Trends in Undergraduate Research (2025) 8(1): c25-35
https://doi.org/10.33736/tur.7493.2025

NR-Connect: Development of UNIMAS Non-Resident Mobile Application

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Date received: 29/7/2024 Date accepted: 20/03/2025
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Abstract

The NR-Connect application was developed to address the communication and emergency response needs in between NR students, felos, and administrator of Universiti Malaysia Sarawak (UNIMAS). This project leveraged the Waterfall methodology to systematically design, implement, and verify an integrated platform combining features for news dissemination, event management, and emergency reporting. The application utilizes Flutter for the front-end and Firebase for back-end services, ensuring a seamless user experience across various devices. Key functionalities include a login and registration system, a horizontal scrollable menu for event categories, and real-time data fetching from Firestore. The evaluation of NR-Connect highlighted significant improvements in information accessibility and response efficiency for the university community. Feedback from users indicated high satisfaction with the application's usability and relevance. Future enhancements will focus on expanding features, improving performance, and integrating advanced analytics to further support the dynamic needs of UNIMAS students, felos, and administrator.

Keywords: Mobile application, Software development, Information management, Non-college resident

1. INTRODUCTION

Accessing information has become incredibly convenient in today's world, thanks to mobile applications. The use of mobile applications (Abdullah & Zeebaree, 2021) has numerous advantages, particularly in terms of information sharing and security. These applications are user-friendly and can be created by people of all skill levels. It ranges from simple drag-and-drop methods to more advanced techniques involving programming languages like *JavaScript*, such as *React.js* or *Dart.js*.

Previously, information management was centered on Hypertext Preprocessor (PHP) and databases embedded within websites. This approach presented significant challenges because it required an extensive number of processes to store data from the website into the application, also known as a Web Application. Users were inconvenienced by the requirement to open a web browser in order to access the application, adding another layer of complexity to the user. Organizational effectiveness and decision-making rely heavily on information management. When relevant and accurate data is needed, effective information management ensures that it is available. A well-structured information management framework significantly improves organizational communication, operational efficiency, and overall productivity (Sommerville, 2011).

It is understandable that having an application to assist students in managing their daily lives is important, particularly when it comes to protecting personal information from potential leaks. Universiti Malaysia Sarawak (UNIMAS) faces a significant challenge as a result of this. UNIMAS has always

welcomed a diverse group of students. This diversity, however, creates a distinctive problem: the limited availability of college accommodations (Hanson et al, 2020), which mainly remain available for active students and new students each academic year. As a result, a significant number of UNIMAS students, known as Non-Residential (NR) students, end up living off-campus. The challenge for NR students is the lack of a dedicated communication platform or information resource tailored to their specific needs (Muslim et al, 2012; Sikhwari et al, 2020). In addition, at university management level, the administrator faces difficulty to track NR students on where they are staying while studying in UNIMAS. The situation would be definitely difficult when calamity is happening to the NR students. This gap leaves them somewhat separated, making it difficult for the university to stay in touch and quickly address any issues that may arise in their off-campus residences. There is a noticeable communication gap in times of emergency or routine administrative matters, leaving NR students without proper support.

Recognizing the critical need to bridge this gap and provide comprehensive solutions to NR students, we propose the development of an innovative mobile application. This application is developed to act as a crucial connection between UNIMAS and its NR students. Its goal is to provide them with critical information, improve their safety outside of UNIMAS, and protect their personal information. The project aims not only to address NR students' immediate concerns, but also to improve their overall university experience.

2. OVERVIEW OF NON-RESIDENT MOBILE APPLICATION

NR-Connect helps non-residence students by staying in touch with them from their registered home address. This information can be obtained by registering for the first time from all students who are staying outside campus based on their residences. The administrator then supervised these students in the event of an emergency that occurred outside of UNIMAS. Typically, these students do not have a way of reporting to the person in charge of UNIMAS, so if anything happens, UNIMAS will likely take slow countermeasures to assist them. As an outcome, NR-Connect provides an emergency button in the application to alert any nearby person-in-charge (PIC) of NR, simply known as *felos*, to assist them. The project also includes PIC contact information in case they need to contact them outside of emergency situations. This system will make it easier for non-residents to improve their safety even when they are outside of UNIMAS territory.

The development of NR-Connect is quite similar with Altruistic (Chowdhury & Alam, 2023), Silver Lining (Nath & Chowdhury, 2022) and Emergency-Incident Reporting and Response Mobile Application in State University Setup (ERiAS) (Tolentino & Hernandez, 2020) applications, in which, all of these applications are related to university students' accommodation or welfare. However, the first two applications (Altruistic & Silver Lining), are focused on student data information, while ERiAS application is focusing on emergency responses. As for NR-Connect, this application is a combination of those three applications. All information gathered in the NR-Connect is collected based on the information from UNIMAS database (i.e., name, matric number, gender, and program). The only information is needed to be updated by the NR student is a current residential while studying in UNIMAS. In addition, the emergency response feature will work automatically based on the student interaction; if any student requires an assistance, it will be provided based on the location of the registered residence keyed-in previously. The information provided will assist the administrator to monitor and guides the NR if there is any issue happened.

3. MATERIALS AND METHODS

3.1. Requirements Analysis

To ensure the robustness and the development of *NR-Connect* fulfils the user needs, a survey was conducted according to Waterfall model (Gallagher et al, 2019) and received 30 feedbacks from relevant group of people, including UNIMAS staffs and NR students through NR Telegram group channel. There are 14 survey questions in total, divided into two main parts: (i) demographic questions and (ii) specific questions. These questions were analyzed and summarized in order to produce a list of requirements. As shown in Table 1, there are eight (8) major requirements provided as a basis for the

construction of the application. Because of the application is manipulating personal NR students and felos data, then, login function is essential as a verification purpose. In addition, the core of this application is to locate NR student if an emergency is happened and the notification to inform them that the assistant is coming. Any news or event happening related to NR, will be notified through the application.

3.2. System Design

Before the application can be realized, all the requirements (as shown in Table 1) will be translated and be represented through context diagram, data flow diagram (DFD), and entity relationship diagram (ERD) for better understanding (Shelly & Rosenblatt, 2012).

3.2.1. Context Diagram

The general overview of the NR application is shown in Figure 1. The application, which is known as *NR-Connect*, consist of three entities: *Students*, *Felos*, and *Admin*. The *Students* interact with *NR-Connect* with eight input/output data flow. They can register an account, login into the application, updating profile and emergency status update, viewing both *Felos*' details and events, as well as using a QR scanner. However, the *Felos* can view a list of NR students with their residential areas and update the status based on the student's emergency request. At the other hand, as for the *Admin*, there are five data flows are needed: to release and dispatch an emergency notice to the *Felos*, and to update *Students*' list and event.

Table 1. List of requirements for *NR-Connect*.

Req. ID	Requirement Description
R01	User should be able to register and login to the application.
R02	User can register their accommodation, which is located outside UNIMAS via the application.
R03	User can report any emergency to nearby 'felos' in the application.
R04	User can view the details of the person in-charge of NR via the application.
R05	The system can locate a student's emergency using the information provided by students.
R06	The application can send push notifications to students for assistance when needed.
R07	The application can show latest events and news.
R08	The application should allow user to update relevant details.

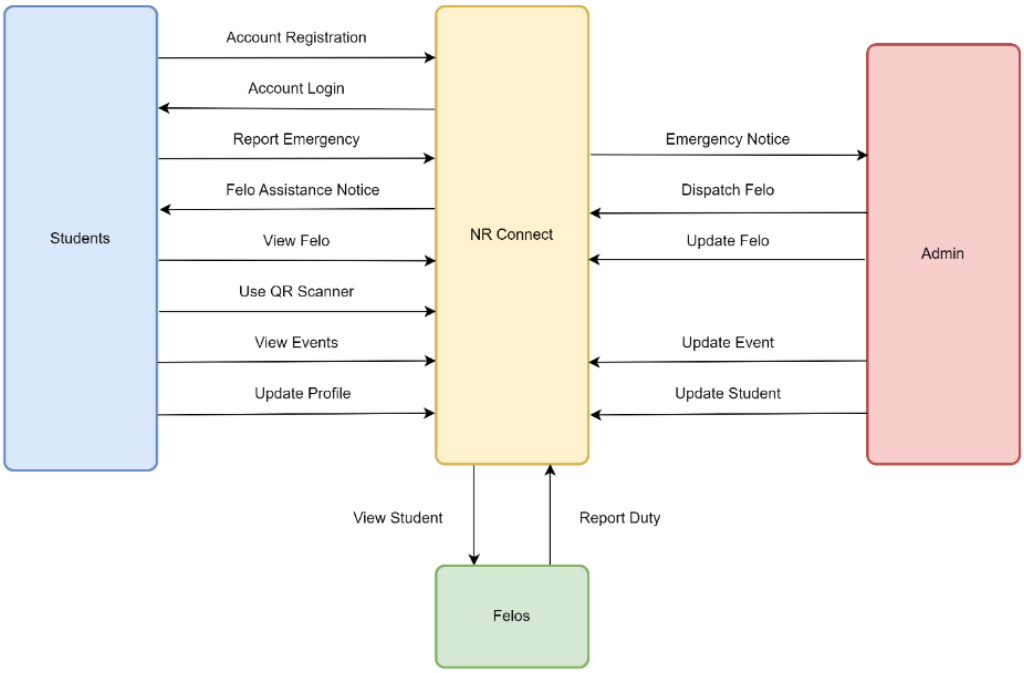


Figure 1. Context diagram of *NR-Connect*.

3.2.2. Data Flow Diagram

In order to view all required processes for the *NR-Connect*, it will be modelled through DFD (Computer Hope, 2017) in which the application will visualize the inter-relationship of required processes to all entities, including *Students*, *Felos*, and *Admin*. In addition, through DFD, which data store to be read/write is also been represented. As shown in Figure 2, there are three entities: *Students*, *Felos*, and *Admins* are connected to a specific process. There are nine (9) major processes available, including *Register System*, *Login System*, *Emergency Report System*, *Emergency Notify System*, *Felo Notify System*, *Felo Information System*, *QR Scanner*, *Events Information System*, and *Student Information*. There are three (3) data stores are available, including *Student Information*, *Emergency_Information*, and *Felo_Information* data stores, respectively. Process *Register System* will write the data into *Student Information* data store, while processes, which are *Login System* and *Student Information*, respectively, will read from this data store. The process *Emergency Report System* will write the data into the data store *Emergency_Information* while this data will be read by process *Emergency Notify System*. As for data store *Felo_Information*, two processes, which are *Felo Notify System* and *Felo Information System*, respectively, will read from it.

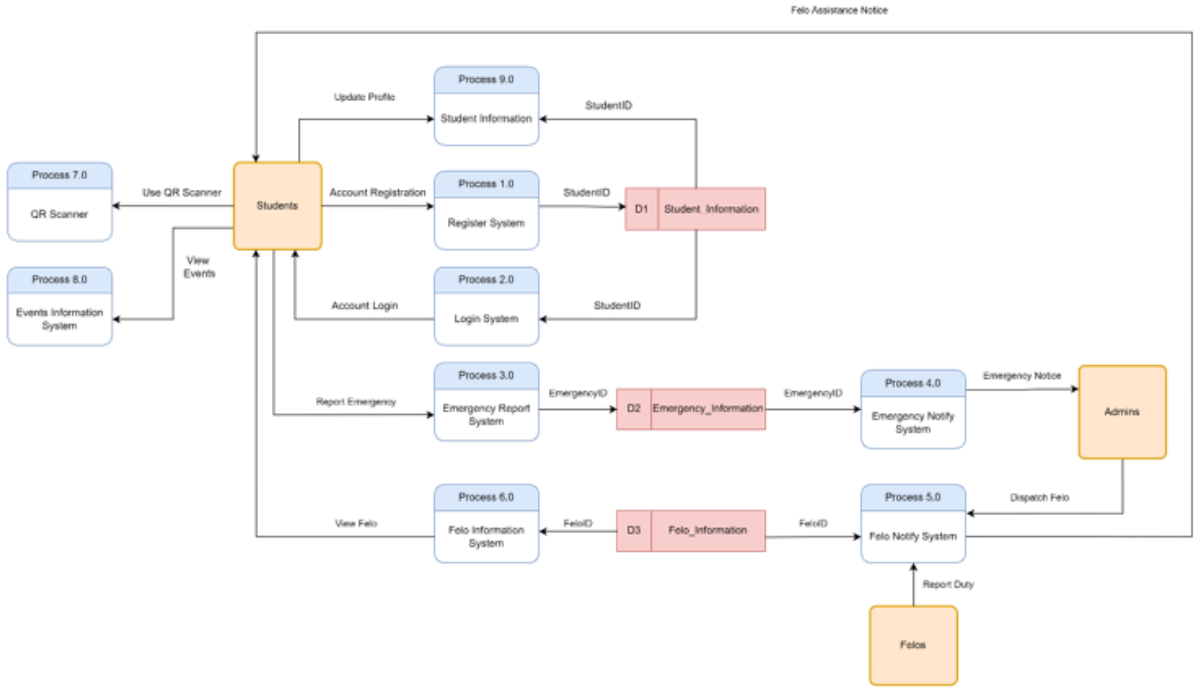


Figure 2. Data flow diagram (Level-0) of *NR-Connect*.

3.2.3. Entity Relationship Diagram

The ERD in which representing required data stores of *NR-Connect* is shown in Figure 3. There are three (3) main classes available, including *Emergency_Information*, *Student_Information*, and *Felos_Information*, respectively. These classes are interconnected through the *Emergency_Information*. The attributes in this class includes *EmergencyID*, *CaseType*, *CaseDescription*, *CaseDate*, *CaseTime*, *CaseDay*, *CaseAddress*, and *CaseStatus*. The attributes available for *Student_Information* are *StudentID*, *StudentName*, *StudentEmail*, *StudentPhone*, *StudentPassword*, *StudentState*, *StudentZipcode*, *StudentAddress*, *StudentMatric*, and *StudentImg*. As for the *Felos_Information*, the available attributes are *FeloID*, *FeloName*, *FeloPhone*, *FeloEmail*, *FeloPassword*, and *FeloImg*.

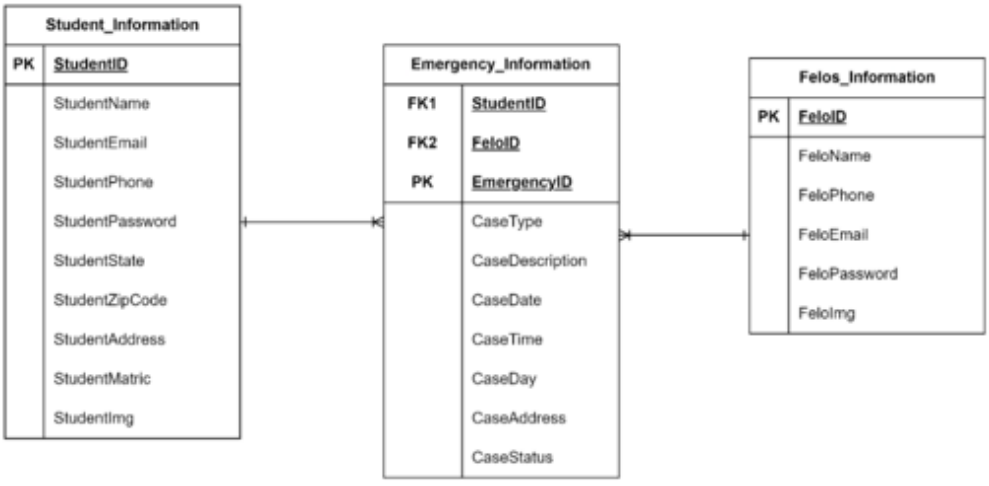


Figure 3. Entity relationship diagram of *NR-Connect*.

4. RESULTS

NR-Connect is developed using the *Dart* language. *Dart* is an open-source language developed by *Google* that predates *Flutter*. However, *Flutter* heavily relies on *Dart* for its functionality. *Dart* code can be compiled to native code for different platforms (i.e., *Android*, *iOS*, web), allowing for a single codebase to be deployed to various platforms, which is a core advantage of *Flutter*. *NR-Connect* uses the *Android Studio* for the environment, which is designed specifically for the *Android* operating system. *Android Studio* offers a great user interface for developing *NR-Connect* and the ability to use *Flutter* as its extensions, making it very reliable compared to using *C#* as the base language. *NR-Connect* also use *Firebase*. *Firebase* is a comprehensive platform developed by *Google* specifically for building mobile and web applications. It offers a suite of tools and services designed to simplify the development process and enhance the functionality and scalability of applications. One of the core features of *Firebase* is its *Realtime Database*, a *NoSQL* cloud database that stores data in *JSON* format and synchronizes it in real-time to every connected client *Google*. This makes it ideal for applications that require real-time data updates.

4.1. Application

The NR-Connect application consists of six (6) major modules which can be accessed by *Admin*, *Felos*, and *Students*. These modules are: (i) *Login/Registration*, (ii) *Emergency Report*, (iii) *Felos/PIC Detail*, (iv) *Events*, (v) *Student Account*, and (vi) *QR Scanner* module, respectively. As shown in Figure 4, In specific, *Admin* can access or manipulate thirteen (13) functions while for *Felos*, there are six (6) functions are enabled. However, as for *Students*, there are seven (7) functions can be accessed.

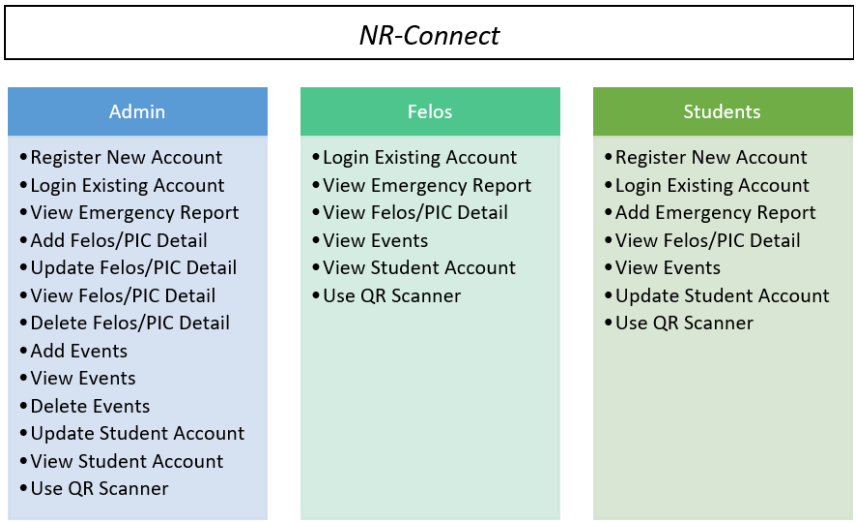


Figure 4. Available functions of *NR-Connect*.

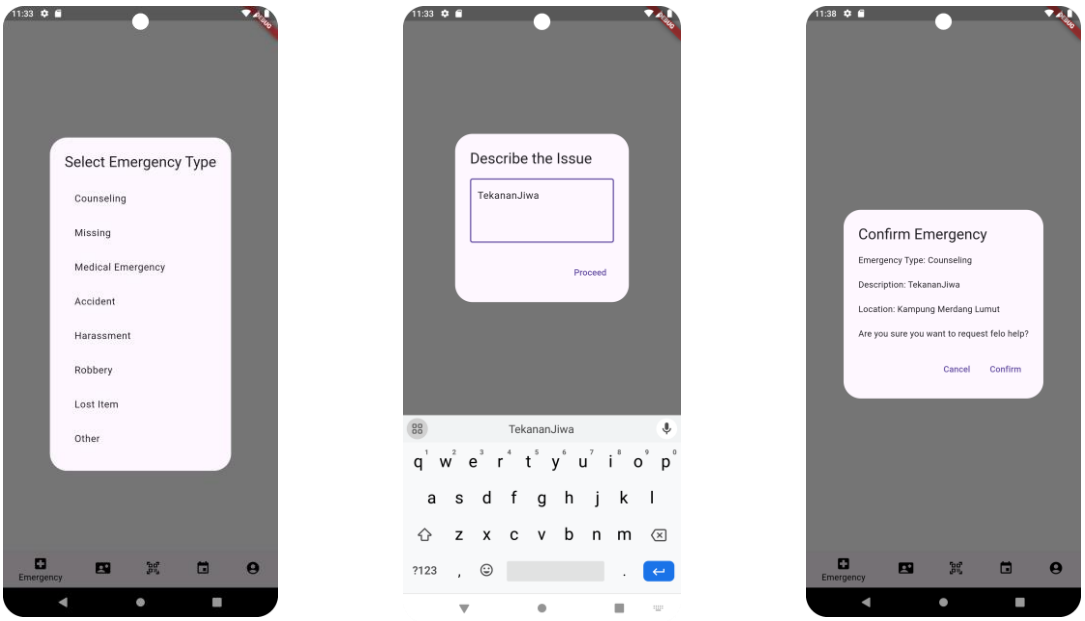
4.2. Emergency Report Module

One of core module in *NR-Connect* is an *Emergency Report*. The aim of this module is to assist NR Students during emergency situation, significantly when the emergency is happened outside UNIMAS. Figure 5 shows the sample of relevant interfaces of *Emergency Report* module. Students simply click “SOS” button, select the emergency type, and describe the issue in detail so that felos and admins can take further action. The emergency report can only be completed by the student, as the data will be saved using the student's information. In addition, the student will be required to identify his/her location and to ensure whether felos’ assistance is needed or not. Once report has been submitted, the notification on felos’ reception will be activated. The report will be saved with the student’s name, contact number, and email, as well as relevant information keyed in during emergency for further action

by the felos. Once the Felos received the notification, any felo nearby can update the status of "I Will Help" button.

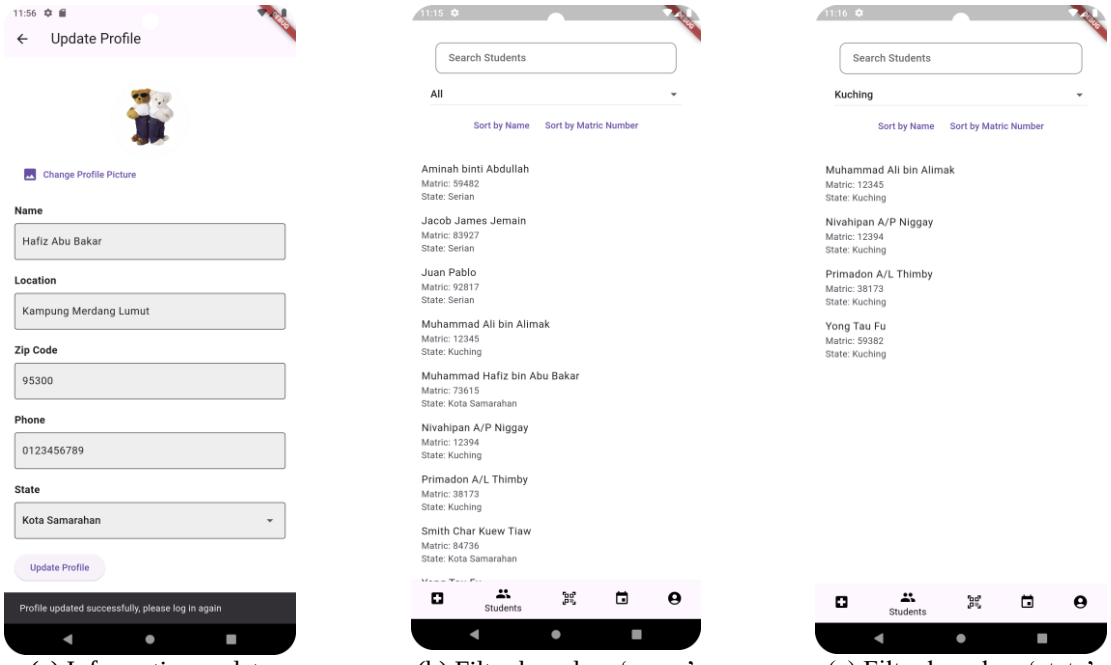
4.3. Student Information

Another important feature of this application is to allow the *Admin* and *Felos* to locate NR students easily based on the information provided. *Students* can be filtered according to their residential areas, student name/matric number, registered states, and specific names as well. *Admin* and *Felos* can view additional information of the registered students, such as their phone number, email, home address, and name. In addition, *Students* can update their accounts based on latest residential location and other related information including their profile. Once updated *Students* are requested to re-login for ensuring the latest data entered to make changes. Figure 6 shows the sample of interface for student information for updating and filtering the list.



(a) Emergency type (b) Issue detail (c) Confirm emergency

Figure 5. Sample of interface for Emergency report: (a) emergency type, (b) issue detail, and (c) confirm emergency.



(a) Information update (b) Filter based on 'name' (c) Filter based on 'state'

Figure 6. Sample interface for Student information: (a) information update, (b) filter based on name, and (c) filter based on state.

5. TESTING

Two types of testing were conducted for *NR-Connect*: (i) functionality testing, in which to test each function of the NR-Connect is implemented correctly and (ii) user acceptance testing, to gain user trust on the developed application. All six (6) major modules and fourteen (14) sub-functions were tested for this application. The sample of functionality testing for *Add Emergency Report* is shown in Table 2 and Table 3, respectively. In Table 2, this test is to ensure (i) the students can send the emergency report and (ii) to cancel the submission of the report. At the other hand, Table 3 is to enable the administrator to delete *Felos*' data in order to remove felo's account entirely when he/she is not responsible for taking care of NR students. Each table has seven (7) components for testing: *Test ID*, *Test Case*, *Input Data* which describing the *Test Case*, the *Expected Result* and the *Actual Result* shown once the testing has been done. If the *Actual Result* shows similar with the *Expected Result*, then, we can say that the *Status* of the testing is *Pass*. Otherwise, it is assumed to be failed. Each of the test can be clarified by identifying the role of each test should be belongs to. As in Table 2, the *User* of the test is *Students* while for Table 3, the *User* is the *Admin*. Both test cases were perfectly passed the test. As for the user acceptance testing, the developed application was revealed to the NR students for their feedbacks. Before *NR-Connect* is deployed for public uses, the application is tested for User Acceptance Testing. Twelve (12) respondents took part in this session and they were requested to give their respond on *NR-Connect* application. Figure 7 shows the sample of their feedback on their confident on using the application. With the scale from 1 (not confident at all) up to scale 5 (strongly confident), all of them are confident to use *NR-Connect* when it is deployed.

Table 2. Functionality testing for *"Add Emergency Report"*.

Module Name : Add Emergency Report **Test Case ID** : 3 **Test Objective** : Verify that a user can successfully report an emergency.						
Test ID	**Test Case**	**Input Data**	**Expected Result**	**Actual Result**	**Status (Pass/ Fail)**	**Role of User**
1	Report an emergency with valid data.	Emergency Type: Medical Emergency Description: Test description Use Registered Address: Yes	User receives a confirmation message that the emergency report has been sent.	User receives a confirmation message that the emergency report has been sent.	Pass	Students
2	User instead choose to cancel report.	Emergency Type: Medical Emergency Description: Test description Use Registered Address: Yes	Report is cancelled and user redirected back to emergency menu	Report is cancelled and user redirected back to emergency menu	Pass	Students

Table *3*. Functionality testing for "*Delete Felos and PIC detail*".

Module Name : Delete Felos / PIC Detail **Test Case ID** : 6 **Test Objective** : Verify the user can successfully delete a felo from the felo list.						
Test ID	**Test Case**	**Input Data**	**Expected Result**	**Actual Result**	**Status (Pass/ Fail)**	**Role of User**
1	Delete existing felo through their ID.	Existing felo with name and email displayed in the felo list.	The felo is removed from the list and a green snackbar appears at the bottom stating, "Felo deleted successfully".	The felo is removed from the list and a green snackbar appears at the bottom stating, "Felo deleted successfully".	Pass	Admin

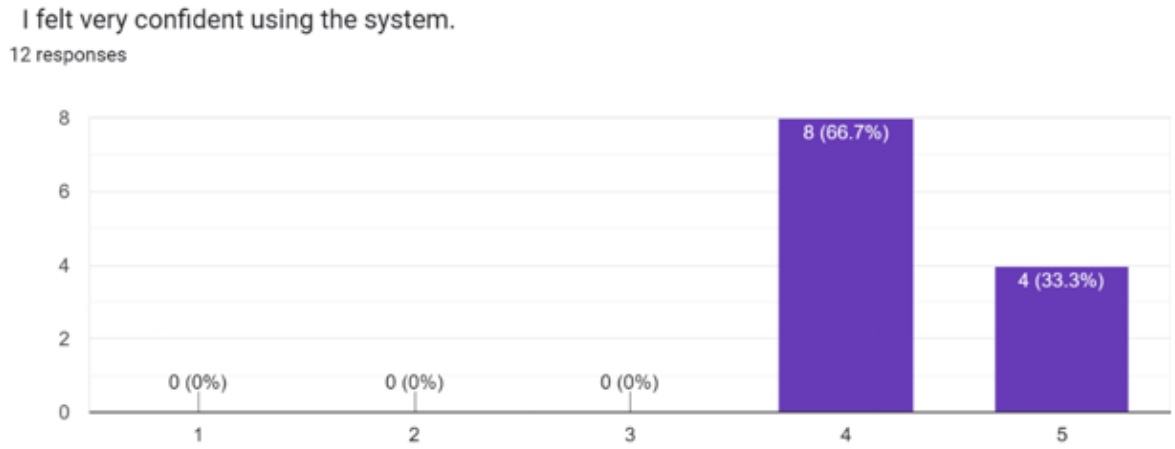


Figure 7. Sample user feedback on system confidence.

6. DISCUSSION

The implementation of *NR-Connect* has successfully addressed several key challenges in student information management and emergency response at UNIMAS. By leveraging modern technologies such as *Flutter* for cross-platform development and *Firebase* for real-time data synchronization tools, we have created a robust and responsive mobile application that caters to the needs of students, felos, and administrators.

One of the most significant achievements of this implementation is the emergency reporting system. This feature directly addresses the safety concerns of students, particularly when they are off campus. The ability for students to quickly send out an *SOS* with location details and emergency type could potentially save lives and demonstrates the practical application of mobile technology in enhancing student welfare.

The use of *Firebase* as our backend solution has proven to be particularly effective. Its real-time database capabilities ensure that critical information, such as emergency reports, is instantly available to relevant parties. This real-time aspect is crucial in emergency situations where every second counts. Additionally, *Firebase*'s authentication services have allowed us to implement a secure login system, ensuring that sensitive student information is protected.

7. CONCLUSION

The *NR-Connect* application was developed to address the communication challenges faced by NR students of UNIMAS. By creating a dedicated platform for these students, the project sought to improve their connection with peers, access to university updates, and overall engagement with the campus community. The project contributes significantly to UNIMAS by addressing the communication gap faced by NR students, who often find it challenging to stay connected with their peers and receive university updates due to living off-campus. By providing a dedicated platform for NR students, the project facilitates better communication and access to information, ensuring that these students remain informed and engaged with the university community. Additionally, the application enables UNIMAS to keep track of NR students' locations, enhancing their safety and ensuring they receive timely support and updates from the university.

However, there are a few of limitations encountered along the way of developing the application. Firstly, the application does not include live tracking or GPS functionality due to the lack of hardware for testing. As a result, it relies solely on the information provided by the students. Secondly, the application is currently available only for Android users, leaving *iOS* users unable to access it at this time. Additionally, administrators who wish to export the *Firestore* database to keep student details must pay for additional features, as *Firebase* only allows admins to view student details in their dashboard without supporting exporting without additional costs. Lastly, the effectiveness of the

application also depends on widespread adoption by NR students and ensuring that all students register and update their information regularly might be challenging.

As for future work, we aim to address these limitations to enhance the functionality and reach of the *NR-Connect* application. Implementing live tracking or GPS functionality will be a priority once the necessary hardware is available, allowing for more accurate and real-time location tracking during emergency situation. Expanding the application to be compatible with *iOS* devices will ensure that all NR students, regardless of their mobile operating system, can benefit from the application. Additionally, exploring alternative methods or securing additional resources to enable administrators to export *Firestore* database details without incurring extra costs will be essential. Lastly, strategies to encourage widespread adoption and regular updates from NR students will be developed, ensuring the application effectiveness and reliability in maintaining up-to-date student information.

ACKNOWLEDGEMENTS

We would like to thank the Faculty of Computer Science & Information Technology, UNIMAS for the guidance and facility provided throughout the study. We also would like to express our gratitude to the Non-Resident (NR) students who provided feedback and cooperation during the data collection sessions, facilitating the acquisition of the project requirements.

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