Hanap: UPLB Class Venue Finder Mobile Application

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***Abstract*— This study addresses the persistent challenges of the University of the Philippines Los Baños (UPLB) constituents in navigating campus spaces, particularly in locating class venues. The Hanap mobile application is designed to help students alleviate these wayfinding challenges. This study aimed to develop, implement, and evaluate the application based on its usability and capability to aid users in campus navigation to a chosen destination. Testing by admin and non-admin users revealed an average System Usability Scale (SUS) score of 85.58, indicating excellent usability in providing users with a tool for campus navigation. This also means that the application excels in effectiveness, efficiency, and overall ease of use.**

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

I. Introduction

A. Background of the Study

The challenges 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 are instrumental in easing navigation within such environments [1]. Wayfinding, defined as the user's ability to navigate to a chosen destination and recognize it when in proximity [2], is particularly crucial in academic institutions like UPLB.

UPLB students still have difficulties finding the details and locations of their classrooms despite proactive measures taken by academic institutions, such as placing campus maps and organising tours. Existing campus resources, including maps [3] and organised tours [4], did not completely solve these challenges. A sensing survey involving 30 respondents revealed a mean rating of 8.03 out of 10, indicating a significant challenge in locating these class venues.

The primary cause of this difficulty stems from the lack of detailed and organised databases within the UPLB campus. Despite utilising common avenues for assistance, students still experience delays in navigation and inaccuracies in the information received. These issues are further highlighted in the results of the pre-survey conducted in this study.

[5] reinforce the significance of efficient wayfinding on campuses specifically in locating class venues. The challenges identified by UPLB students align with the broader consensus that easy and efficient wayfinding is crucial for avoiding lateness, anxiety, and stress caused by getting lost on campuses.

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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 prioritise 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?
3) What features and functionalities should be prioritised in developing a user-centric 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 main objective of this study is to develop a mobile application that addresses the challenges faced by UPLB constituents in locating their class venues within the UPLB Campus. Specifically, it aims to achieve the following goals:

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

D. Significance of the Study

UPLB constituents are consistently challenged with 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.

With this, 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, minimising 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 aimed to develop an application tailored to the needs of UPLB constituents, providing information about rooms and facilitating wayfinding to selected locations. The scope is limited to rooms detailed in the Student Academic Information System (SAIS) and the UPLB Academic Management Information System (AMIS). Additionally, the research assessed the application's performance in assisting target users with campus navigation.

The research was 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 commenced in November 2023 and continued 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 creating tools for improved indoor wayfinding. They lack the critical aspect of user acceptability.

Wayfinding in different environments presents unique challenges. For instance, navigating urban environments involves distinct difficulties characterised by the intricacies of city navigation. The complexities of urban areas demand specialised wayfinding strategies, such as signage 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 including late arrivals for inpatient and outpatient care, adding stress for patients and medical staff.

Several studies have already integrated technologies into wayfinding tools to enhance navigation experiences. For instance, [9] developed a hybrid mobile application supporting indoor and outdoor navigation. The technology utilised RFID, ultrasonic-based sensors, radio signals, and QR codes. However, the authors focused solely on creating the application for one operating system. This calls for 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] reviewed these technologies and their incorporation into existing methodologies like machine learning and deep learning. A notable gap identified is the development 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 mobile application was developed using Flutter for the front end and Firebase for the back end and database. The Geolocator package was employed to retrieve the user's current location. Additionally, the application utilised the Mapbox API to display maps and plot the user's current location and the locations of buildings [13]. 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) The 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 administrative oversight and user-friendly navigation at the University of the Philippines Los Baños (UPLB) Campus.

C. Database Design

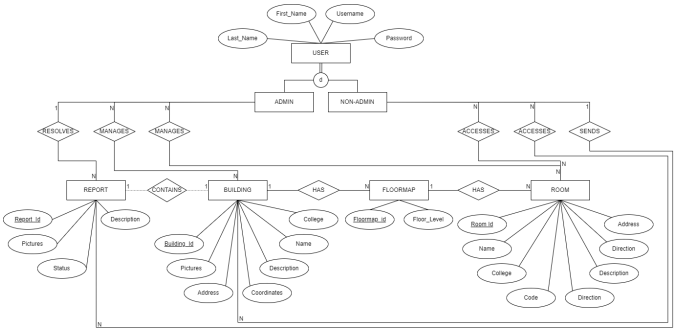

Fig. 1. Entity-Relationship Diagram

Figure 1 illustrates the Entity-Relationship Diagram (ERD) of the application. Firebase was used in different 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 entities: users, reports, rooms, and buildings. Additionally, the application maintains logs to track changes within the system.

The *User* entity represents 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* entity contains information relevant to the rooms they host. It provides essential data to aid in wayfinding within the application.

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

The *Report* entity documents 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 allowing tracking and reviewing of modifications and updates made in the system.

D. User Flow and Use Case Diagram

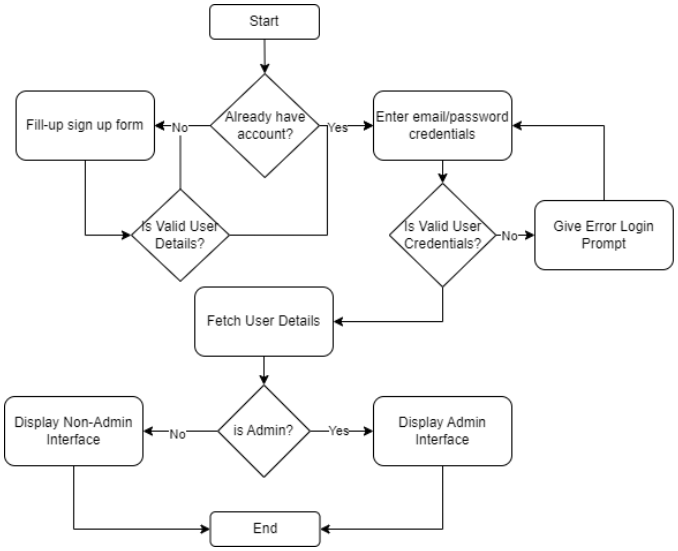

Fig. 2. User Flow for Account Log In

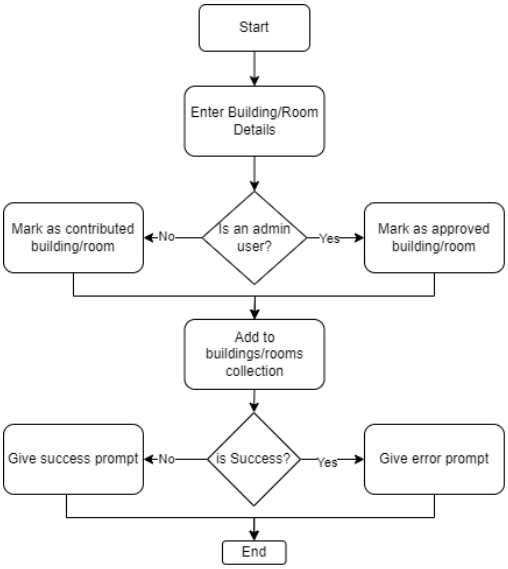

Fig. 3. User Flow for Adding/Contributing Building/Room

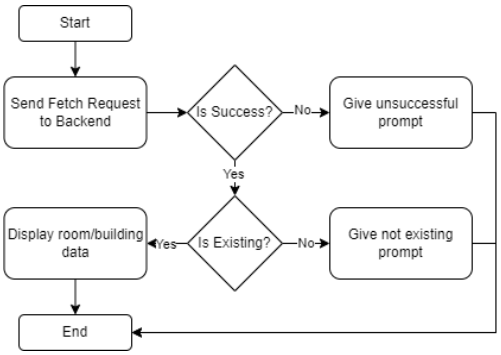

Fig. 4. User Flow for Fetching/Viewing Building/Room Details

Figures 2 to 4 illustrate the various user data flows 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 5 displays the various user types and their capabilities. *Non-admin users* primarily access the application for wayfinding and navigation purposes. They assist in maintaining the system by reporting any encountered problems. Moreover, non-admin users can add to the database by contributing room and building data.

Admin users primarily manage the system by performing CRUD operations on room and building data. They also approve or reject contributed data to ensure the system's correctness and accuracy. Admin users maintain the system by evaluating and resolving reported problems. Additionally, they help populate the database by adding room and building data to the system.

Super admin users 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 sent by non-admin users.

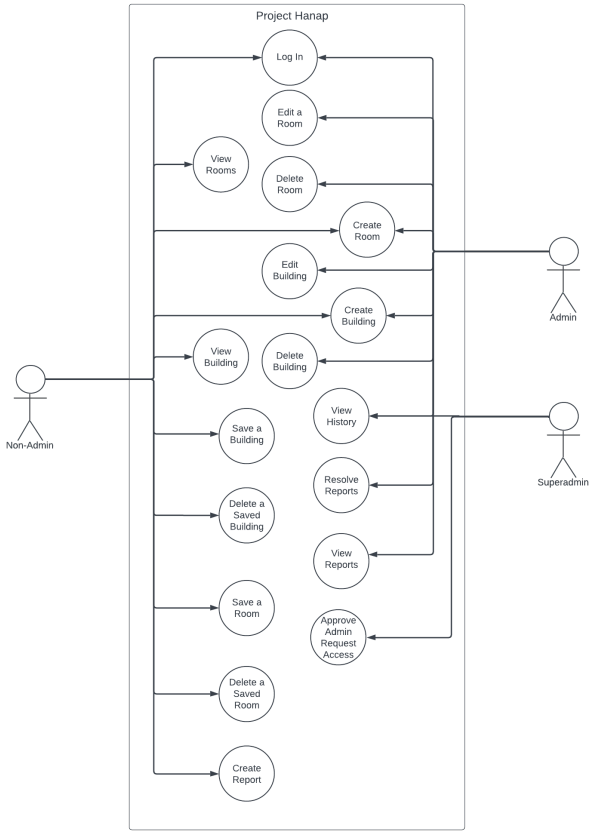

Fig. 5. Use Case Diagram

E. Application Features

Users have different privileges according to their roles within the system. The following discusses the various features based on user type:

1) User Authentication: This feature validates users by allowing access to the system only if they have previously registered. This feature also determines whether to display the non-admin or admin interface.

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-admin users is flagged as "under evaluation" and requires approval. This protocol maintains the system's accuracy and correctness through a careful assessment before approval.

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

7) Admin Dashboard: This grants admin users access to various management features within the system, including 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 enables admin users to track changes 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 used 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 (30) UPLB constituents were invited to participate in the testing. Among them, 10 acted as admin users while the remaining 20 acted as non-admin users. Additionally, two admin users were allowed to explore the super admin interface.

The participants were tasked with exploring and testing the 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 and to request admin access. Admin users were tasked to manage 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. Two admin users were granted super admin 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 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.

This testing is crucial to determine if the system effectively achieves its goal of assisting users in finding their respective class venues.

3) Data Analysis: The pre-survey responses were evaluated to determine 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 added and multiplied by 2.5 [12].

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 Discussion

A. Mobile Application

The application aims to assist users, particularly UPLB constituents, in locating their chosen destinations within the campus. To achieve this, the mobile application was designed to be user-friendly, easy to use, and straightforward for users to understand.

To access the application's features, users must first create an account. New users must sign up by providing their first name, last name, email, and password. Once the account is successfully created, users must log in using their credentials.

Upon successful login, users are directed to their designated user interface based on their role (either admin or non-admin). The application will remain logged in unless the user decides to log out.

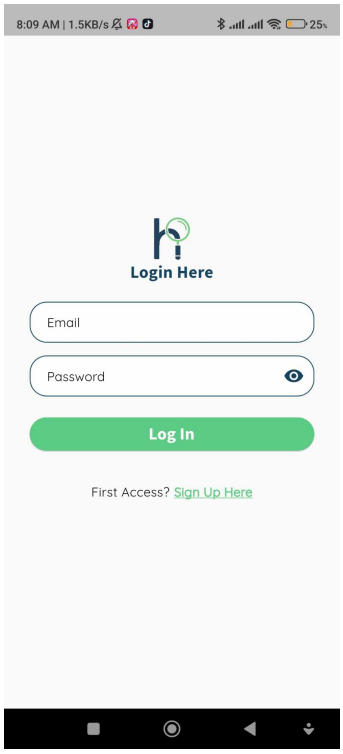

Fig. 6. Login Screen

Non-admin users will first see the map screen upon successful login. The map screen displays their current location, buildings approved in the application, and the UP Oblation as the default reference point.

Admin users, on the other hand, are directed to the admin dashboard, which provides access to administrative features, including the management of rooms, buildings, and reports.

Clicking on a pin on the map allows users to view details of the chosen building. Users can also view room details by searching for them. Non-admin users can bookmark both buildings and rooms for later reference.

Another feature is the search screen, which allows users to find specific buildings or rooms and use filters to simplify the search process.

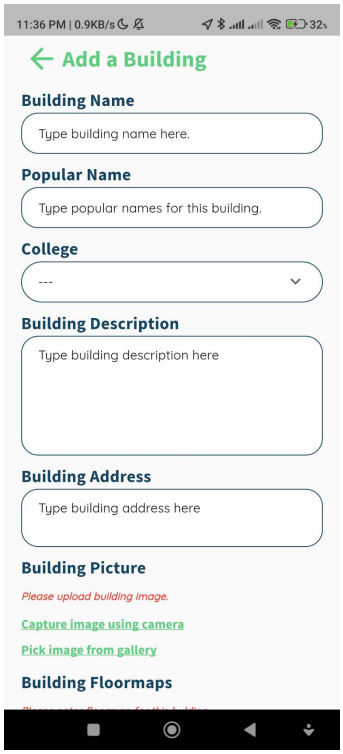

Fig. 7. Add or Contribute Screen

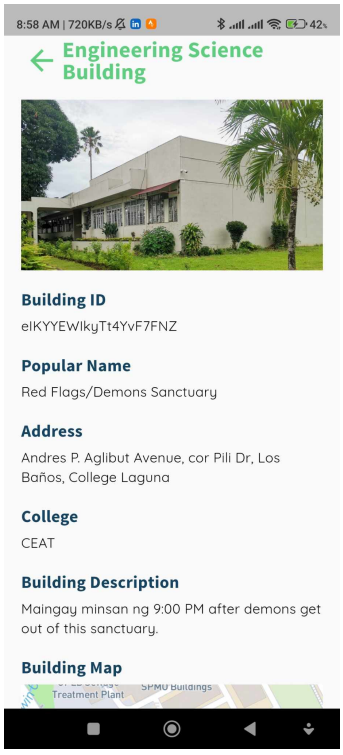

Fig. 8. View Details Screen

Admin users can add, delete, and edit room and building details. They are responsible for approving or rejecting user contributions for rooms and buildings.

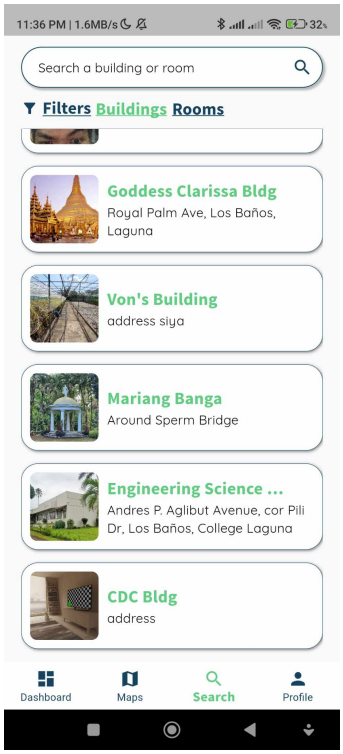

Fig. 9. Search Screen

To maintain data accuracy, non-admin users can report any problems they encounter. These issues might arise from overlooked inaccuracies that require immediate attention. Admin users are responsible for verifying, evaluating, and resolving these reports.

Non-admin users may request admin access. Superadmins are responsible for approving or rejecting these requests based on proof or verification documents. Admin users must be faculty members, utility staff, university-affiliated officials, or responsible student volunteers capable of handling the associated responsibilities.

The Hanap application has effectively provided a reliable tool for UPLB constituents to navigate the campus, ensuring accurate location information and user-friendly navigation.

B. 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 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.

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

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	

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											

mouth. However, students reported that these methods often do not guarantee timely or reliable feedback. This difficulty arises from the lack of detailed and organized databases, leading to late arrivals, frustration, and stress, especially in unfamiliar room venues.

These responses indicate a challenge in locating class venues, underscoring the importance of the created Hanap application designed to address these wayfinding difficulties.

C. Post-Survey

After testing the different functionalities of the application, participants were asked to complete a post-testing System Usability Scale (SUS) questionnaire. 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.

Respondents were asked about their thoughts and experiences with 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. A few of their recommendations for future development include allowing user customization and making the application available for all platforms.

V. CONCLUSION AND FUTURE WORK

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 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 adding customizable colour palettes and sizes. This will give various user demographics better control over the application. Additionally, it is advisable to test and implement the application across different platforms and make it available for web use. Currently, the application is available for mobile users, particularly Android users. Expanding the application to iOS and other operating systems is encouraged, as many UPLB constituents use these platforms.

Furthermore, debugging the application across different OS to catch all possible errors is crucial for improving the user experience for all target demographics. Expanding the scope of the application by incorporating AI and digital image processing for indoor mapping can provide additional information beyond crowdsourcing. Lastly, improving the search functionalities by adding customizable filter fields and enhancing backend server handling for search queries is advisable.

APPENDIX I
ADDITIONAL UML DIAGRAMS

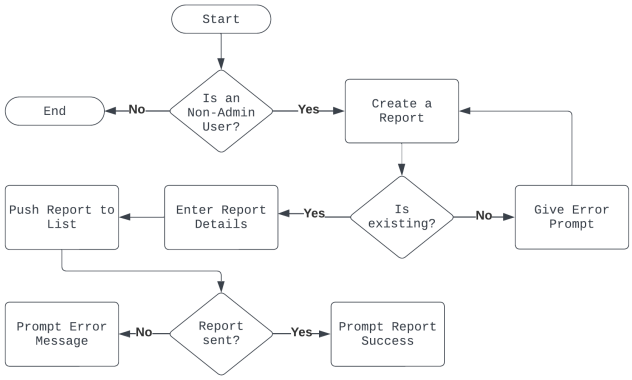

Fig. 10. User Flow for Sending a Report

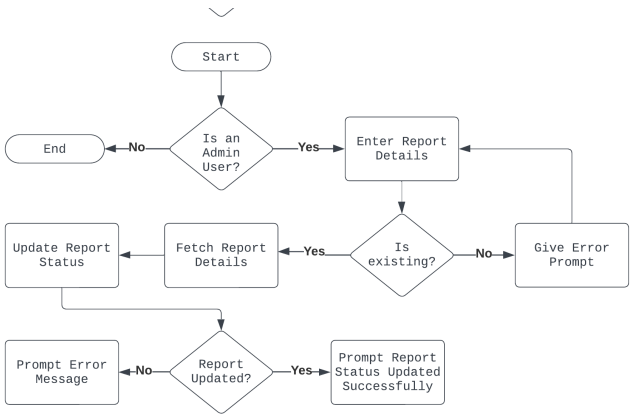

Fig. 11. User Flow for Updating Report Status

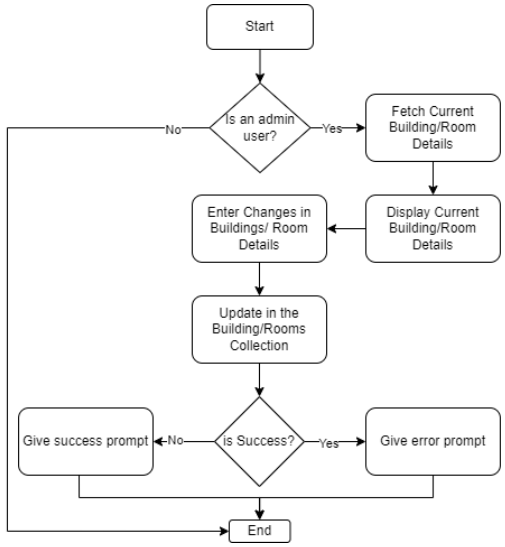

Fig. 12. User Flow for Updating Building/Room Details

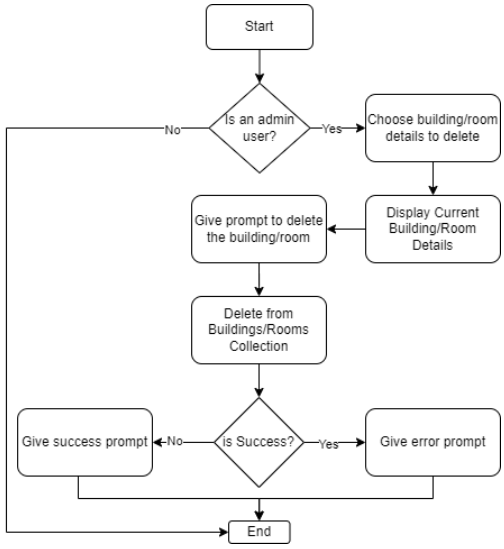

Fig. 13. User Flow for Deleting a Building/Room

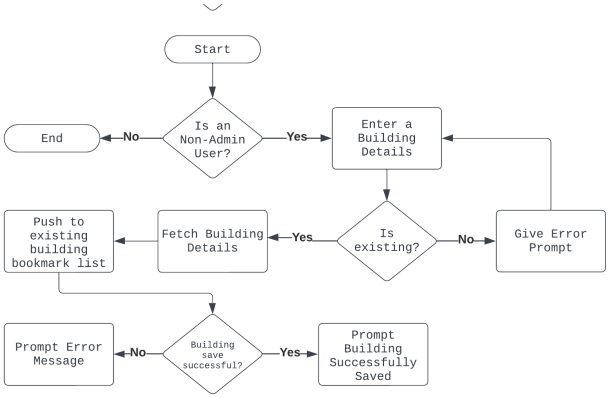

Fig. 14. User Flow for Saving or Bookmarking a Building

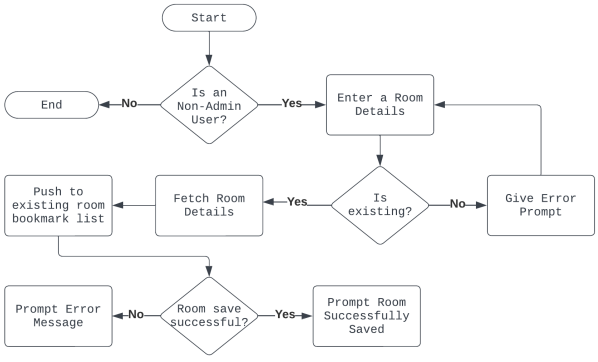

Fig. 15. User Flow for Saving or Bookmarking a Room

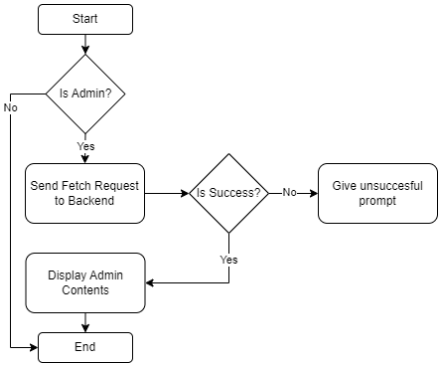

Fig. 16. User Flow for Fetching Users

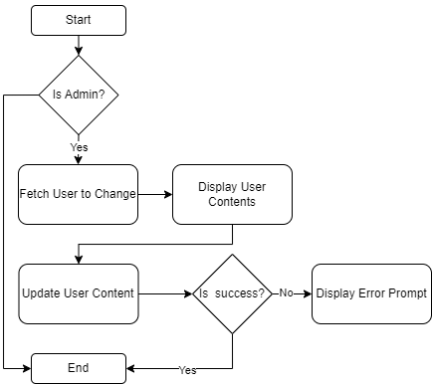

Fig. 17. User Flow for Updating Users

APPENDIX II
ADDITIONAL APPLICATION SCREENS

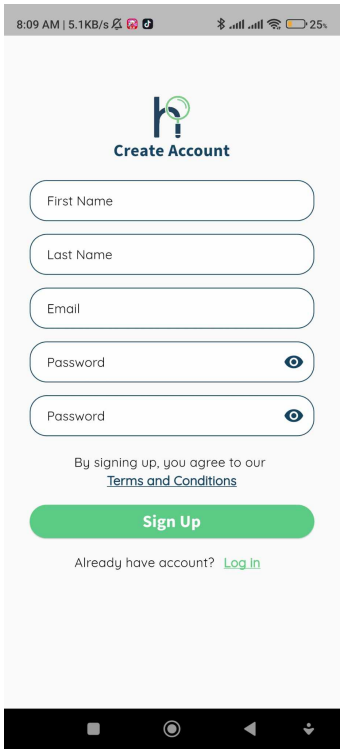

Fig. 18. Create Account Screen

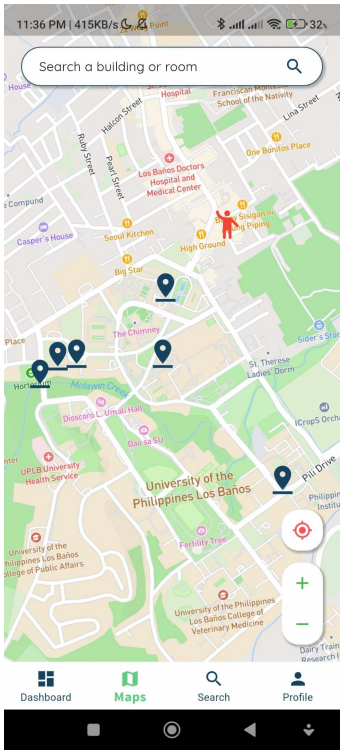

Fig. 19. Maps Screen

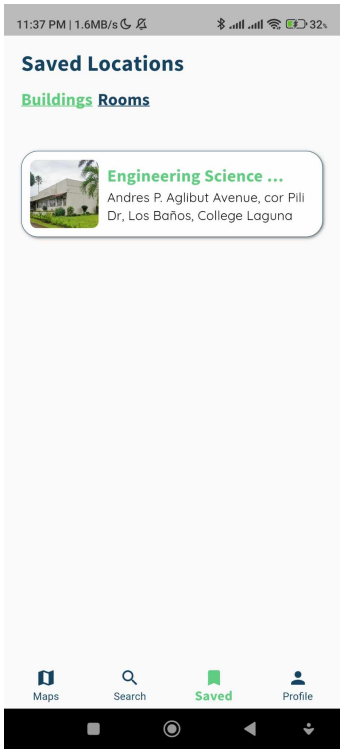

Fig. 20. Saved or Bookmark Screen

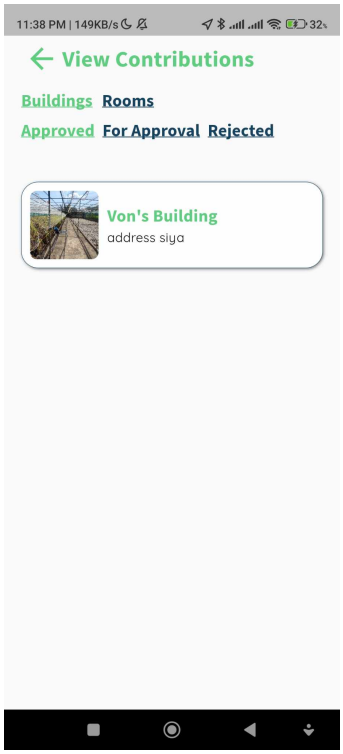

Fig. 21. View Contributions Screen

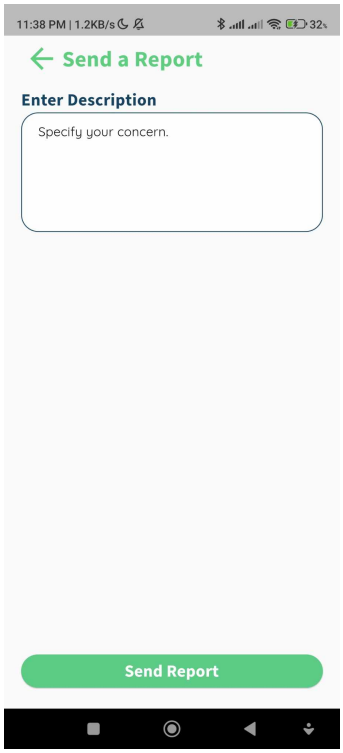

Fig. 22. Send Report Screen

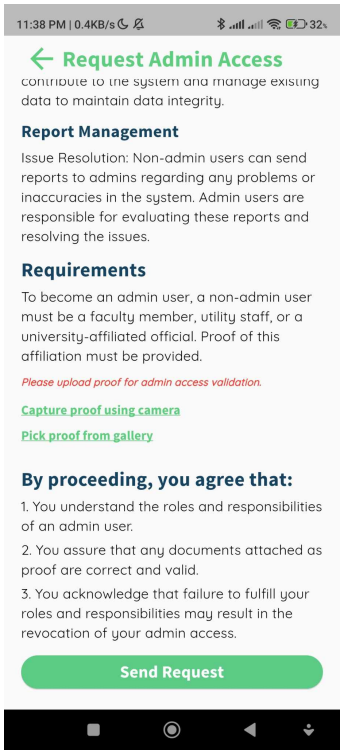

Fig. 23. Request Admin Access Screen

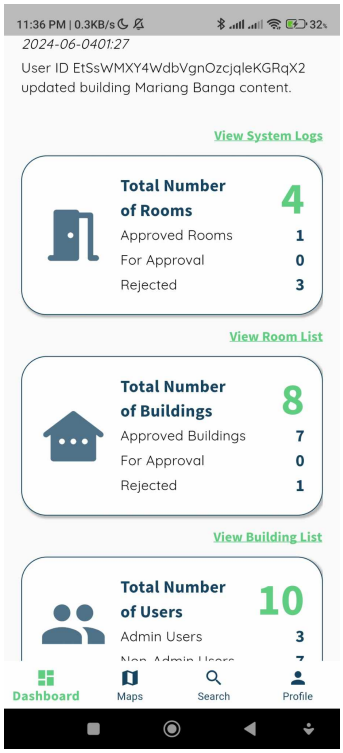

Fig. 24. Admin Dashboard Screen

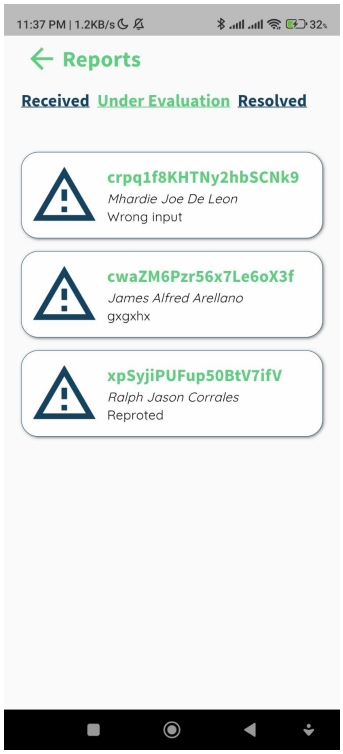

Fig. 25. View Reports Screen

APPENDIX III
SURVEY QUESTIONNAIRES

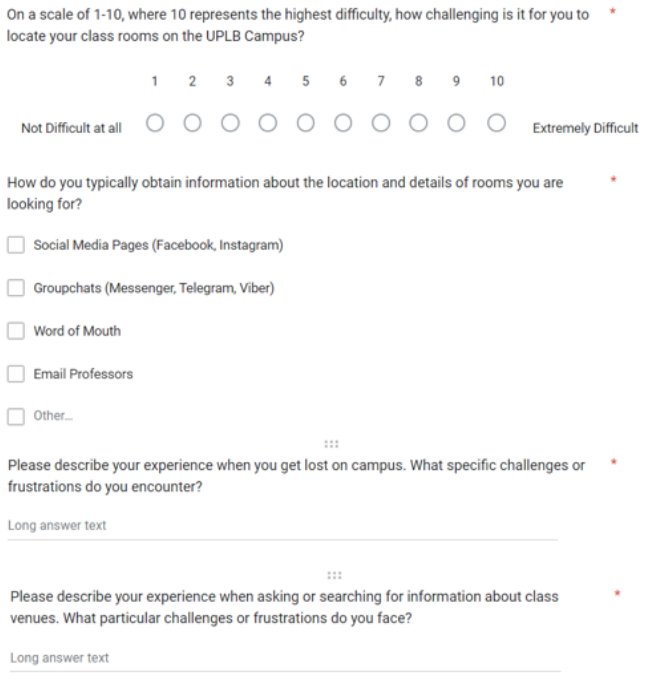

Fig. 26. Pre-Survey Questions

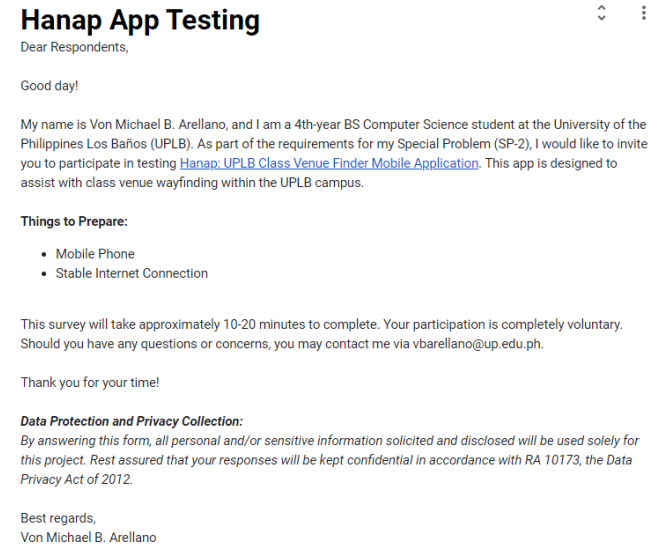

Fig. 27. Post-Survey Questions

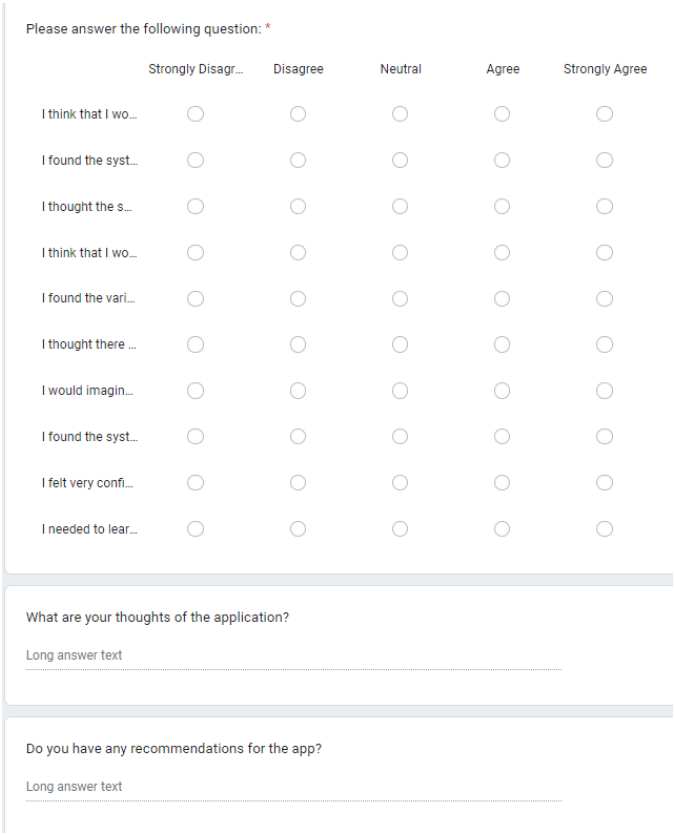

Fig. 28. Post-Survey Questions (cont.

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