Hanap: UPLB Class Venue Finder Mobile Application

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***Abstract*—This study addresses the persistent challenges faced by University of the Philippines Los Baños (UPLB) constituents in navigating campus spaces, particularly in locating class venues. The Hanap application is a mobile application designed to help students alleviate these wayfinding challenges. This study aimed to develop, implement, and evaluate the application in terms of its usability and capability to aid users in campus navigation to a chosen destination. Testing involved simulations by admin and non-admin users, with results showing a mean System Usability Scale (SUS) score of 85.58, indicating excellent usability. This study contributes to a more positive academic environment by reducing stress and enhancing navigation for UPLB constituents.**

***Index Terms*—wayfinding, campus navigation**

I. Introduction

A. Background of the Study

The challenges faced in navigating the University of the Philippines Los Baños (UPLB) campus are not unique; similar issues have been observed in various complex structures such as schools, malls, hospitals, and airports. Wayfinding apps and tools have proven to be instrumental in easing navigation within such environments [2]. Wayfinding, defined as the user's ability to navigate to a chosen destination and recognize it when in proximity [1], is particularly crucial in academic institutions like UPLB.

Despite the proactive measures taken by academic institutions, including the placement of campus maps and the organization of tours, UPLB students still encounter difficulties in finding details and locations of their classrooms. The existing campus resources, such as maps and organized tours [3] [4], have not completely alleviated the challenges faced by students. A sensing survey involving 30 respondents revealed a mean rating of 8.03 out of 10, indicating a significant challenge in locating class venues.

The primary cause of this difficulty stems from the absence of detailed and organized databases within the UPLB campus. This results in inconvenience, such as late arrivals, frustration, and stress, particularly in unfamiliar room venues. Despite resorting to common avenues for assistance, such as group chats, social media platforms, and campus interactions, students often encounter delays and inaccuracies in the information received.

The existing literature, as discussed by [5], reinforces the significance of efficient wayfinding on campuses, with a specific emphasis on locating class venues. The challenges identified by UPLB students align with the broader consensus that easy and efficient wayfinding is crucial for avoiding tardiness, anxiety, and stress caused by getting lost on campuses.

In response to these challenges, there is a pressing need for a dedicated application tailored to assist UPLB constituents in locating their respective class venues on the campus. Such an application should prioritize user-centric design to effectively address the current needs and challenges within the academic environment.

B. Research Question

1) How do UPLB constituents perceive the usability of the mobile application that provides details about the locations of the rooms around the campus?
2) How can an application effectively address the challenges faced by UPLB students in locating the details and venues of their rooms within the campus, considering the limitations of existing approaches and technologies?
3) What features and functionalities should be prioritized in the development of a user-centric, scalable application that caters to the unique needs and challenges of the UPLB campus, ensuring immediate and accurate feedback for room finding?

C. Objective of the Study

The study aims to develop a mobile application that addresses the challenges faced by UPLB constituents in locating their class venues within the UPLB Campus. Specifically, the study aims to achieve the following goals:

1) Develop an application that gives instructions on navigating to a room location;
2) Provide basic information of rooms and buildings that will help in wayfinding;
3) Provide CRUD features for managing room and building details;

D. Significance of the Study

UPLB constituents consistently struggle with the challenge of locating class venues, especially during registration periods and the initial week of classes. The surge in social media inquiries across online platforms further highlights the need for an improved wayfinding system at UPLB. Currently, relying on group chats and social media is time-consuming and does not guarantee feedback. Moreover, the lack of information regarding class venues often results in delays, tardiness, and heightened stress levels for students.

In response, creating a dedicated wayfinding application for the UPLB Campus can help constituents in their wayfinding experience. This application would empower them with

information that can significantly reduce the time and effort invested in navigating the campus. By mitigating stress, minimizing delays, and enhancing overall wayfinding experiences, the proposed application contributes to a more efficient and positive academic environment for UPLB students and faculty.

E. Scope and Limitations

The study aims to develop an application tailored to the needs of UPLB constituents, providing information about rooms and facilitating wayfinding to the selected locations. The scope is limited to rooms detailed in the Student Academic Information System, specifically on those required by students. Additionally, the research will assess the application's performance in assisting the target users with campus navigation.

The research will be conducted at the Institute of Computer Science, housed within the College of Arts and Sciences at the University of the Philippines Los Baños in Laguna. The study is set to commence in November 2023 and will run until May 2024.

II. Review of Related Literature

Numerous studies have delved into the development of mechanisms for wayfinding. Wayfinding is integral to users' productivity and decision-making, particularly in large spaces like school campuses, malls, and hospitals [6]. Wayfinding tools contribute to more efficient and prompt navigation. However, existing literature predominantly concentrates on the creation of tools for improved indoor wayfinding, often neglecting the critical aspect of user acceptability.

Wayfinding in different environments presents unique challenges. For instance, navigating urban environments involves distinct challenges characterized by the intricacies of city navigation. The complexities of urban areas demand specialized wayfinding strategies, such as the use of signages and landmarks to guide individuals through the overwhelming buildings and streets [7].

Indoor navigation in healthcare facilities encounters challenges due to the complex layout of healthcare environments. [8] discussed that ineffective navigation within healthcare facilities can lead to issues such as late arrivals for inpatient and outpatient care, adding stress for both patients and medical staff.

Several studies have already integrated technologies into the development of wayfinding tools to enhance navigation experiences for users. For instance, [9] developed a hybrid mobile application supporting both indoor and outdoor navigation. The technology utilized RFID, ultrasonic-based sensors, radio signals, and QR codes. However, the authors focused solely on creating the application for one specific operating system, iOS, lacking further development for compatibility across various platforms and devices.

Another study involves integrating Near-Field Communication for wayfinding. [10] successfully implemented this integration in their Jaguar application, facilitating indoor navigation. While the study suggests the potential of NFC and KML in indoor navigation, it lacks comprehensive testing to assess usability and functionality from the user's perspective.

Other technologies, such as WiFi, Bluetooth, and Geomagnetic technologies, have been integrated into wayfinding [11]. [11] provided a review of the utilization of these technologies and their incorporation into existing methodologies like machine learning and deep learning. A notable gap identified in this literature is the absence of development and implementation of these technologies on varying hardware.

This study aims to develop and test a comprehensive wayfinding application for the University of the Philippines Los Baños (UPLB) Campus. The app will assist users in locating class venues which can reduce stress and tardiness. Moreover, it aims to create a reliable tool for the UPLB community to enhance navigation within the campus.

III. Materials and Methods

A. Development Tools

The application is a mobile application developed for both admins and non-admin users. It was developed using Flutter and utilizes Firebase for the backend and database. The system was developed on a computer with the following specifications:

- 11^{th} Gen Intel(R) Core(TM) i7-1165G7 @ 2.80GHz 2.80 GHz
- 8.00 GB RAM
- 500 GB SSD
- 64-bit operating system, x64-based processor
- Windows 10

B. Process Model

The application is designed to incorporate features aligned with the articulated objectives.

1) The application features an Admin Interface for managerial control, allowing administrators to add, edit, and remove buildings/rooms. They address user issues and ensure timely map updates. The Admin Interface also allows users to manage requests for admin access.
2) TThe Non-Admin Interface aids students and faculty in efficient wayfinding, offering access to information, bookmarking, and offline access. Users can actively report issues for continuous improvement. Non-admins may also contribute room/building information to the system.

The design caters to both administrative oversight and user-friendly navigation at the University of the Philippines Los Baños (UPLB) Campus.

C. Database Design

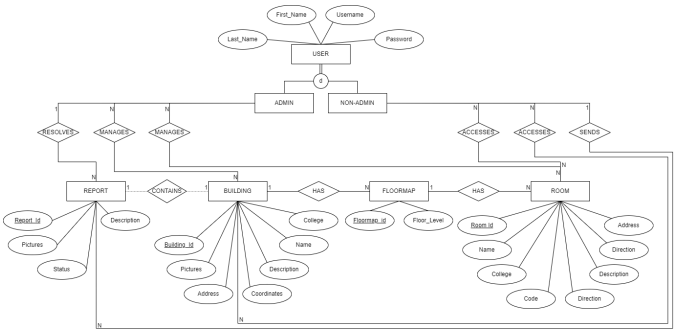

Fig. 1. Entity-Relationship Diagram

D. User Flow and Use Case

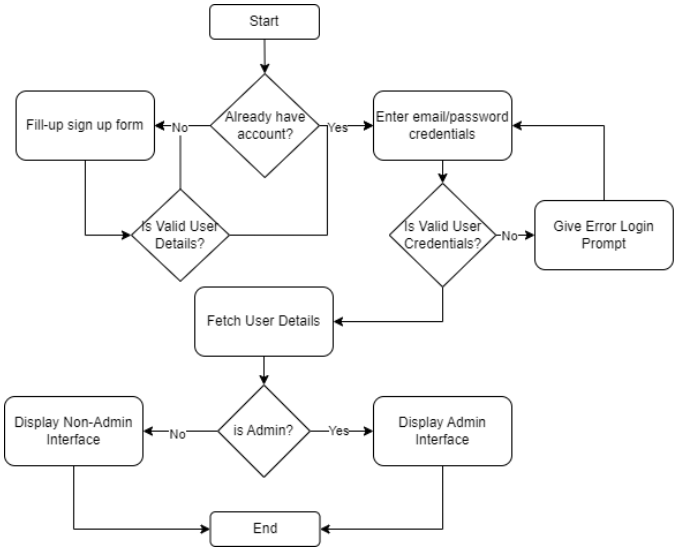

Fig. 2. User Flow for Account Log In

Figure 1 illustrates the Entity-Relationship Diagram (ERD) of the application, which utilizes Firebase for handling Create, Read, Update, and Delete (CRUD) functionalities. Firebase Authentication is employed for user authentication, while Firebase Storage manages the storage of images. The database comprises four main collections: users, reports, rooms, and buildings. Additionally, the application maintains logs to track changes within the system.

The *User* entities represent individuals who can be either administrators or non-admin users. These users are responsible for performing and managing data operations to ensure the accuracy and integrity of the system's data.

The *Building* entities contain information relevant to the rooms they host. These entities are managed by users and provide essential data to aid in wayfinding within the application.

The *Room* entities represent individual rooms where classes are conducted. Users access and manage these entities, which contain navigation information to assist users in locating specific rooms.

The *Report* entities document problems encountered by users. Users can submit and manage reports to maintain data accuracy and correctness within the system.

Logs record all changes made within the application, enabling administrators to efficiently track and review modifications.

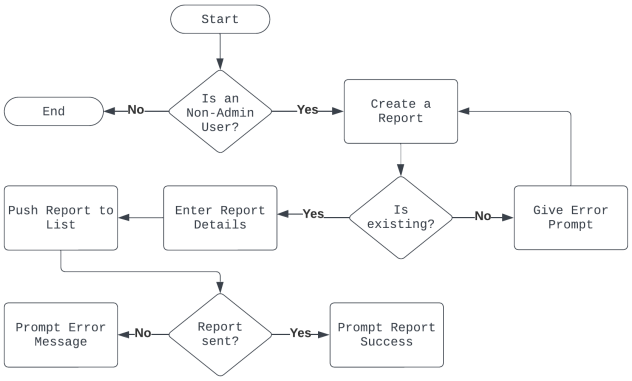

Fig. 3. User Flow for Sending a Report

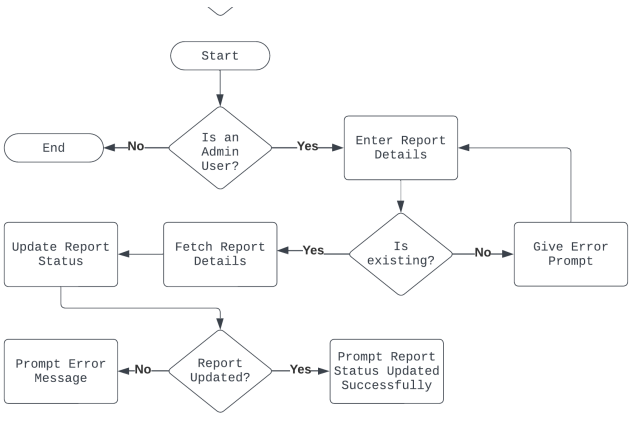

Fig. 4. User Flow for Updating Report Status

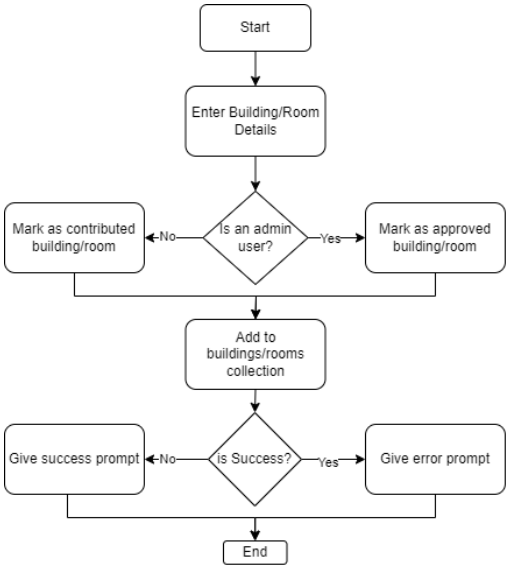

Fig. 5. User Flow for Adding/Contributing Building/Room

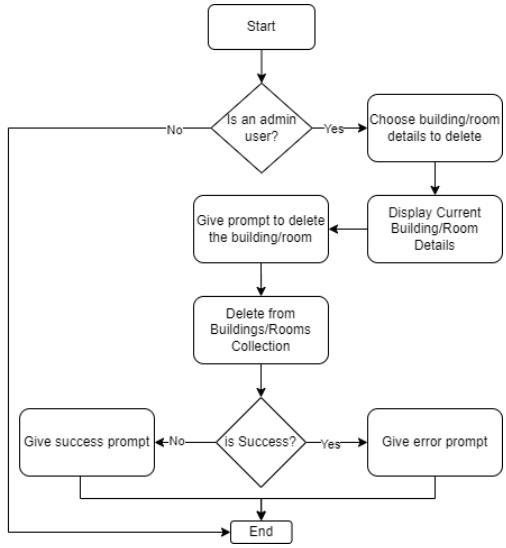

Fig. 8. User Flow for Deleting a Building/Room

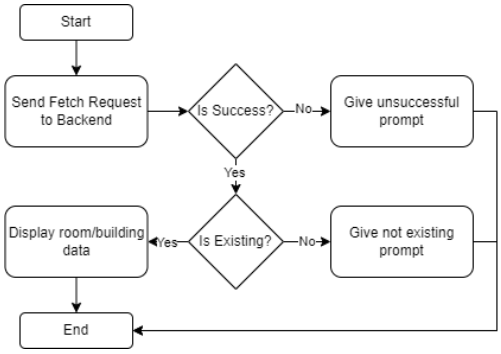

Fig. 6. User Flow for Fetching/Viewing Building/Room Details

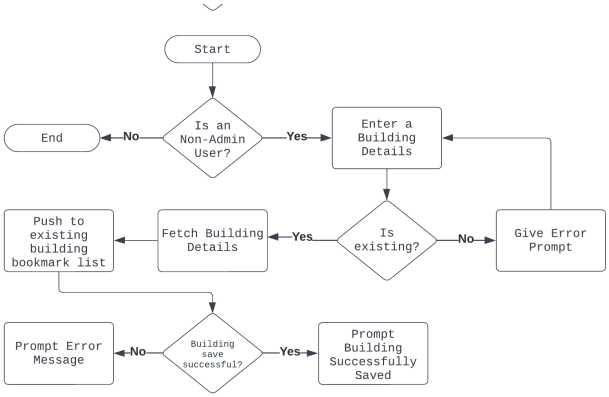

Fig. 9. User Flow for Saving or Bookmarking a Building

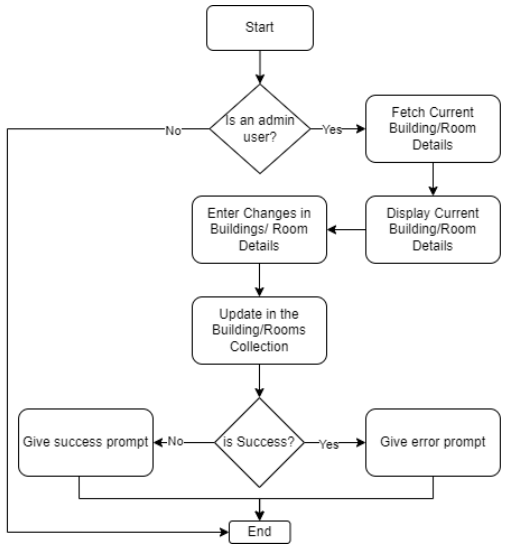

Fig. 7. User Flow for Updating Building/Room Details

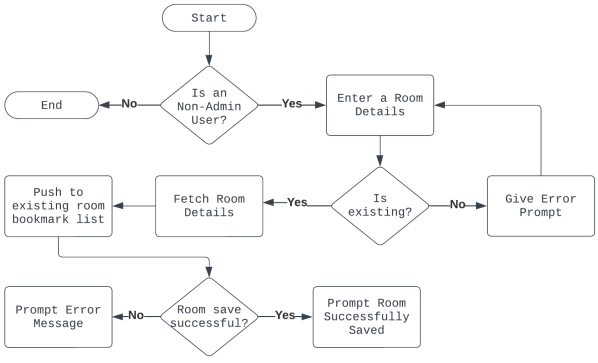

Fig. 10. User Flow for Saving or Bookmarking a Room

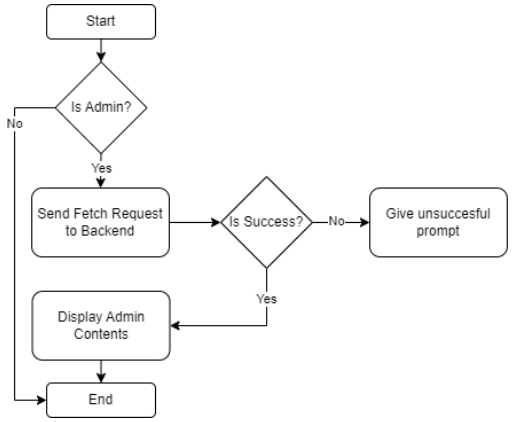

Fig. 11. User Flow for Fetching Users

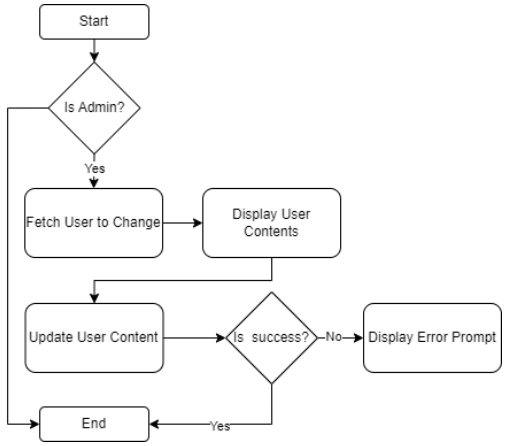

Fig. 12. User Flow for Updating Users

Figures 2 through 12 illustrate the various flows of user data within the application corresponding to different user actions. These flowcharts serve as visual guides to comprehensively understand the data processes from start to end.

Figure 13 displays the various user types and capabilities of each user in the application.

Non-admin users primarily access the application for wayfinding and navigation purposes. They help to the maintenance of the system by reporting any encountered problems. Additionally, non-admin users can assist in enriching the database by contributing room and building data to the system.

Admin users primarily manage the system by creating, reading, editing, and deleting room and building data. They also approve or reject contributed data to ensure the system's correctness and accuracy. Admin users aid in maintaining the system by evaluating and resolving reported problems. Additionally, they contribute to enriching the database by adding room and building data to the system.

Superadmins possess all the capabilities of admin users but with additional responsibilities. They provide an extra layer of security by approving or rejecting system admin access requests.

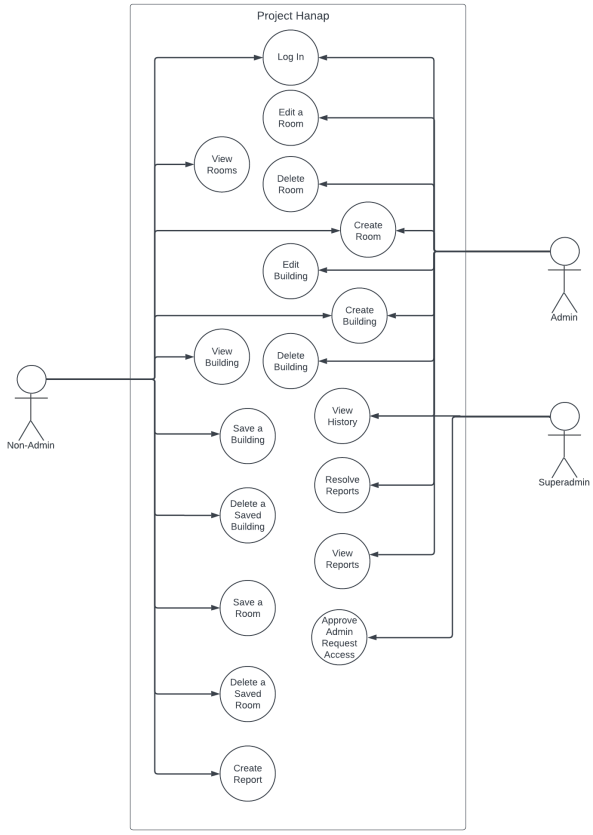

Fig. 13. Use Case Diagram

E. Device Features

Users have different privileges according to their roles within the system. The following section displays the various screens of the application and their corresponding features based on user type:

1) User Authentication: This feature validates users by allowing access to the system only if they have previously registered. Unregistered users must sign up before gaining access. This feature also determines whether to display the non-admin interface or the admin interface, based on the user's credentials.

2) Map Feature: This feature displays the user's current location and the approved buildings in the area. This functionality assists users in determining their position relative to a selected building. This feature is accessible to all user types.

3) Search and Explore Feature: This feature enables users to search for a selected location. It also allows users to refine their searches for faster and more efficient location selection.

4) Save Feature: This feature permits non-admin users to bookmark specific locations, enhancing their user experience by facilitating easier retrieval of saved locations for future reference.

5) Contribute/Add Feature: This feature allows users to supplement data within the system. However, data contributed by non-administrative users is flagged as "under evaluation" and requires approval. This protocol maintains the system

accuracy and correctness through careful assessment before approval.

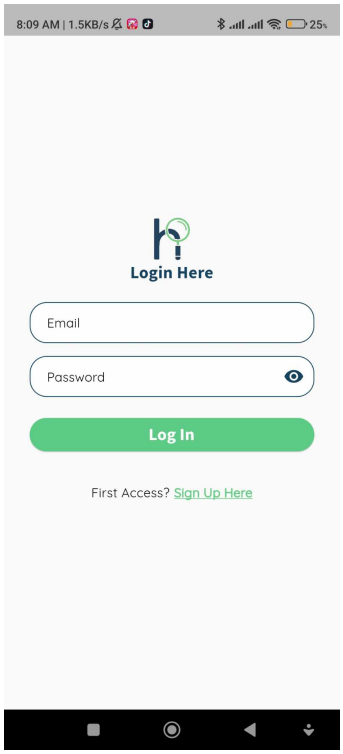

Fig. 14. Login Screen

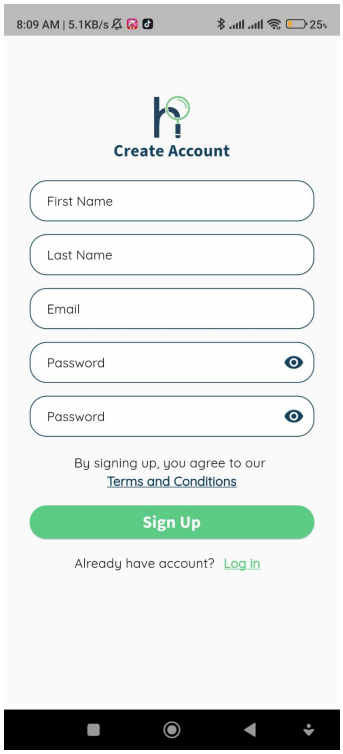

Fig. 15. Create Account Screen

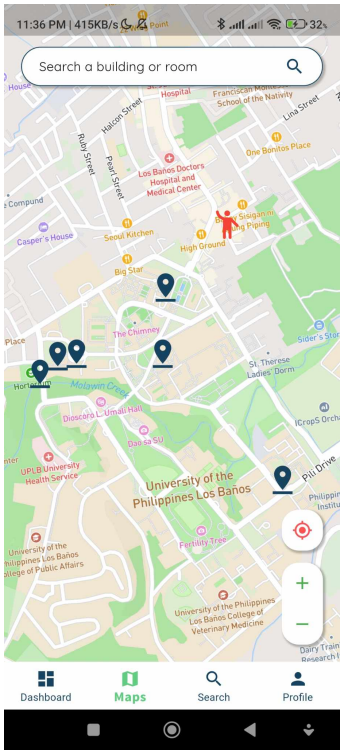

Fig. 16. Maps Screen

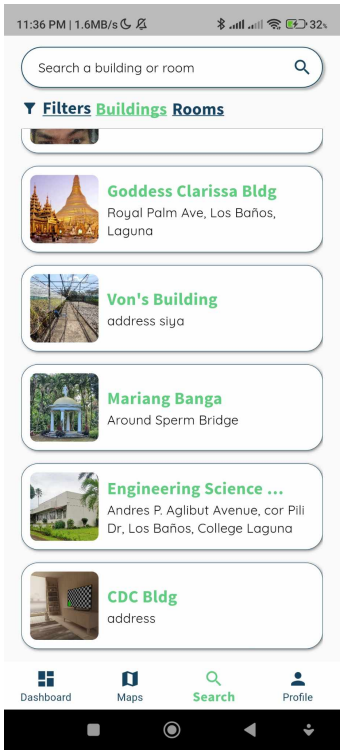

Fig. 17. Search Screen

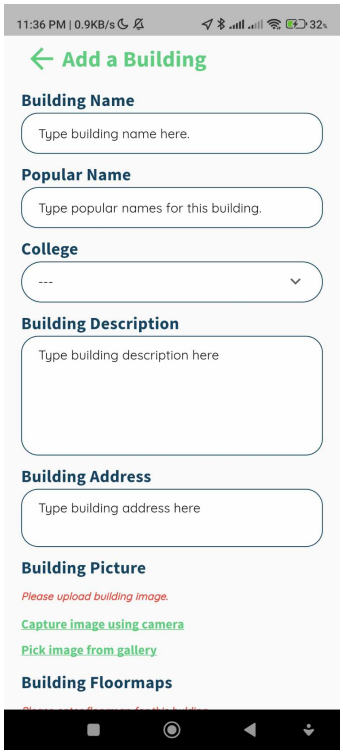

Fig. 18. Add or Contribute Screen

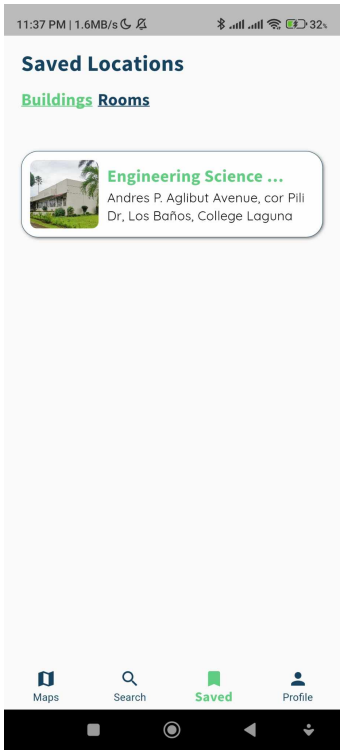

Fig. 19. Saved or Bookmark Screen

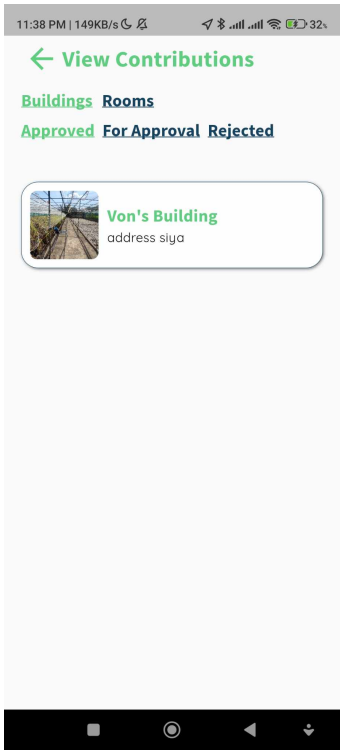

Fig. 20. View Contributions Screen

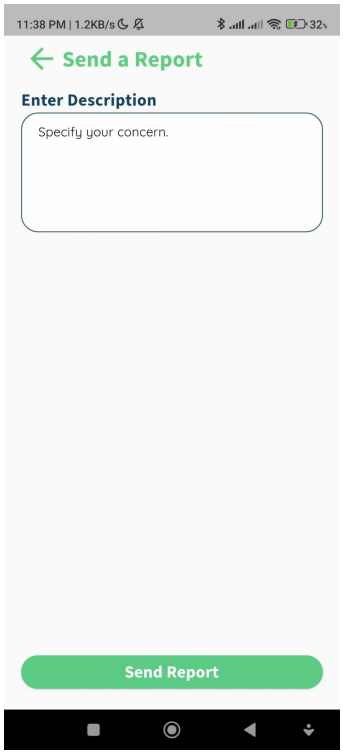

Fig. 21. Send Report Screen

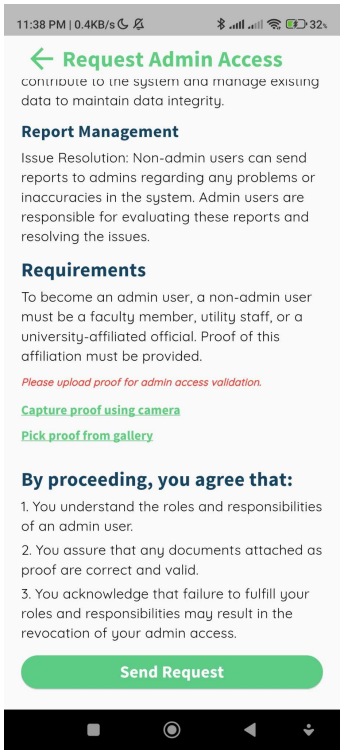

Fig. 22. Request Admin Access Screen

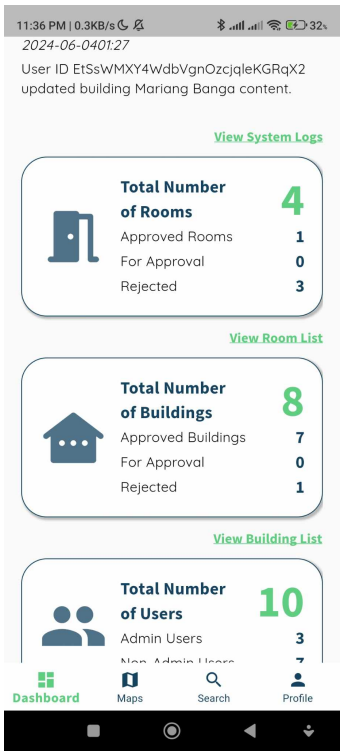

Fig. 23. Admin Dashboard Screen

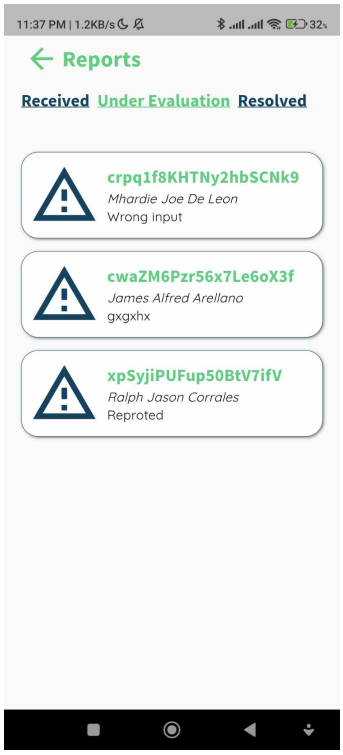

Fig. 24. View Reports Screen

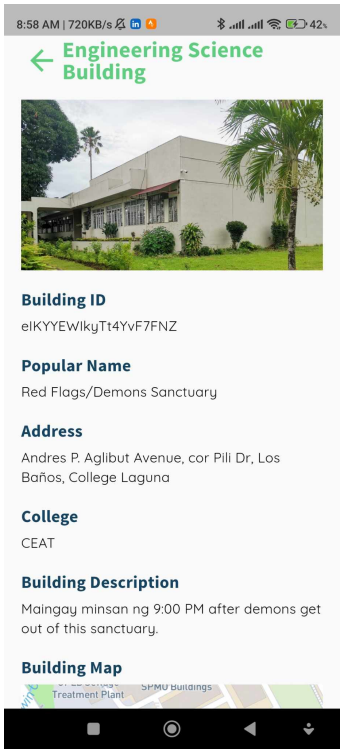

Fig. 25. View Details Screen

6) Send Report: This feature enables users to notify administrators of any encountered problems within the system. Reports are received, evaluated, and resolved by administra-

tors. This non-administrative to administrative communication channel facilitates system maintenance across all users.

7) Admin Dashboard: This provides admin users with access to various management features within the system. It allows users to navigate to room, building, user, and report management functionalities.

8) System Logs: This provides admin users with a comprehensive overview of all changes made within the system. This functionality is implemented to enable admin users to track alterations and maintain a clear record of system modifications.

F. User Evaluation

1) Pre-Survey: A survey was conducted among 30 UPLB students to identify their pain points and challenges in wayfinding to their respective class venues. The survey utilized a ten-point scale, with 10 representing the highest level of challenge and 1 the lowest. Additionally, the survey included questions aimed at describing these challenges and identifying the students' sources of wayfinding information. This survey was conducted to inform the development of the application and ensure it better meets the needs of UPLB constituents.

2) Post-Survey: Before the actual testing, mock-up data was first uploaded into the system. Thirty UPLB constituents were then invited to participate in the testing. Among them, 10 acted as admin users while the remaining 20 acted as non-admin users. Additionally, 2 of the admin users were given the opportunity to explore Superadmin access.

The participants were tasked with exploring and testing the various features of the application. Initially, they performed user authentication by creating accounts and logging into the system.

Non-admin users were instructed to view, contribute, bookmark, and search for building and room details. They were also asked to send reports for any problems encountered and to request admin access.Admin users were tasked with managing the system by editing, deleting, and adding data. They were also responsible for approving or rejecting contributions from non-admin users and addressing and resolving reports submitted by non-admin users. All actions performed were recorded in the system logs. Out of the admin users, 2 were granted Superadmin access to manage admin access requests, and they were asked to reject or accept these requests.

After testing the application, participants were asked to complete a survey using the System Usability Scale (SUS), which consists of 10 questions designed to gauge their agreement or disagreement with various aspects of the application. This testing is crucial to determine if the system successfully meets its objectives.

3) Data Analysis: The pre-survey responses were evaluated and analyzed the need for the application and to identify user expectations for a wayfinding solution.

Post-survey results were used to compute the System Usability Scale (SUS) scores. Each respondent's answers were assigned points corresponding to their responses: 1 for Strongly Disagree, 2 for Disagree, 3 for Neutral, 4 for Agree, and 5 for Strongly Agree. The SUS score for each respondent was calculated by summing the points for the odd-numbered and even-numbered questions separately. The sum of the odd-numbered questions was subtracted to 5, while the sum of the even-numbered questions was subtracted from 25. The resulting values were then added together and multiplied by 2.5. [13]

The mean SUS score for all 30 respondents was calculated to determine the overall usability score of the application. A mean score of 68 or above indicates that the application is usable and effective in achieving its goals.

IV. Results and Discussions

A. Pre-Survey

UPLB students were asked to complete a pre-survey questionnaire to assess the difficulty of wayfinding on campus. Table 1 displays the results for the question, "How challenging is it to locate classrooms on the UPLB campus?" Respondents rated the difficulty on a scale of 1 to 10, with 1 indicating the lowest difficulty and 10 indicating the highest difficulty. The results showed that UPLB students had a mean rating of 8.03 out of 10, indicating a high level of difficulty in finding their classrooms. Students described their experience as time-consuming and frustrating, often resulting in lateness to class.

TABLE I
Pre-Survey Ratings for Difficulty in Campus Wayfinding

Respondents.	Rating
R1	9
R2	8
R3	7
R4	10
R5	9
R6	8
R7	7
R8	7
R9	5
R10	5
R11	6
R12	8
R13	8
R14	10
R15	10
R16	10
R17	9
R18	7
R19	9
R20	8
R21	8
R22	9
R23	7
R24	7
R25	8
R26	9
R27	9
R28	8
R29	8
R30	8
Mean Difficulty Rating: 8.03	

The pre-survey also revealed that UPLB students primarily use social media pages, such as UPLB P2P and UPLB Freedom Wall, as well as group chats to ask for directions to their respective room locations on campus. Other sources

of information include asking around and relying on word of mouth. However, students reported that these methods often do not guarantee timely feedback and reliability. This difficulty arises from the lack of detailed and organized databases, resulting in late arrivals, frustration, and stress, especially in unfamiliar room venues.

These responses indicate a significant challenge in locating class venues, underscoring the need for an application designed to address these wayfinding difficulties.

B. Post-Survey

After testing the different functionalities of the application, participants were asked to complete a post-testing System Usability Scale (SUS) questionnaire. This survey consisted of 10 questions, each with five response options: Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. The following are the questions asked to both the admin and non-admin users:

1) I think that I would like to use this system.
2) I found the system unnecessarily complex.
3) I thought the system was easy to use.
4) I think that I would need the support of a technical person to be able to use this system.
5) I found the various functions in this system were well integrated.
6) I thought there was too much inconsistency in this system.
7) I would imagine that most people would learn to use this app very quickly.
8) I found the system very difficult to use.
9) I felt very confident using the system.
10) I needed to learn a lot of things before I could get going with this system.

Table 2 displays the respondents' SUS scores for the Hanap application. The results show that the application had a mean SUS score of 85.58. This indicates that users find the application to have excellent usability in achieving its goal of providing wayfinding capabilities to UPLB students and constituents.

As part of the post-survey questionnaire, respondents were asked about their thoughts and experience in the application. They were also asked to provide recommendations for further development of the application. It showed that they find the application, functional and friendly to users. Moreover, they indeed find the application helpful for wayfinding. Few of their recommendations for the future development includes allowing users to have a customization capabilities and making the application available for all platforms.

TABLE II
SUS INDIVIDUAL SURVEY RESPONSES FOR HANAP

Res.	S1	S2	S3	S4	S5	s6	s7	s8	S9	S10	SUS
R1	5	2	5	1	4	1	5	1	4	1	92.5
R2	5	2	5	2	4	2	5	2	5	2	85
R3	5	1	5	2	5	1	5	1	4	1	85
R4	4	2	5	2	4	1	4	1	5	2	85
R5	5	1	5	1	4	1	4	1	5	1	100
R6	5	1	4	1	4	1	5	1	4	1	92.5
R7	2	3	4	2	4	2	5	2	3	3	67.5
R8	3	2	5	1	4	1	5	1	5	1	90
R9	3	2	4	2	4	3	5	1	5	2	77.4
R10	5	2	5	3	5	2	5	2	4	3	80
R11	4	2	5	1	4	1	4	1	4	2	85
R12	4	3	4	2	4	2	4	2	4	2	70
R13	5	1	5	1	4	3	5	1	5	1	92.5
R14	4	2	4	1	4	2	4	2	3	3	75
R15	5	1	5	1	4	2	5	1	5	1	97.5
R16	5	1	5	1	5	1	5	1	5	1	100
R17	5	1	4	2	5	2	5	1	5	1	95
R18	5	2	4	1	4	2	4	2	4	2	82.5
R19	5	2	5	2	4	1	4	1	4	2	85
R20	5	1	4	3	4	2	4	2	4	2	77.5
R21	4	2	5	1	4	2	5	1	5	1	87.5
R22	4	2	5	2	4	2	5	2	5	1	85
R23	4	4	4	2	4	2	4	2	4	2	90
R24	5	2	5	1	4	2	5	1	5	1	90
R25	5	2	5	2	4	2	5	2	5	1	90
R26	5	2	5	1	5	1	5	1	5	1	90
R27	4	2	4	2	4	2	4	2	4	2	72.5
R28	5	2	5	1	4	3	5	1	5	1	72.5
R29	4	2	4	2	4	2	4	2	3	3	87.5
R30	4	4	4	2	4	2	4	1	4	2	87.5

Mean SUS Score: 85.58

V. CONCLUSION AND RECOMMENDATIONS

Based on the testing and survey results, the Hanap application has effectively addressed the need for a more usable and user-friendly solution to alleviate wayfinding difficulties on the UPLB campus. Respondents rated the application highly for its management capabilities regarding rooms, buildings, reports, and users, resulting in a System Usability Scale (SUS) score of 85.58. This score indicates that the application excels in terms of effectiveness, efficiency, and overall ease of use, providing users with valuable tools for navigating the campus to their chosen destinations.

For future work, it is recommended to implement user suggestions for customization, such as the inclusion of customizable color palettes and sizes, to allow various user demographics better control of the application. Additionally, it is advisable to test the application across various platforms and make it available for web use. Expanding the scope of the application by incorporating AI and digital image processing for indoor mapping can also provide an additional source of information beyond crowdsourcing.

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