NavigateMe:
An in-Building Navigation Application

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Abstract— For some people to reach their destination and complete their daily tasks, navigation systems serve as an aid, a tool, or an assistance. Currently, International Islamic University Malaysia (IIUM) lacks an in-building navigation system that could assist users, particularly new students, in finding their way to the location of their choice. This paper has two goals. This study first examines the current campus navigation systems and the relevant research article. Second, this work suggests a mobile navigation system that facilitates user navigation within Kuliyyah of Information and Communication Technology (KICT) facilities. Methods used to build the application were according to Software Development Life Cycle (SDLC). The suggested navigation application, NavigateMe, helps users navigate within buildings by providing sequential instructions and images of landmarks along the route. It stands out for being usable even in the event of sporadic internet connectivity. In conclusion, visitors and the IIUM community, particularly the new students of KICT, will benefit from an in-building navigation application like NavigateMe to effortlessly reach their destination.

Keywords— navigation application, mobile application, locations, path finding

I. INTRODUCTION

A. Project Overview

NavigateMe is a mobile application that helps the user to navigate through the campus (KICT and nearby location). This application benefits the user as it can save time in finding desired destinations on the campus and was created for public use due it not requiring any credentials like ID and password for login except for the staff responsible to update and manage the application so it is usable for IIUM visitors. A few existing systems such as ClassFind.com [1], University of Calgary Interactive Map (UoC) [2] and the USF Interactive Campus Map [3] were referred to research and understand more in how this kind of applications work. They (USF & UoC) assist users to search for their desired location by inputting the keyword of the location. Moreover, the systems (ClassFind, USF & UoC) display the map for clearer view of the campus so they can know the landmarks surrounding the location. Furthermore, it (ClassFind) also provides a navigation function that guides the user to their destination. If the navigation does not work, the system provides an external link for the floor plan, building and department information as an alternative as implemented in the USF & UoC system. Therefore, all the functions which were possible to code are included in the NavigateMe system including the features where the system informs the user of their current location that allows the user to find their destination manually using the provided floor plan in case of unstable internet connection or navigation problem.

B. Problem Statement

A navigation system has been used to help the user find their desired location. It cannot be denied that without the system, something cannot be solved or would be difficult to solve, for example business processes where the delivery of goods needs to be done and a good navigation system would reduce a lot of effort and time. Both staff and students can arrive at their workplace and classes faster and easier. For IIUM, which is a large campus with different kinds of department buildings, it would be difficult to find certain places. With the existence of navigation systems like Google Maps, it is indeed beneficial, however some users might have difficulties in using such navigation systems. Research has shown that not everyone is able to easily navigate using the existing navigation system and this is said to be true due to differences in gender, between males and females [4]. Some users, especially females are not able to interpret the map easily and research has shown that it is due to the different visual and spatial capacity of both users [5]. Some of the users, mostly females, depend on the landmark along the way to find their desired location.

So, with our navigation system, we intend to solve this problem by providing the simplest version of the map so that all users can use it with ease.

C. Project Objective

- To investigate the components and current designs of existing navigation systems from the literature
- To design and develop a user friendly and easy to use version of navigation system for all types of users in IIUM.
- To test the developed system within IIUM campus

D. Significance of Project

The significance of this project is that users, especially the students and visitors, can use this system to find their desired location in the campus easily. In addition, the system is user-friendly for all generations by having easier features than the existing navigation system. This system shows landmarks, a few icons and steps to navigate through the way to their desired location. Other than that, this system is reliable since it is accessible even during intermittent internet access, which means that the user would only need to know the starting point that is displayed, and the rest of the steps would be shown by the images displayed in the page. Even though other functions cannot be accessed during internet intermittent, in some cases, the page would still be there with all images for navigation to the destination.

II. RELATED WORKS

For the first research papers authored by researchers and developers, the problem of where to locate classrooms at Politeknik Kuching Sarawak is discussed [6]. With a focus on user interaction and authored by Helmi Abd Kadir, Muhd Nazmi Ismail and Muhammad Firdaus Aminuddin, the paper covers requirements analysis through evaluation. Real-time maps, comprehensive class information and user notifications were all included in the built program. The study offers insights on user-centric development and the effects of technology integration in educational settings, despite its limitations in terms of scope and technical details. The second case study examined navigational issues on university campuses and suggested a mobile navigation system. It was carried out by Akanbi Caleb, I K Ogundoyin, and A O Lawal [7]. System design, user testing and data collection were all part of the technique. Highlights include turn-by-turn directions and interactive maps. Despite having many useful features, the study lacks technical specifics and considers scalability. Considering this, it encouraged the effective fusion of GPS technology with the ideas of user-centred design.

In the third case study, Susovan Jana and Matangini Chattopadhyay demonstrated an Android-based event-driven navigation system [8]. By integrating with the university's event management system, the method

guaranteed precise location, real-time updates, and an intuitive user interface. Reliability, broader application, accessibility, and security issues are among the challenges. The study highlights the value of user feedback for continual improvement and recommends continuing research for testing in real-world settings.

TABLE I
COMPARISON BETWEEN THE EXISTING SYSTEMS AND THE PROPOSED SYSTEM

	USF Interactive Campus Map	University of Calgary Interactive Map	ClassFind.com	NavigateMe (Proposed System)
Choose location	✓	✓	✓	✓
Real life map	✓	✓	✓	✓
Use coordinates	✓	✓	✗	✗
Live location	✗	✗	✗	✗
Starting points	✗	✗	✓	✓
Search location	✓	✓	✓	✓
Layer list	✓	✓	✗	✗
Navigation guide	✗	✗	✓	✓

Table I shows the comparisons between the existing systems. Three existing systems were chosen for this such as the USF Interactive Campus Map, University of Calgary Interactive Map and ClassFind.com. To compare, all three systems have features for the user to choose their desired location and to search it by key in the key word in the search feature available. These systems are also able to display a real live map for the user to use it. But all these systems do not have live location features where it displays the current location of the users. For USF Interactive Campus Map and the University of Calgary Interactive Map, both somehow have almost the similar features. They use coordinates in their system, the real-life map has the layer list functions where the user can choose which layer, they prefer to use. For example, campus planning, parking, and transportation. But these two systems do not have a starting point for the user to start navigating. Other than that, it does not have a navigation guide for the user to use to help them navigate to the location. But it is different for ClassFind.com. In this system, it has a starting point and navigation guide step by step for the user to start navigating. The navigation guide is in the form of pictures with arrows in it which display the landmarks of the route and location. Unfortunately, it does not use coordinates in its system, and it does not have a layer list for the user to use. This study has proposed NavigateMe system, a system that provides clear and real-life visualization of the routes to the desired location for navigation. This system has the location displayed for the user to choose from, for example, the list of room in KICT. Second, the

system gives the user a list of starting points where the user may use where they want to start navigating. Other than that, NavigateMe displays the images with arrows for the user to use as a navigation guide. This system provides the user the ability to search their desired location and the option to use the real- life map which is linked to the Google Map. NavigateMe does not display real-life maps because this system is meant to help the user that has low visual and spatial capacity, in other words, they have difficulties in using the real-life map. This also means that the system does not have a layer list and live location function since it is an in-building navigation application. The other important feature of the system is the authenticity of the contents shown on the website are provided by only authorized staff and the system.

III. PROPOSED SYSTEM

A. Design

In designing the system, a prototype for the system was created using Canva. The design was inspired from the Classfind.com navigation system. The design was done by completing the requirements specification for this system. As shown in Fig 1, there are two systems in the use case which are NavigateMe and Firebase.
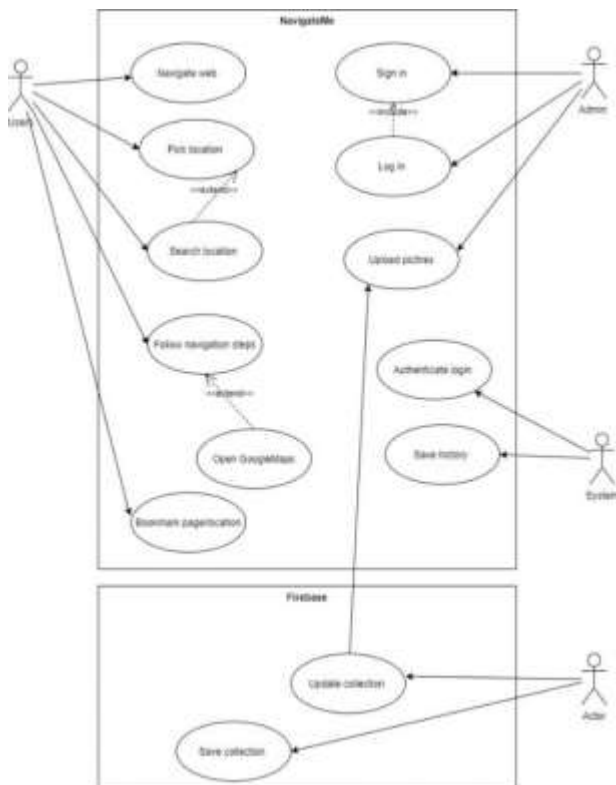

Fig. 1 Use Case Diagram

The actors for the NavigateMe are users that interact with the front-end of the application and the second actor

is the admin that manages and updates the contents. The description of the use case is stated in detail in Table II.

TABLE II
DESCRIPTIONS OF USE CASE DIAGRAM

Use Case	Description
Naviagate web	Allow the user to navigate through the web application
Pick location	Allow the user to pick their desired destination
Search location	Allow the user to search their desired location by key in the key word
Follow naviagtion steps	The system display series of images as guide for the user to navigate
Sign up	Admin create account to get authorize permission to manage database
Login	Allow the admin to log in into the web application
Upload pictures	Allow the admin to upload images into the web application
Update collection	Allow the admin to update the images in the database
Save collection	Allow the admin to save changes of collection

The flow of the whole process of using the navigation system is shown in Fig 2 and relationships between the entities is systematically explained in Fig 3.
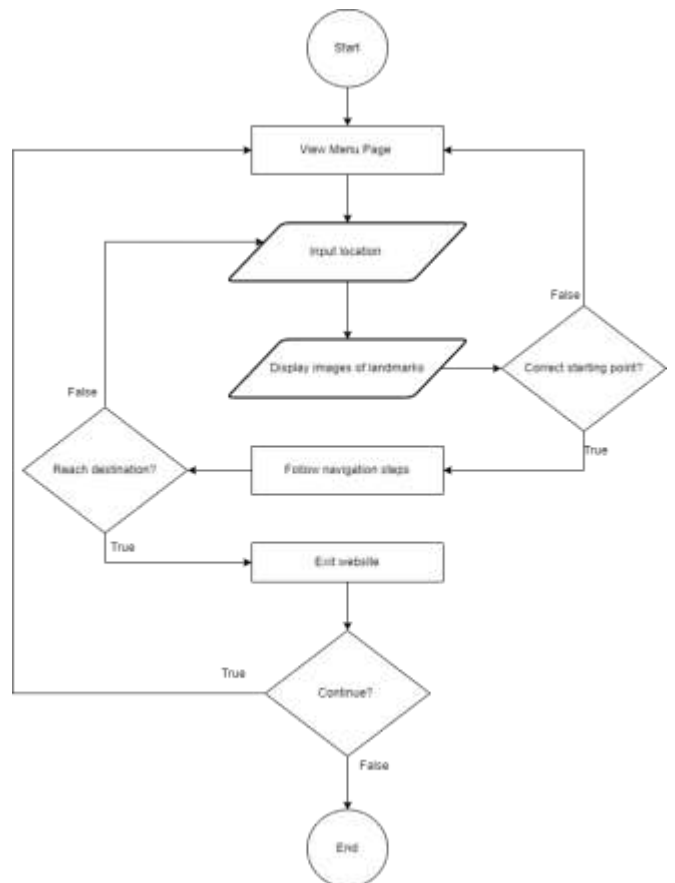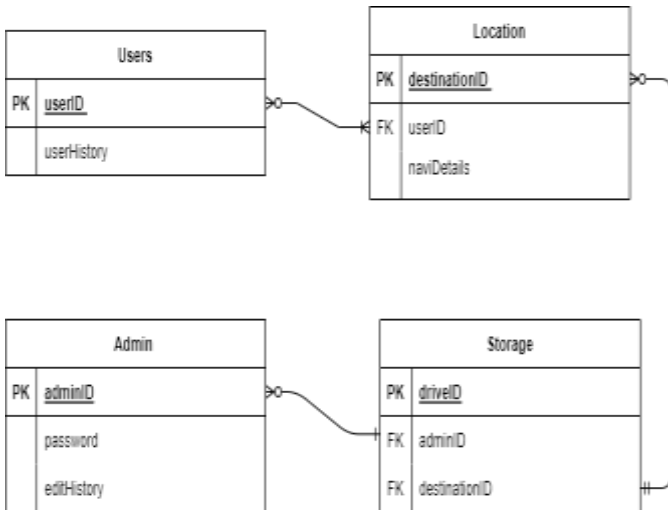

Fig. 2 Flowchart Diagram

Fig. 3 Entity Relationship Diagram

Fig. 5 Navigation steps Page which is for the user

B. Implementation

The data required for the proposed system is collected by capturing pictures of the landmarks within the KICT building and detailed information on every location is taken from the IIUM official website. The programming language used is Dart and the application is connected to the Firebase Realtime Database. The system has two different types of interfaces which are for the user who are the visitors and for the admin who are the authorized personnel that manage the system.

Fig 4 the staring to Fig 5 are all the prototypes of the mobile application opened in a website mode (e.g. Chrome). Fig 4 runs until Figure 5 where the pages displayed to the users after clicking "Start Searching" button in the users' homepage. The homepage has two buttons' options; users click on the "Start Searching' button to use the application while admins click the "Log In" button to log in. The pages shown below is the focus of the navigation application.

Fig. 4 Homepage

C. Testing

Unit testing has been chosen to test the NavigateMe system. Generally, unit testing is where the individual components of the software are tested and validate that each unit of the software works as intended and meets the objective. The primary goal was to ensure that each unit of the system performs as expected in isolation, before integrating them into the overall system. For NavigateMe system, there are 3 modules for the testing and all these modules are decided according to the list of system requirements.

1. User Interface Module

This module tested the responsiveness of interactive elements, such as buttons and forms, was a primary focus. The system was tested to ensure that all interactions, including clicking, hovering, and inputting text, were accurately and quickly registered. This responsiveness is essential for a smooth user experience.

2. Data Display Module

This module is tested on the images displayed in the system. The system was tested to ensure that the data that were stored in the databases were able to be displayed in the system upon user input such as clicking and inputting text.

3. Admin Module

This module tested on the admin side of the system. This system was tested to ensure it can apply changes done by the admin to the user system such as location, images and the navigation steps.

Under these modules are the components of the system. The table below shows the features that were tested according to its module.

TABLE III
TEST MODULES

Modules	Components
User Interface	Navigation bar; Search box; Chatbot; Selecting building of the location; Display details of the destination; Choosing the location; Choosing the starting point; Use indicator to choose steps of the navigation guide
Data Display	Display image Display navigation steps
Admin	Login Input new locations, images, and steps Save updates

The tests were done module by module to ensure all components were working well. Any errors or unsatisfactory output were recorded while doing the tests and it was fixed and improved first before moving on to other modules. Then, the modules were integrated together and tested. During this phase, the system was tested, and errors or issues were recorded and fixed.

IV. Results and Discussion

NavigateMe's objectives are to develop the simplest version of navigation system that is user friendly to all types of users from various backgrounds and ages including those without prior IT knowledge, to guarantee the authenticity of the contents shown in the application that are provided by only authorized staff, to provide a reliable system and to provide clear and real-life visualization of the route to the location for the navigation. Thus, using the test cases in Table IV, unit testing was conducted to test all the modules of the navigation system.

Generally, unit testing is where the individual components of the software are tested and validate that each unit of the software works as intended and meets the objectives. From the testing, it was observed that almost all the test cases being tested passed with a few of them not meeting the requirements (see Appendix 1). For the planned users' interfaces, unit testing allows us to test the navigation within the application from page to page. Clicking on the "Start Searching" button implemented in the home page for the users will lead to the next pages, "Pick Your Destination" pages in which the destinations are sorted in different pages named as level 1, level 2, level 3, level 4 and level 5 following the real layout of the KICT building. The codes also include functions such as URL launcher to navigate external websites.

The links are embedded under each of the images in the form of image description as can be seen in the prototype in the Implementation section. Overall, all the features for the users' interfaces worked fine but the problem was in the limitations in the search function as the system was not implemented with the auto suggest feature or the auto correct feature that could make the usage of the application easier especially when the users want to search something within the application. For the admin interfaces, it was observed that the login functions worked fine but the problem was that the edits made by the admin were not displayed in the users' interfaces. The recommendations and studies on how to resolve each of these issues that arise from the unit testing are covered in the discussion. The user would benefit from the implementation of the auto suggest or auto correct features, which might make using the application easier, particularly when the user wants to search within the application. One possible solution to the issue of photo updates not appearing on the user's end is to thoroughly inspect the connection between the database and navigation system. In addition, a chatbot feature might be included to the navigation system to help users, such as when they have questions about the Kulliyyah or the location

V. Conclusion

This study examined and discussed research articles on navigation systems as well as the current on-campus navigation system. It advances the conversation about contrasting the features of all current navigation systems. All these systems have certain flaws, and NavigateMe was suggested as a solution to address them. NavigateMe only provides navigation within the KICT building, thus it is intended that in the future, its coverage will expand to include buildings from various kuliyyah and benefit the IIUM community members as well as visitors.

conflict of interest

The authors declare that there is no conflict of interest

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Appendix 1

Test Case ID	Objective	Input	Expected Result	Special Procedural Requirements
TC-01-001	Navigate through website	User click on the navigation bar	The desired page is displayed	The link to each page is working and stable internet connection
TC-01-002	Key in location in search box (No auto-correct)	Users type the keyword of the location or the exact name of the location	The navigation steps to the location is displayed	The users have to write the correct name.
TC-01-003	Communi cate with a chatbot on a website.	Users click on the chatbot and write on the message box displayed	Chatbot display an appropriate e reply message	Must have a stable internet connection
TC-01-004	Choose any building of their destinatio n.	Users click on the link (the name) of their desired location (e.g. "Kulliyyah of ICT")	The next page, the page of starting point is displayed	Must have working links and stable internet connection
TC-01-005	View details of location.	Users click on "Details" under the destination link.	IIUM official website containing all the details of the location will be displayed	Must have working links and stable internet connection
TC-01-006	Choose a room in a certain level of the building.	Users click on "FIND" button for any location they want to go to (e.g button under the "CITA")	The next page, the starting point page is displayed	Must have working links and stable internet connection
TC-01-007	Choose starting point	Users click on the "Start" button under the name of any the starting points provided in the page (e.g. button under "Cafeteria ")	The next page, the navigation steps page will be displayed	Must have working links and stable internet connection
TC-01-008	Display navigation n steps for users	Users click on "Start" button	The navigation steps page will be displayed	None
TC-01-009	Choose any steps of navigation	User click on steps button (e.g. "Step 3")	The page will scroll down to that particular step (in case the steps are long)	Must have stable internet connection at that particular time, if not need to just scroll there
TC-01-010	Login (Admin)	Admin key in their username and password in the space provided	The admin can view the next pages that they can do updates on	Authorized account with correct username and password
TC-01-011	Update data on the website (pictures and details)	Admin click on the edit icon	The admin can do updates on the information and upload pictures on the website	Only those who are authorized account can see the edit features
TC-01-012	Update picture collection in database (google drive).	The admin upload more pictures or delete pictures in	The collection is updated	Admin must be authorized and internet connection