all, we extend our deepest appreciation to our families for their unwavering love, patience, and support. Their sacrifices, encouragement, and belief in our capabilities have been the foundation of our strength and determination. This achievement would not have been possible without them.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25may641

REFERENCES

[1] Al-Ghuwainem, A., & Al-Khalifa, H. S. (2020). Smart parking systems: A comprehensive review. International Journal of Advanced Computer Science and Applications, 11(4), 300–309.

[2] Barth, M., & Shaheen, S. A. (2002). Smart parking and transportation demand management. Transportation Research Record: Journal of the Transportation Research Board, 1817(1), 89–96.

[3] Brown, L., & Wilson, J. (2019). Campus parking management: Security and access control challenges. Journal of Urban Technologies, 26(2), 125–138.

[4] Chen, L. (2019). AI-driven solutions in smart parking management systems. Journal of Transportation Technologies, 9(1), 11–23.

[5] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340.

[6] Garcia, M., & Torres, R. (2018). Smart mobility and the cloud: University campus applications. Journal of Smart and Sustainable Cities, 2(1), 45–52.

[7] Geng, Y., & Cassandras, C. G. (2012). A new "smart parking" system infrastructure and implementation. Procedia - Social and Behavioral Sciences, 54, 1278–1287.

[8] Geng, Y., & Cassandras, C. G. (2013). A new smart parking system based on optimal resource allocation and reservations. IEEE Transactions on Intelligent Transportation Systems, 14(3), 1129–1139.

[9] Hassan, M. F., Rahman, M. A., & Islam, M. M. (2020). Review on IoT-based smart parking system for smart cities. International Journal of Computer Applications, 975, 8887.

[10] Idris, M. Y. I., Leng, Y. Y., Tamil, E. M., Noor, N. M., & Razak, Z. (2009). Car park system: A review of smart parking system and its technology. Information Technology Journal, 8(2), 101–113.

[11] Kumar, P., & Singh, R. (2021). Smart parking systems: Opportunities and challenges in implementation. International Journal of Engineering Research and Applications, 11(7), 55–62.

[12] Lee, H., Park, C., & Lee, J. (2022). Cloud-based management system for university smart parking. Journal of Intelligent & Robotic Systems, 104(4), 1–13.

[13] Machado, L. S., Ferreira, L. M., & Cunha, J. R. (2018). Environmental benefits of intelligent parking systems. Journal of Cleaner Production, 172, 3044–3056.

[14] Nguyen, T., Do, H., & Tran, L. (2020). User-friendly smart parking app interface: An HCI perspective. Journal of Human-Centered Technology, 6(3), 188–197.

[15] Nielsen, J. (1994). Usability engineering. Academic Press.

[16] Norman, D. A. (1988). The design of everyday things. Basic Books.

[17] Shoup, D. C. (2011). The high cost of free parking. American Planning Association.

[18] Shoup, D. (2017). Parking and the city. Routledge.

[19] Zheng, Y., He, S., & Zhang, X. (2021). IoT and AI integration in urban smart parking systems. Sensors, 21(3), 701.