

Findly.

Fin^oly.

Findly

IT 497: Graduation Project Report Product Release-2

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FINDLY

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Abstract (English):

Lost and found items on university campuses are a real issue where lots of members lose important items of theirs that may affect them negatively despite what the item is. On the other hand, members could find items and struggle to deal with them or take them to the lost and found office. Therefore, Findly came to offer a lost and found item announcements platform that emphasizes communication. Moreover, Findly application has many features such as private chat, chatbot, and notification system. We worked under the Agile methodology to develop Findly, which calls for rapid iteration of working software to achieve continuous delivery. After conducting the system evaluation, all the user stories have been passed. The total results showed a good level of user satisfaction, which is a good indicator.

Abstract (Arabic):

تشكل الممتلكات المفقودة التي يتم العثور عليها في الجامعة مشكلة حقيقة، حيث إن بعض من أعضاء الجامعة يفقدن ممتلكاتهم الشخصية المهمة والتي قد تؤثر عليهم سلباً بغض النظر عن ماهية الشيء، ومن منطلق آخر، قد يغتر البعض على ممتلكات شخصية ضائعة ولا يكون لديهم متسع من الوقت لتسليمها لمكتب الأمانات في الجامعة. لذلك تم إنشاء تطبيق فايندلي، حيث أنه يمكن المستخدمين من الإعلان عمّا تم فقده أو ما تم العثور عليه والتواصل فيما بينهم فيما يخص الإعلان. علاوة على ذلك يحتوي تطبيق فايندلي على العديد من المميزات ومنها محادثات خاصة ومحادثة إليه مع الروبوت ونظام التنبيهات. وقد تم بناء التطبيق تحت منهجية تطوير البرمجيات أجيال، حيث ترتكز على تقديم أجزاء متابعة من البرنامج على أن تكون الفترات بين الأجزاء قصيرة لتحقيق الاتصال المستمر لبرنامج قابل للاستخدام من قبل المستخدمين بشكل أسرع. بعد إجراء اختبار للنظام، اجتازت جميع فصص المستخدمين بنجاح وأظهرت النتائج دلائل إيجابية وحصلنا على مستوى عالٍ من رضا المستخدم.

Keywords: KSU, KSU member, SDLC, loss, found, announcement, lost and found office, chatbot, notification.



1
INTRODUCTION

1 Introduction

Whenever we lose an item on campus, we may start manually sending messages about it in groups or writing a note and leaving it on the announcement wall located in the college lobby, which is not a very recognizable way and can take a lot of time and effort. Although there is a lost and found office, some people do not bother or find it hard to take the lost item to the office, because they may be busy with classes and other responsibilities. For example, students may be busy with assignments and exams and preparing for them, so it will be difficult for them to frequently review the office. This scenario applies to administrative staff and faculty members. And most importantly, the lack of communication between the finder and the person who lost an item, and this has always been an issue in such cases. A real-life example happened with one of our team members, when she lost her university ID and couldn't get it until the following semester, which is a long time, and it is one of the most important documents for a student.

Findly was developed to offer a platform for lost and found items on the KSU female campus by solving the lack of communication between the person who loses an item and the person who found their item. The application is designed for King Saud University female members which include students, faculty members, and administration employees.

Findly will provide many features for the user, such as:

- View lost/found announcements.
- Add / delete / edit announcements.
- Contact through private chat.
- Get assistance from a chat bot.
- Notifications system of matching category announcement and oppose type.



As well as it will provide many features for the admin, such as:

- View lost/found announcements.
- View/ manage reported announcement.
- Add category or building name.

Moreover, *Findly* software is an Android mobile application. It will be programmed using Dart programming language and under flutter framework. Also, it will support the English language for the current time.

Additionally, *Findly* vision is: For a female member of KSU who finds\loses an item, who strives for a platform that helps them to find their lost items or to add an announcement about found items, the *Findly* is an Android mobile application, that shows lost/found items, to help re-uniting the owners with their lost items, unlike Get it back – Lost and Found application [1], our product will notify the users with matching category announcements, and it will offer the assistance of a chat-bot.

We followed the Agile Software development life cycle (SDLC) methodology, which involves developing software in increments. We have delivered five increments in two releases.

Building the software started from the planning stage to find out the best solutions and ideas appropriate for implementation to solve our defined problem. Requirements elicitation is an essential process where we worked to analyze our users and understand their needs. During the process, we employed a range of techniques to elicit requirements as we generated the main requirements by using two requirements discovery methods where we conducted interviews and published questionnaires. Therefore, based on the requirement elicitation results we decided on the features for the application. Following that, we started to develop the design of the software according to the



specifications written during the planning stage. We built the architecture design of the system structure of the database along with the component-level designs and the user interfaces. After that, the team started to implement the application and as the application was evolving, we updated the system design accordingly. When the application was complete, we started the system evaluation and testing stage to assure high product quality. The application was tested in the real world by its intended audience. Testers write some high-level test scenarios and provide them to different users to take their feedback and get reports of the bugs if there are any to help build the application more efficiently[2].

Our solution to the defined problem was to develop a mobile application that will allow the users to have a platform where they can announce items that were lost on KSU female campus. In addition, it will help the campus members return any items they find to their owners in a faster and easier manner. *Findly* would solve the problem by enhancing the communication process via private one-to-one chat rooms between the users to exchange information about the announced item more effectively. Moreover, users will be able to instantly navigate and search through numerous Find/Lost announcements. This is done with the swipe of a finger which will save users considerable effort and time.

In a global sense, this solution can provide inspiration in high-traffic areas like airports, entertainment places, and shopping malls to create similar lost and found item announcements platforms. With an increase in crowded areas comes an increase in lost items. As such, *Findly* platform could help reduce the amount of lost and found items that remain unclaimed or end up in landfills. By encouraging the return of lost items, *Findly* could help reduce waste and the negative environmental impact of manufacturing new items to replace lost ones.

Locally, *Findly* provides the KSU female campus with a tool that assists in gathering lost & found items and improves communication through an announcement system. This will eventually make it easier to connect lost and found items with their owners. Moreover, the application could help reduce



the amount of time and energy university staff spend on managing lost and found items, allowing them to focus on other duties. *Findly* could also promote a sense of community among university members by encouraging them to help each other out by returning lost items.

Overall, *Findly* has the potential to make a positive impact both locally and globally, by reducing waste, promoting sustainability, and fostering a sense of community among university members.

Findly stands out from its competitors by offering specialized chatbot assistant technology. In addition, *Findly* is dedicated to a specific type of user and a specific area which is the KSU female campus, yet our competitors in the market offer their services in a much more general manner and without any user distinction.

The remainder of this document is organized as follows: chapter 1 represents the introduction which describes the problem and solution. Chapter 2 represents the background and descriptions of domain knowledge. Chapter 3 provides a literature review that shows the *Findly* competitors. Chapter 4 system represents the Product Backlog, system design, and implementation. Chapter 5 provides the system evaluation which includes User Acceptance Testing. Chapter 6 draws the conclusions and future work. Chapter 7 is for Acknowledgements. Chapter 8 provides the list of references, and lastly, chapter 9 includes appendices for extra details and information



2 BACKGROUND

2 Background

Findly would solve the defined problem by providing many functionalities to enhance the experience associated with lost and found items in our application, including notifications, search, and filtering, chatbot assistance. Therefore, this chapter will provide a general background about the used features and will also concentrate on the methods that are applied in our application.

2.1 Notification systems

Users have been informed of events or changes within an application or system for a long time via notification systems. They assist users in staying informed about crucial updates or actions that need to be made and are a crucial communication tool.

The term "notification" refers to a message that the device shows to the user outside of the user interface (UI) of the program to tell them of reminders, other users' communications, or other timely information from your app. Users can tap the notification to open the application or take an action directly from the notification. [3]

Notification systems can be classified into two main categories:

- **Local notifications(In-App notification):**

Messages that the user gets inside the application after they have opened it and are generated and displayed by the application itself. They are generally pre-scheduled and fire when certain actions are performed by the user in the app. [4]

- **Push notifications:**

The term *Push notification* just defines that the message is coming from a remote server and is pushed/sent directly to your device in real-time. They are messages that the user sees without opening the app and is often used to alert the user of events or changes that are not specific to the application, such as the arrival of a new email or the availability of a software update. [4]



Both types of notifications can be useful in different contexts, and the choice between the two depends on the specific needs of the application.

In *Findly*, we used Firebase cloud Messaging (FCM), which is a mobile messaging service developed by Google that allows app developers to send push notifications and messages to their users on Android, iOS, and web applications. It is a cross-platform messaging solution that lets you reliably send notifications to single or a group of devices.

Token-based push notifications

Token-based push notifications in Firebase relate to a mechanism that allows a server (in our example, Firebase Cloud Messaging or FCM) to send push notifications via tokens to particular devices or users. The Firebase SDK generates tokens on the client side, which are one-of-a-kind identifiers that signify a certain device or person.

Firebase SDK generates unique tokens on the client side for devices and users. When a user installs the app, the Firebase SDK generates an encrypted and authenticated token that is sent to the server. This token, unique to the device, is used to send push notifications securely and reliably.

Token-based push notifications are easy to integrate into apps with Firebase's APIs and tools. With FCM, it is possible to target users and deliver notifications based on preferences and behaviors, providing them with the latest app news and updates [5].



To further enhance user experience, we implemented local notifications along with push notifications. As it is best to use both components together.

2.2 Search and Filtering

2.2.1 Search

Users might feel overwhelmed with huge number of announcements while they search for specific item, unless we minimize their efforts by providing them with a search box and give them a fast-track way to get where they want to go in the application.

A search box or search field is a common graphical user interface design element, one which allows the user to enter letters, words, and terms in a web search engine, application, etc. As a result, users expect it to return content *directly related* to their input. [6]

Search boxes are usually found in Lost & Found Applications. for example: "Lost Property", "Mafqudat", and "Mafqud " and *Findly* as well. as a main feature to help the user look for what they want easily and fast. The search type in our application would likely be a keyword-based search. The reason for this is that users of the application would likely enter keywords related to the item they have lost or found to locate it within the database.

For example, a user who has lost their wallet might enter keywords such as "wallet", "credit cards", or "id card." A keyword-based search process would then go to the database and perform a search for any records that match those keywords and return them to the user.



2.2.2 Filtering

Filtering is a common technique that is used to reduce the amount of data that needs to be processed or displayed. It allows users to narrow down many items to a smaller, more manageable subset that meets certain criteria, making it easier to find specific items or patterns within the data. [7]

Filtering has been used in various contexts for many years, including in database management, data analysis, and user interfaces. In the context of user interfaces, filtering is often used to allow users to find specific items within a list or data set more easily, by applying specific search criteria or filters.

Filters can be applied manually by the user or automatically based on predefined rules.

In *Findly* the user is able to filter manually based on date of publishing the announcements, category of the announcement, and the building where the item was lost or found.

2.2.3 Searching in filtered results.

Along with that, *Findly* application gives its users the ability to search in filtered results, where the user can narrow the filtered result further with Search feature.



2.3 Chat-bot

The basic function of a chatbot is to mimic and interpret human speech and typed communication as if it were real, enabling users to converse with digital devices as if they were speaking to a real person. There are many kinds of chatbots, ranging from simple one-line programs to more complex digital assistants that can learn and evolve as they learn and process more data to provide even more personalized service. Data is processed by chatbots to answer questions of all types. They are powered by AI, automated rules, natural-language processing (NLP), and machine learning (ML).

Chatbots fall into two main categories:

- **Task-oriented (declarative) chatbots:**

Dedicated programs that are intended to accomplish a specific task. Their automatic responses to user inquiries are based on rules, natural language processing (NLP), and very little machine learning (ML). Imagine strong, interactive FAQs when thinking of these chatbots, which are highly specialized, well-structured, and best suited for support and service operations. An automated chatbot that is designed to cater to task-oriented inquiries, such as inquiries relating to business hours and straightforward transactions with few variables, can handle frequent inquiries with ease. Despite employing natural language processing (NLP) to enable conversational user experiences, they are somewhat limited in their capabilities. Most of the chatbots currently in use fall under this category.

- **Data-driven and predictive (conversational) chatbots:**

These systems, which are on a level of sophistication, functionality, and personalization far beyond task-focused chatbots, are often referred to as "virtual assistants" or "digital assistants". A chatbot can learn as it goes through natural language understanding (NLU), natural language processing (NLP), and machine learning (ML). By utilizing predictive intelligence and analytics,



these chatbots can offer personalization based on the profiles of users and previous behaviors of users. As a user's preferences are gradually learned, digital assistants can make suggestions, and even anticipate needs. Additionally, they can monitor data and intent and start dialogues. Apple's Siri and Amazon's Alexa are both examples of consumer-centric, data-driven, predictive chatbots.

As well as linking multiple chatbots that serve a single purpose, advanced digital assistants gather data separately and then combine this data to carry out a task while maintaining context, so the chatbot does not get "confused".[8]

Chatbots can add to the user experience while using found and lost applications in several ways such as what we implemented in *Findly* using Dialogflow, where *Findly* chatbot assists the users to choose the category of the item to be announced.

Dialogflow

"Dialogflow is a natural language understanding platform that makes it easy to design and integrate a conversational user interface into your mobile app, web application, device, bot, interactive voice response system, and so on. Using Dialogflow, you can provide new and engaging ways for users to interact with your product.

Dialogflow can analyze multiple types of input from your customers, including text or audio inputs (like from a phone or voice recording). It can also respond to your customers in a couple of ways, either through text or with synthetic speech.".[9]

The Google Cloud Platform hosts Dialogflow, as a Google service. Dialogflow is an intuitive and user-friendly tool that includes Google's machine learning expertise and some Google products. NLP (Natural Language Processing) platform Dialogflow is used to create applications for conversations and experiences for the company's clients across a number of platforms and languages. The majority of Google Assistant actions are built using Dialogflow [10].

How does Dialogflow work?

We will be using Dialogflow AI conversational agent in our application to provide our users with a chatbot assistant to help them choose the most suitable category for the item that they want to announce about. When the conversation is initialized between the user and the chatbot by the user, the service will start and figure 1 shows a representation of the steps listed below:

- 1- The chatbot will prompt the item name from the user.
- 2- The user will provide that information and *Findly* application will deliver it to the Dialogflow conversational agent.
- 3- The chatbot will provide the user with the most appropriate category to announce the item on, by taking the item name and run it under a model that will classify or categorize the input to the matching intent this process is named “Intent matching” as mentioned previously.
- 4- When an intent is matched, Dialogflow uses assigned entities or context parameters and prepares formatted and personalized answers and detects a response and forwards it to the application to

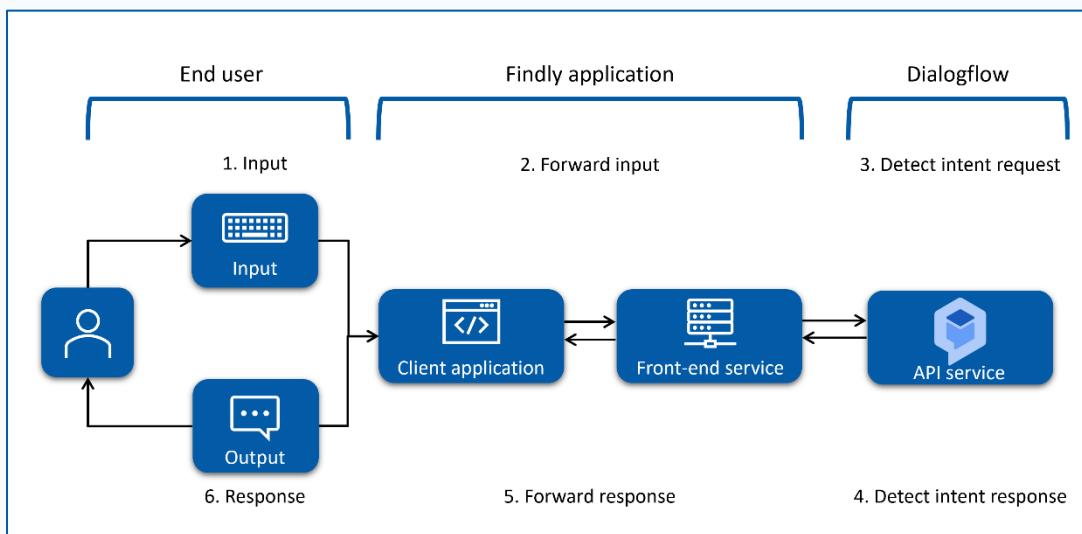


Figure 1 Dialogflow work steps.[9]



Why Dialogflow?

Dialogflow simplifies the coding process, which helps developers save time. With the system's integrated inline code editor, developers may do all their coding-related duties. Using this, their agents can connect to their application either on-premises or over Cloud Functions.

Google's machine learning technology is now supporting and powering Dialogflow, dramatically enhancing its capabilities. This provides a platform for app developers to educate their chatbots to understand people better. This is accomplished by taking the pertinent information from the conversation and applying it to help the AI comprehend the conversations. Dialogflow can be used to build chatbots that can have more natural conversations. This means that even when the clients are speaking to a machine or an application program, usually to request help or support, they will still get contextual responses. The chatbot wouldn't seem overly mechanical or robotic. [11]



3
**LITERATURE
REVIEW**

3 Literature Review

This section will review and compare our potential competitors by defining them and mentioning some of their features as well as providing their logo and some screenshots of their interfaces, those will be helpful for us during project requirement specification and elicitation.



3.1 Get it back – lost & found



Figure 2 Get it back - lost & found logo.

Figure 2 shows Get it Back - Lost & Found application logo [1] which is an Android app for finding lost, stolen, or found items to give to their owners. Also, it allows finding lost objects by searching for found items added by others.

Some Get it Back - Lost & Found application features are:

1. Users can Report things that were lost, stolen, or found anytime and anywhere.
2. Users can search for missing lost items and then can go to corresponding category to find objects.
3. Users can Upload/View images of lost or found items or missing people's photo or pet's pic or lost Fitbit.

Figure 3 shows Get it back - lost & found interfaces:



Figure 3 Get it back - lost & found interfaces.



3.2 Mafqud



Figure 4 Mafqud logo

Figure 4 shows Mafqud [12] which lets users announce what they have lost or found.

Some Mafqud application features are:

1. Users can delete or modify any announcement or add an announcement.
2. Users can add new categories to the application.
3. Users can view members' comments on the announcement with the possibility of activating them, deactivating them, or deleting them permanently.
4. Users can contact each other through private chat.

Figure 5 shows “Mafqud” interfaces:



Figure 5 Mafqud interfaces.

3.3 Mafqudat



Figure 6 Mafqudat logo

Figure 6 shows Mafqudat logo [13]. Mafqudat application is designed to help you find your lost items as well as announce everything you find.

Some of Mafqudat application features are:

1. Users can contact each other through private chat.
2. Users can filter the lost and found announcement according to the item's category and date and location.
3. Users can receive notifications on their mobile of everything happenings within the application, whether it is a new post, comment, sharing of a post, or private messages.

Figure 7, shows Mafqudat interfaces:

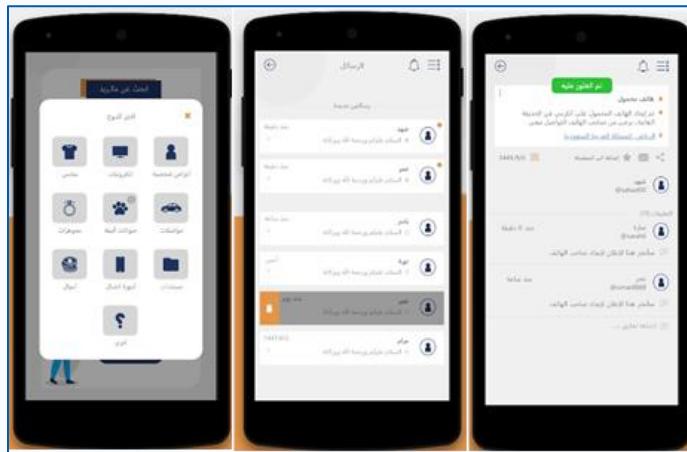


Figure 7 Mafqudat interfaces



3.4 Lost Property



Figure 8 Lost Property logo

Figure 8 shows Lost property application logo [14]. Lost property is an advanced and simple application that helps connect items (such as baggage or pets) lost at airports, cruise liners, hospitals a, etc. to its owners, file auto police complaints, anywhere in the world with the option to ask finders to deliver at your doorstep.

Some of lost property application features are:

1. Users can search the last 48 hours location.
2. Users can contact lost item finders via call, email, video calls & chats.
3. Users can submit lost & found item.
4. Users can activate auto notifications for any found or lost items.

Figure 9 shows Lost Property interfaces:

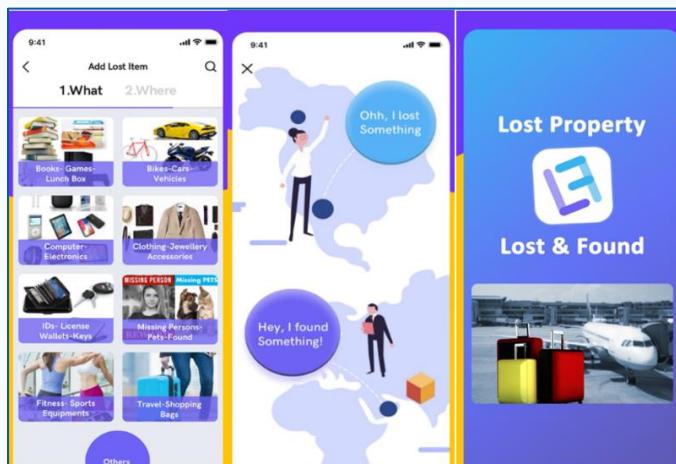


Figure 9 Lost Property interfaces



3.5 Lost And Found



Figure 10 Lost And Found logo.

Figure 10 shows Lost And Found application logo [15]. Lost And Found is an Android app for reporting lost, stolen or found items. You can also search for the lost or found items added by others.

Some of Lost And Found application features are:

1. Users can send messages through chat.
2. Users can report things that were lost, stolen or found.
3. Users can search for missing people and found items added by others and contact them.
4. Users can upload/view images of lost or found items or missing people's photo.

Figure 11 shows Lost & Found interfaces:

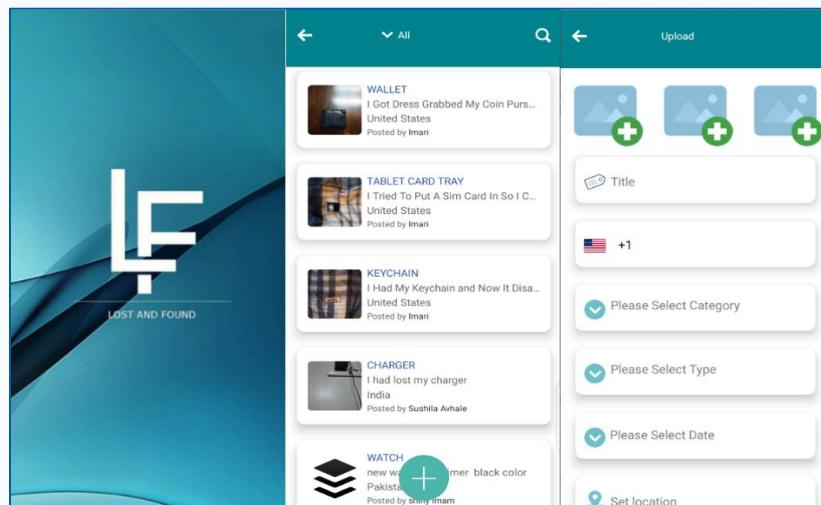


Figure 11 Lost and Found interfaces.



Table 1: illustrates a comparison between *Findly* and its competitors.

Table 1 Competitive analysis.

Application name \ futures	<i>Findly</i> 	Get it back – lost & found 	Mafqud 	Mafqudat 	Lost Property 	Lost And Found 
User can Register	Yes	Yes	Yes	Yes	Yes	Yes
User can view\edit their profile page.	Yes	*	Yes	Yes	Yes	Yes
User can add an announcement about lost or found items.	Yes	Yes	Yes	Yes	Yes	Yes
User can view all announcements.	Yes	Yes	Yes	Yes	Yes	Yes
User can search by the item name.	Yes	Yes	Yes	Yes	Yes	Yes
User can filter the announcement.	Yes	Yes	Yes	Yes	Yes	Yes
User can contact through private chat.	Yes	Yes	Yes	Yes	Yes	Yes
User can contact through email.	Yes	No	No	No	Yes	No
User can contact through phone number	Yes	No	No	No	Yes	No
User can get assistance from a chatbot	Yes	No	No	No	No	No



User can get notifications	Yes	*	Yes	Yes	Yes	*
User can view members' comments on announcement	No	*	Yes	Yes	No	*
User can report an announcement	Yes	No	Yes	No	No	No
Language	English	English	Arabic	Arabic	Arabic / English / France / Chines/ Indian/ Urdu	English

* Means no information available since the application does not work well.

3.6 Summary of competitive analysis

Findly is an application that helps KSU members find their lost items or return found items on the female campus, whereas other applications are available to the community. Despite some of our competitors' applications having similar features to ours, none of them combines all the features. The feature of our application that make *Findly* different is that users can get assistance from a chatbot Finally, there are some of our competitors like "Mafqud"[12] and "Mafqudat"[13] that offer the feature to add a comment on announcement, but we did not find this feature to be of great benefit to our users. Therefore, this feature is not provided by our application.



4

SYSTEM DESIGN AND DEVELOPMENT

4 System Design and Development

4.1 Methodology

In this project, we followed the Agile SDLC methodology that is based on collaborative decision making between requirements and the team, and a cyclical, iterative progression of producing working software. The project is done in regularly iterated cycles, known as sprints, that usually last for two to four weeks [2].

FinDly team applied the agile approach by working to continuously deliver small pieces of working software created in rapid iterations and concurrently testing them, to focus on continuous improvement for our application and to respond to change more efficiently. Our team Consist of software developers regularly meeting in-person and online throughout the software development lifecycle.

Scrum is an agile project management framework that helps teams' structure and manage the work through a set of values, principles, and practices. Scrum encourages teams to learn through experiences, self-organize while working on a problem, and reflect on their wins and losses to continuously improve. [16]

Roles in Scrum

- 1- Scrum master: The person who leads the team guiding them to comply with the rules and processes of the methodology.
- 2- Product owner: Is the representative of the stakeholders and customers who use the software.
- 3- Scrum Team: A group with the necessary technical knowledge who develop the project jointly carrying out the stories they commit to at the start of each sprint. [16]



Events in Scrum

Each of the Scrum events facilitates the adaptation of some of the aspects of the process, the product, progress, or relationships.

1- Sprint: Sprint is the basic unit of work for a Scrum team. This is the main feature that marks the difference between Scrum and other models for agile development.

2- Sprint Planning: The goal of the Sprint Planning is to define what is going to be done in the Sprint and how it is going to be done.

3- Daily Scrum: The objective of the Daily Scrum is to evaluate the progress and trend until the end of the Sprint.

4- Sprint Review: The goal of the sprint review is to show what work has been completed with regards to the product backlog for future deliveries.

5- Sprint Retrospective: The team reviews the completed goals of the finished sprint, write down the good and the bad, so as not to repeat the mistakes again. [16]

Scrum Artifacts

Scrum Artifacts are designed to guarantee the transparency of key information in decision making.

1- Product Backlog: a list that collects everything the product needs to satisfy potential customers.

2- Sprint Backlog: It is a subset of items of the product backlog, which are selected by the team to perform during the sprint on which they are going to work.

3- Increment: The Increment is the sum of all the tasks, use cases, user stories, product backlogs and any element that was developed during the sprint and that will be made available to the end user in the form of software. [16]



How it all works together

Scrum roles, artifacts, and events (3x5x3) work together within a sprint cycle. The product owner defines a vision using information from stakeholders and users. They identify and define pieces of value that can be delivered to move closer towards the product goal. Before the developers can work on any pieces of value, the product owner must order the backlog so that the team knows what is most important. The team can help the product owner further refine what needs to be done, and the product owner may rely on the developers to help them understand requirements and make trade-off decisions.

During sprint planning, the developers pull a chunk from the top of the product backlog and decide how they will complete it. The team has a set time frame, the sprint, to complete their work. They meet at the daily scrum to inspect progress towards the sprint goal and plan for the upcoming day. Along the way, the scrum master keeps the team focused on the sprint goal and can help the team improve.

At the end of the sprint, the work should be potentially shippable and ready to be used by a user or shown to a stakeholder. After each sprint, the team conducts a sprint review on the Increment and a retrospective on the process. Then they choose the next chunk of the backlog and the cycle repeats [16].

Our project has a scrum team that consists of four members and guided by the product owner and takes the lead from the scrum master. The *Findly* team used the agile methodology by striving to continuously provide small working software parts (sprints) developed in quick iterations and simultaneously. During the sprint *Findly* team plan to accomplish the sprint backlog that is adapted from the product backlog in early stages to achieve the sprint goal. *Findly* team conducts an everyday meeting (daily scrum) that focuses on progress toward the Sprint Goal and produces an actionable plan for the next day of work, and to improve the communication between the team members. At the end of each sprint, a sprint review is conducted with the project supervisor to inspect the outcome of the sprint and adapt the backlog going forward.



GitHub is a website and cloud-based service that helps developers store and manage their code, as well as track and control changes to it.[17]

We will be using (GitHub¹) tool to manage our project and allow us to work collaboratively. Additionally, it provides an easy way to manage our code and keep track of version history [18]. Jira Software provides planning and roadmap tools so teams can manage stakeholders, budgets, and feature requirements from day one[19]. We will be using the project management software tool (Jira²) to manage work and to keep all the data in the same place , resolve bugs, launch a new feature, and to get top traceability of our project[20].

4.2 System Requirements

Because stakeholders frequently have ideas, wishes, or needs floating around in the back of their brains but may not be obvious to themselves, stakeholder analysis is essential. As a result, we employed a range of techniques to elicit requirements, including open-questions user interviews to get a better understanding of the users' wants, and closed-questions online questionnaire to gather more information from respondents. We can determine what users really want using these techniques.

4.2.1 System Users

Findly mobile applications are usable by users with any educational level and basic technical skills that enable them to take advantage of the features that the application offers, such as: searching, filtering, Chat-bot messaging, etc.

¹ <https://github.com/Faijot/2022-GP1-5>

² <https://2022-gp5.atlassian.net/jira/software/projects/GP/boards/1/backlog>



4.2.2 Requirements Elicitation and Analysis

During the requirements elicitation stage, we looked for similar systems and we downloaded their applications such as (“Mafqud”[12], “Mafqudat”[13]), to have a better understanding of the functions and we also got answers of our stakeholders by using two requirements discovery methods which are an online questionnaire that received 103 responses and we conducted 3 interviews with 3 interviewees (2 online interview and 1 on-campus interview), to get a better understanding of what the users’ needs truly are.

According to the questionnaire’s summary, it showed that a diversity of KSU members have answered the questions, and we figured out that 54.4% of them have lost an item on campus which is a concerning rate since that 48.3% of them did not get their items back. Also, the results cleared that 65% of the users have found a lost item but only 17.6% of them took it to the lost and found office, and 47.1% of them used social media applications or the college lobby board to announce about the item. Moreover, “Communication” was the hardest challenge since it got 73.8% of votes, “Time-consuming” and “Effort-consuming” came after with percentages of 60% and 55% respectively. Most of the users agreed that creating an application that facilitates the process of announcing about lost/found items on campus might help returning the items to their owners since “Yes” got 83.5%. “Private chat” was the most preferred way of communication and it got 67% of total votes. In addition, “Private chat”, “Searching”, and “Filtering” were the most requested features having percentages of 83.2%, 67.3%, and 61.4% respectively. The users had the ability to suggest other features and provide more information. The questions and the graphs used in the analysis can be viewed in appendix A section.

Based on interview results, we found that only one interviewee has lost an item on campus. She lost it and got it back after three days by informing all her colleagues on WhatsApp groups. In Addition, while all of them have found a lost item, they expressed different ways to what they did with it. The first interviewee, she would keep them in her office and try to keep them safe until the owners would come and ask about their items, the second interviewee, she gave it to the (lost and found) office, the last interviewee

she would place an announcement of the found item at the place of where it was found and include communication information in the announcement.

And regarding the method of returning the found item to their owners, it depends on how they dealt with it, if she gave it to the lost and found office, she would not know any further information about how long it took to return it or the owner's identity. But if she kept it with her the returning time varies, some items take hours and others take a week or more. And some others may take more than a year to be returned.

The challenges that they faced during their experience with lost/found items are many, such as: The communication issue and knowing the identity of the owner and if the item really belongs to her. They all agreed that creating an application to facilitate the process of announcing lost and found items on campus might help return items to their owners.

Therefore, the features that they suggested to be in the application were:

1. offering a communication method.
2. including category in the form of the lost or found item.
3. If a lost item is found in a certain place, this place should be specified either by map or another way, so that the owner can know the place where she/he lost the item.
4. The ability to include more details about the item and images in announcements.

Lastly, they all agree they would like to have an account on it to save their records and chat.

Interviews details can be found in appendix B.



4.2.3 User Interactions

In *Findly* application there will be two use cases, one for the user, and one for the admin.

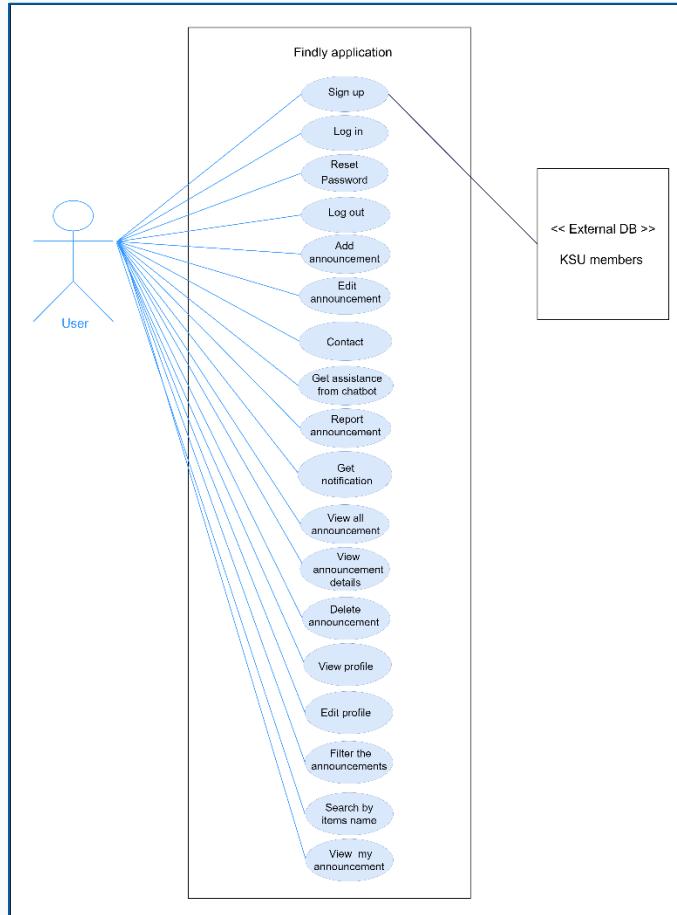


Figure 12 Findly user use case [21].

The *Findly* user use case diagram in figure 12 shows that KSU female members can sign up and log in. By logging in they will be able to log out, view and edit their profile. In addition, the *Findly* user can add, view, edit, and delete announcement, view announcement details, search by item name, filter the announcement according to the item's category, date and the college building where the item was lost/found, contact through private chat, phone number, or email, get notifications, report an announcement, and get assistance from a chat-bot.



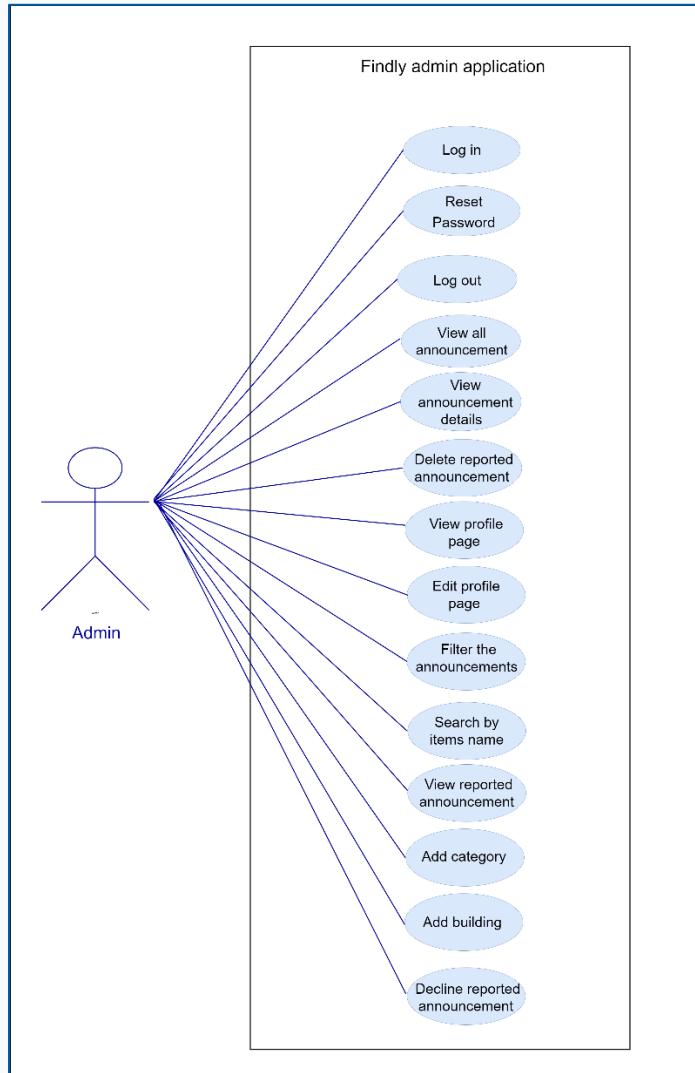


Figure 13 admin use case [21].

The *Findly* admin use case diagram in figure 13 shows that the admin can log in , reset password, log out, view and edit her profile, and view announcements. By viewing all the announcements, she will be able to view announcement details, view and delete reported announcements, she will be able to filter the announcement according to date, buildings name and category, search for a specific announcement. Lastly, she can add new location or new category.



4.2.4 Roadmap and Product Backlog

In this section, we will represent our roadmap as shown in figure 14

It is designed to deliver the application in two releases. Release one includes the proposal,sprint0, and sprint1 and release two includes sprint2,sprint3, sprint4 and sprint 5.

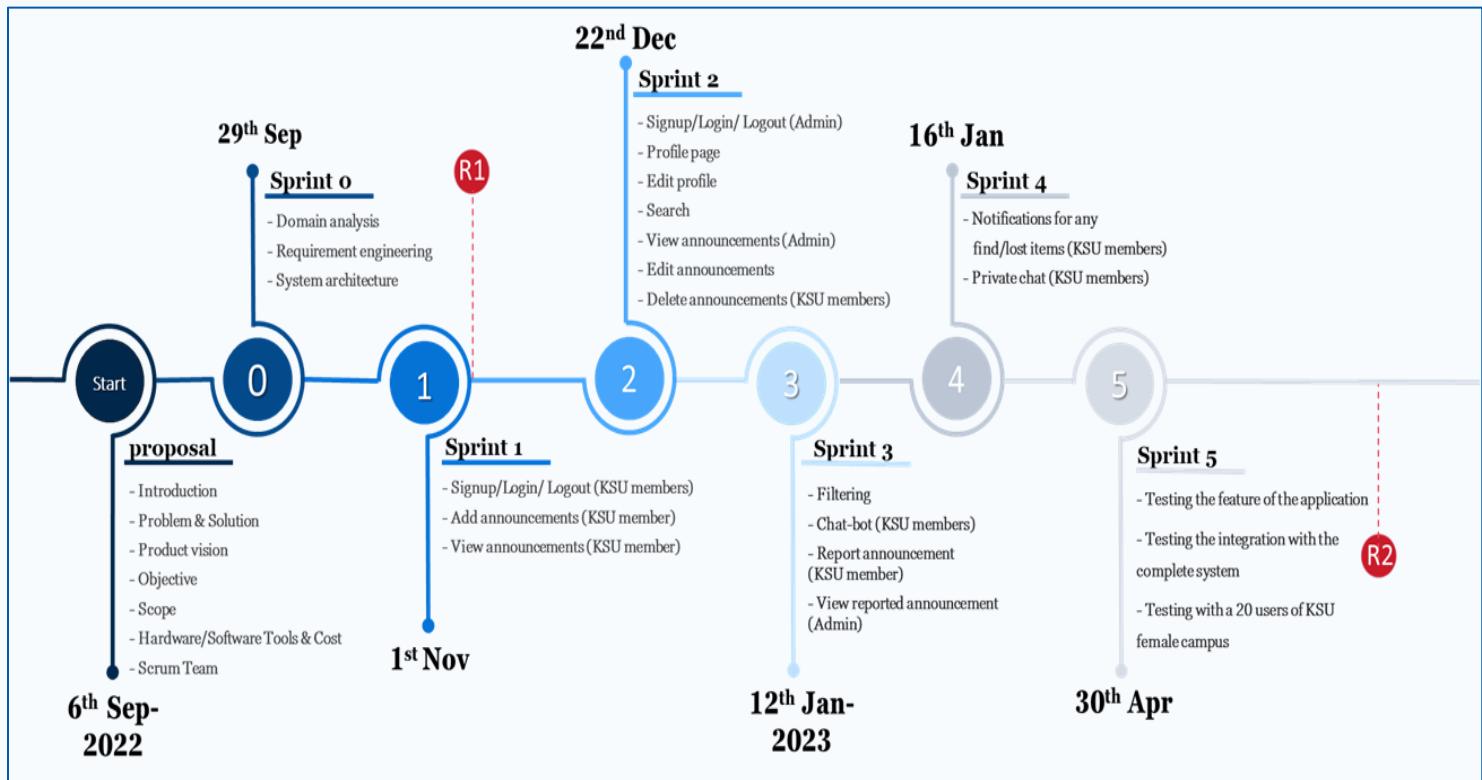


Figure 14 Findly roadmap [22].

Table 2 Findly Product Backlog.

ID	PBIs (User Stories)	Size	Type	Status	Acceptance Criteria
"User" user stories					
1	As a user I want to sign up by creating an account so that I can benefit of the application features.	3	Feature	Done	<ul style="list-style-type: none"> -As a user, if I don't fill a mandatory field then I will receive an error message. -As a user, if I fill a field in a wrong format then I will receive an error message. -As a user, if I complete the form correctly then I will receive a conformation message and my account will be creates and my information will be saved to the database. -As a user, if I completed the form correctly and received a confirmation message then I will be directed to a log in screen.
2	As a user, I want to log in so that I will be able to access my account.	3	Feature	Done	<ul style="list-style-type: none"> -As a user, if I fill a field with a wrong value then I



					will receive an error message. -As a user, if I filled the fields correctly, then clicked on “Log in” I will be directed to my dashboard screen and a confirmation message will appear.
3	As a user, I want to reset my password, so that I will be able to reclaim access to my account if I forgot my original password.	3	Feature	Done	-As a user If I want to log in but forgot my password, I will click on “Reset it now” in Log in screen, then I will be redirected to Reset Password screen. -As a user, If I typed my email in Reset Password screen then clicked on “Reset Now!”, then I will get an email with a link to reset my password and a confirmation message will appear. -As a user if I clicked on the link in my email, I will be directed to a web page to update my password and it will be updated in the database.
4	As a user, I want to log out so that the content is inaccessible to others.	3	Feature	Done	-As a user, if I click on the drawer “Log out” then a pop-up dialog will appear.



					<p>-As a user, if the pop-up dialogue appeared and I clicked "Cancel" then I will remain at the drawer.</p> <p>-As a user, if the pop-up dialogue appeared and I clicked "OK" then I will be logged out and I will be redirect to the Welcome screen and a confirmation message will appear.</p>
5	As a user, I want to view my profile page so that I can access my account information.	5	Feature	Done	<p>-As a user, if I clicked on the "Profile" in the drawer then I will be directed to my profile screen and I will be able to view my information.</p>
6	As a user, I want to edit my account information so that I can update my information.	5	Feature	Done	<p>-As a user, if I am on my profile screen there will be an edit icon next to the editable information.</p> <p>-As a user, if I am on my profile screen there will be a change password button.</p> <p>-As a user, if I want to edit my information then I will click on the edit icon, a pop-up editing form will appear.</p> <p>- As a user, if I fill a field in a wrong format then I will receive an error message.</p>



					<p>-As a user, if I clicked on “Cancel” the form will disappear.</p> <p>-As a user, if I complete the form correctly and click on “Update”, then I will receive a confirmation message and my information will be updated in the database.</p>
7	As a user, I want to be able to announce my lost/found item so that people can help me reclaim my item back or I can help them reclaim their items.	8	Feature	Done	<p>-As a user, if I clicked on “Add announcement” in the dashboard screen then I'll be redirected to add announcement form.</p> <p>- As a user, if I don't fill a mandatory field then I will receive an error message or indicator.</p> <p>-As a user, if I want to get assistance from a chatbot about an item category then I should click on chatbot icon that is next to the item category.</p> <p>-As a user, if I want my announcement be a lost announcement then I should choose “lost” from announcement type from the dropdown menu.</p> <p>- As a user if I want my announcement to be a found announcement then I should choose “found”</p>



					<p>from announcement type dropdown menu.</p> <p>-As a user, if I clicked on “Cancel”, I will be redirected to the dashboard screen.</p> <p>-As a user, if I completed the form correctly and clicked on “Add announcement”, I will receive pop-up dialogue.</p> <p>-As a user If I received a pop-up dialogue and I clicked "No" I will be redirected to the same form.</p> <p>-As a user If I received a pop-up dialogue and I clicked "Yes" then my announcement will be added to the database, and I will receive a conform message and I will be redirected to the dashboard screen.</p>
8	As a user, I want to be able to view all the lost/found announcements so that I can reclaim my item or find the owner of the item.	5	Feature	Done	<p>-As a user, if I want to view the lost announcement then I should click on “Lost” in the dashboard screen, and I will be directed to another screen where all lost announcements are listed.</p>



					<p>-As a user, if I want to view the found announcement then I should click on “Found” in the dashboard screen and I will be directed to another screen where all found announcements are listed.</p>
9	As a user, I want to be able to view all my lost/found announcements so that I can manage my announcements.	5	Feature	Done	<p>-As a user, if I click on "My announcements" in the dashboard screen, then I will be directed to another screen where all my announcements will be shown.</p> <p>-As a user, if I click on Lost, then I can view all my lost announcements.</p> <p>-As a user, if I click on Lost, then I can view all my lost announcements.</p> <p>As a user, if I click on Found, then I can view all my found announcements.</p>
10	As a user, I want to be able to view single announcement details so that I can get more details about a lost/found announced item.	3	Feature	Done	<p>-As a user, if I click on an announcement, then I will be redirected to the “Announcement details” screen where I can view all the information related to the announced item.</p>
11	As a user, I want to search for a specific announcement by the item’s name so that I can easily find it.	5	Feature	Done	<p>-As a user, if I type the item’s name in the search bar then I will get the matched results.</p>



					-As a user If I have any typos then I will not be getting any results.
12	As a user, I want to apply single or multi filtering on the announcements either by its category, date or building name so that I can obtain the desired announcements.	5	Feature	Done	<p>-As a user, if I clicked on Filter icon in the app bar, then a pop-up screen that contains the available filter options will be appear.</p> <p>-As a user, if I clicked on “date” drop down menu and chose an option then clicked “Filter”, all the announcements will be filtered according to the chosen option.</p> <p>-As a user, if I clicked on “category” dropdown menu and chose a category then then clicked “Filter”, all announcements will be filtered accordingly.</p> <p>-As a user, if I clicked on building name dropdown menu then chose or a search for a specific building name then clicked “Filter”, all announcements will be filtered accordingly.</p> <p>- As a user, if I want to apply a multi- filtering then I can choose more than one filtering option</p>



					<p>then clicked filter all the filters will be applied to the results.</p> <p>-As a user, if I clicked “Reset” all filtering options will be cleared.</p>
13	As a user, I want to contact the item's founder/owner using a private chat so that we will have a better way of communication.	8	Feature	Done	<p>-As a user, if I clicked on the “chat now” button in the announcement details screen then I will be redirected to the chat room.</p> <p>-As a user, if I'm in the chat room then I will be able to exchange messages and images with the other user.</p>
14	As I user, I want to view my chat history so that I can keep track of the people I am talking to about different items.	3	Feature	Done	<p>-As a user, if I clicked on “My Chats” button from the dashboard screen then I will be directed to chat screen where I can view all the chat rooms in which I am in a party in.</p>
15	As a user, I want to get in touch with the item founder or item owner through phone number or e-mail so that I can have more communication channels to talk about the details related to the item.	5	Feature	Done	<p>-As a user, if I viewed the announcement details screen then the phone number or the e-mail of the publisher will be included in the details of the announcement.</p> <p>-As a user, if the preferred communication channel of the publisher was phone</p>



					<p>number, then there will be a button titled “Call Now”.</p> <p>-As a user, if I clicked on “Call Now” then I will be directed to the dialing pad and the publisher’s phone number will be pasted there.</p> <p>-As a user, if the preferred communication channel of the publisher was E-mail then there will be a button titled “Send an Email”.</p> <p>-As a user, if I clicked on “Send an Email” then I will be directed to the e-mail app and a new message will be created to the publisher’s e-mail.</p>
16	As a user, I want to get notified about any new announcements that match the of my item category and has the opposite announcement type so that I will be notified about new announced items that might be considerable.	13	Feature	Done	<p>-As a user, if I announced lost item, then the notifications will be of the found items in the same category.</p> <p>- As a user, if I announced found item, then the notifications will be of the lost items in the same category.</p>
17	As a user, I want to get private chat notification so that I will get notified when I get new messages.	13	Feature	Done	<p>-As a user, if I get a new message then I will receive a notification that contains the text of the message or the title “An image has been sent to you”.</p>



18	As a user, I want to edit my announcement so that I can update its information.	8	Feature	Done	<ul style="list-style-type: none"> -As a user, if I was in “My announcement details” screen and I clicked on the edit icon then I will be redirected to the edit announcement form. -As a user, if I want to get assistance from a chatbot about an item category then I should click on chatbot icon that next to the item category. - As a user, if I don't fill a mandatory field then I will receive an error message. -As a user, if I completed the form correctly and clicked on “Update announcement”, I will receive pop-up dialogue. -As I user If I received a pop-up dialogue and I clicked "No" I will be redirected to the same form. -As a user If I received a pop-up dialogue and I clicked "Yes" then my announcement will be updated in the database, and I will receive a conform message and I will be



					redirected to the dashboard screen.
19	As a user, I want to talk with a chat-bot so that I can get assistance in choosing item category.	13	Feature	Done	<p>-As a user, if I send “Hi” or “Hello” to the chatbot then it will reply with an introductory message of itself and will ask me to talk about the item I want to announce.</p> <p>-As a user, if I sent the item information to the chatbot it will provide me with a category to announce the item under it.</p> <p>-As a user if I typos in the item name then it will reply with misunderstanding message and it will ask the user to retype the item name</p>
20	As a user, I want to be able to delete my announcement so that I can have manage over my announcements.	8	Feature	Done	<p>-As a user, if I want to delete my announcement then I should click on the delete icon in “Announcement details” screen and a pop-up dialogue will appear.</p> <p>-As a user, if the pop-up dialogue appeared and I clicked "Cancel" then I will remain at “My announcement details” screen.</p> <p>-As a user, if the pop-up dialogue appeared and I</p>



					<p>clicked “OK” then another dialogue will appear asking about the item status.</p> <p>-As a user, if the item was ‘Lost’ then then dialogue will ask if it is found or not, if the user click “Yes” the returned or found item counter will be incremented, if the user click “No” it will not increment then the item announcement will be deleted.</p> <p>- As a user, if the item was ‘Found’ then then dialogue will ask if it is returned or not, if the user click “Yes” the returned or found item counter will be incremented, if the user click “No” it will not increment then the item announcement will be deleted.</p> <p>-As a user, if the item announcement was deleted successfully, I will get a confirmation message.</p>
21	As a user, I want to report inappropriate announcements so that I can have better content in the application.	3	Feature	Done	<p>-As I user, if I want to report inappropriate announcement then I should click the report icon in the announcement details screen.</p>



					<p>-As I user, if I clicked a report icon a pop-up dialogue will appear.</p> <p>- As a user, if the pop-up dialogue appeared and I clicked "Yes" then the announcement will be reported successfully and a confirm message will appear.</p> <p>- As a user, if the pop-up dialogue appeared and I clicked "No" then the announcement will not be reported.</p>
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"Admin" user stories

22	As an admin, I want to log in so that I can access my account.	3	Feature	Done	<p>-As an admin, if I fill a field with a wrong value then I will receive an error message.</p> <p>-As an admin, if I filled the fields correctly, then clicked on “Log in” I will be directed to my dashboard screen and a confirmation message will appear.</p>
23	As an admin, I want to reset my password, so that	3	Feature	Done	-As an admin If I want to log in but forgot my



	I could reclaim access to my account if I forgot my original password.				password, I will click on “Reset it now” in Log in screen, then I will be redirected to Reset Password screen. -As an admin, If I typed my email in Reset Password screen then clicked on “Reset Now!”, then I will get an email with a link to reset my password and a confirmation message will appear. -As an admin if I clicked on the link in my email, I will be directed to a web page to update my password and it will be updated in the database.
24	As an admin, I want to log out so that the content is inaccessible to others.	3	Feature	Done	-As an admin, if I click on the drawer “Log out” then a pop-up dialog will appear. -As an admin, if the pop-up dialogue appeared and I clicked "Cancel" then I will remain at the drawer. -As an admin, if the pop-up dialogue appeared and I clicked “OK” then I will be logged out and I will be redirect to the Welcome



					screen and a confirmation message will appear.
25	As an admin, I want to view my profile page so that I can access my account information.	5	Feature	Done	<p>-As an admin, if I clicked on the “Profile” in the drawer then I will be directed to my profile screen and I will be able to view my information.</p>
26	As an admin, I want to be able to change my password so that I can update my password for security matters.	5	Feature	Done	<p>-As an admin, if I am on my profile screen there will be a change password button.</p> <p>-As an admin if I click on "Change Password" button then I will direct to a form.</p> <p>- As an admin, if I fill a field in a wrong format then I will receive an error message.</p> <p>-As an admin if I clicked on “Cancel” the form will disappear.</p> <p>-As an admin, if I complete the form correctly and click on “Change password”, then I will receive a confirmation message and my password will be updated in the database.</p>
27	As an admin, I want to be able to access all the lost/found announcements so that I can view them.	5	Feature	Done	<p>-As an admin, if I want to view the lost announcement then I should click on “Lost” in</p>



					<p>the dashboard screen, and I will be directed to another screen where all lost announcements are listed.</p> <p>-As an admin, if I want to view the found announcement then I should click on “Found” in the dashboard screen and I will be directed to another screen where all found announcements are listed.</p>
28	As an admin, I want to be able to view a single announcement detail so that I can get more information about it.	3	Feature	Done	<p>-As an admin, if I click on an announcement, then I will be redirected to the “Announcement details” screen where I can view all the information related to the announced item.</p>
29	As an admin, I want to search for a specific announcement by the item’s name so that I can easily find it.	5	Feature	Done	<p>-As an admin, if I type the item’s name in the search bar then I will get the matched results.</p> <p>-As an admin If I have any typos then I will not be getting any results.</p>
30	As an admin, I want to apply single or multi filtering on the announcements either by its category, date or building name so that I can obtain the desired announcements.	5	Feature	Done	<p>-As an admin, if I clicked on Filter icon in the app bar, then a pop-up screen that contains the available filter options will be appear.</p> <p>-As an admin, if I clicked on “date” drop down menu and chose an option then clicked “Filter”, all the announcements will be</p>



					<p>filtered according to the chosen option.</p> <p>-As an admin, if I clicked on “category” dropdown menu and chose a category then then clicked “Filter”, all announcements will be filtered accordingly.</p> <p>-As an admin, f I clicked on building name dropdown menu then chose or a search for a specific building name then clicked “Filter”, all announcements will be filtered accordingly.</p> <p>- As an admin, if I want to apply a multi- filtering then I can choose more than one filtering option then clicked filter all the filters will be applied to the results.</p> <p>-As an admin, if I clicked “Reset” all filtering options will be cleared.</p>
31	As an admin, I want to be able to add new categories or building names, so that I can add more options to the users to make the application more efficient.	5	Feature	Done	<p>-As an admin if I want to add new building then I should click on " Add building" in the dashboard then I'll be redirected to add building form.</p>



					<ul style="list-style-type: none"> -As an admin if I was in the add building form then all building that already added before will appear with a search bar. -As an admin if I click "Cancel" then I will direct to the dashboard. -As an admin if I fill the name building field and click "Add building" then a pop-up dialogue will appear. -As an admin if the pop-up dialogue appears and I click "Yes" then the new building will add to the DB and a confirm massage will appear. -As an admin if the pop-up dialogue appears and I click "No" then the pop-up dialogue will disappear. -As an admin if I want to add new category then I should click on " Add category" in the dashboard then I'll be redirected to add building form. -As an admin if I was in the add building form then all categories that already added before will appear with a search bar.
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					<ul style="list-style-type: none"> -As an admin if I click "Cancel" then I will direct to the dashboard. -As an admin if I fill the category field and click "Add category" then a pop-up dialogue will appear. -As an admin if the pop-up dialogue appears and I click "Yes" then the new category will add to the DB and a confirm massage will appear. -As an admin if the pop-up dialogue appears and I click "No" then the pop-up dialogue will disappear.
32	As an admin, I want to be able to view reported announcements so that I can manage them.	5	Feature	Done	<ul style="list-style-type: none"> -As an admin, I will have access to reported announcements from my dashboard by clicking on the "Reported announcements." From the dashboard screen. -As an admin, if I am in the "Reported announcements" screen then I will be able to view all announcements that got reported by users. -As an admin, if I want to view a single reported



					announcement's details then I should click on it.
33	As an admin, I want to delete/decline the reported announcements so that manage them.	5	Feature	Done	<p>-As an admin if I want to delete the reported announcement then I should click on "Delete" button in the announcement details screen then a pop-up dialogue will appear</p> <p>- As an admin if I click on "No" on the pop-up dialogue then the pop-up dialogue will disappear</p> <p>-As an admin if I click on "Yes" then the reported announcement will be deleted from the DB and a confirm massage will appear.</p> <p>-As an admin if I want to decline the reported announcement then I should click on "Decline" button in the announcement details screen</p> <p>- As an admin if I click on "NO" on the pop-up dialogue then the pop-up dialogue will disappear</p> <p>-As an admin if I click on "Yes" then the reported announcement will be</p>



					considered as not reported and a confirm massage will appear.
Non-Functional requirements					
34	As a user, I want the application to be easy to use so that it will increase my satisfaction level when using it.	3	Feature	Done	-As a user, if there is a connection loss then I should receive a banner notification.
35	As a user, I want the application not to sign me up until I create a strong password so that I keep my data protected.	3	Feature	Done	<p>-As a user, if I clicked on the password field in the sign-up form then the password validator will dynamically change according to my input.</p> <p>-As a user, if I submitted the form with a password that doesn't match the rules then an error message will appear on the field requiring me to enter a strong password.</p>
36	As a user, I want the application to be available 99% of the time so that I will have access to the services unless there is some update.	3	Feature	Done	-As a user, If I access the application, then the application will be 95-99% available.



4.3 System Design

4.3.1 Architectural Diagram

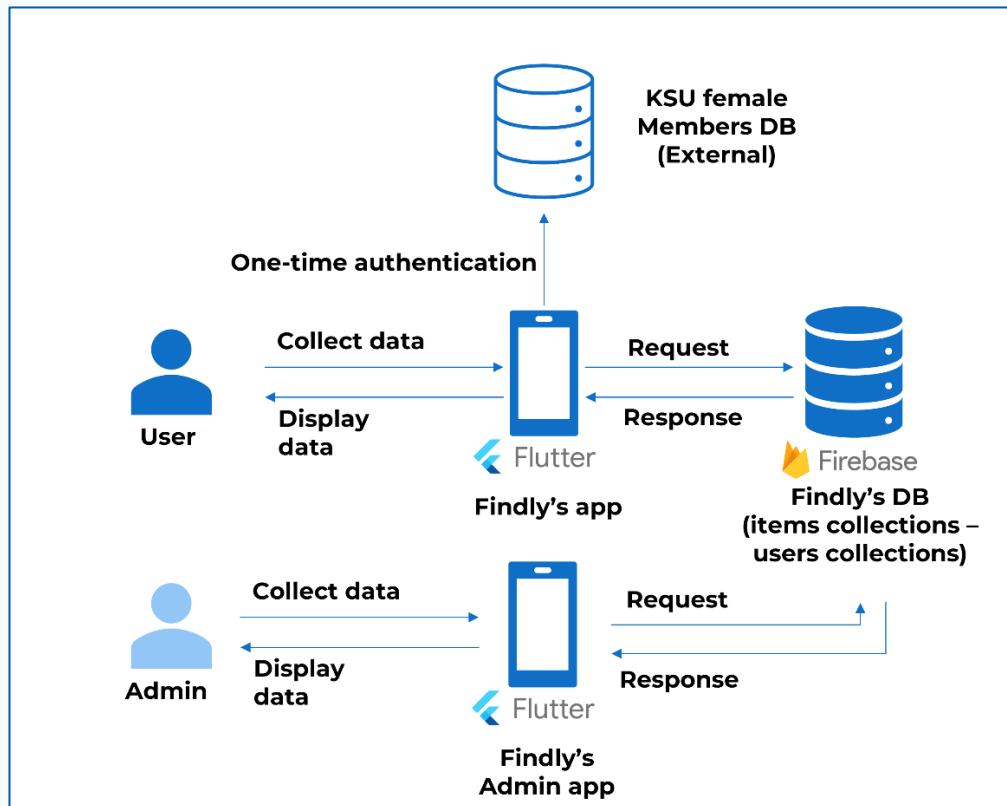


Figure 15 Findly architectural diagram [23].

In figure 15, *Findly* mobile application will use the Client-Server architecture since the data that will be collected needs to be in a centralized database and will be requested and accessed from different locations on the female campus.

Our users are: KSU members (Students, Faculty members, Administration employees) and *Findly* admins who are responsible for managing and overseeing the content of *Findly* user application and facilitating it. The users will be able to use the application through interacting with the user interface that will be implemented using Dart Language – Flutter framework and each user type has different functionalities, and this explains the separation of the two applications. Another reason for the separation is to optimize



the performance of the devices and to not expose admin code in the users' applications. Moreover, the data will be collected and sent to *Findly's* database using Firebase Firestore (cloud-based). For example, if the users wanted to search about an item, they would type an item name in the search bar, then the data will be sent in a request to the database and after processing the results will be fetched and sent back as a response and will be displayed on the user interface.



4.3.2 Class Diagram

A class diagram has been created to show the classes in *Findly* and the associations between them, as *Findly* has two applications, we built two class diagrams one for the *Findly* users and one for the *Findly* admin.

4.3.2.1 Findly user class Diagram

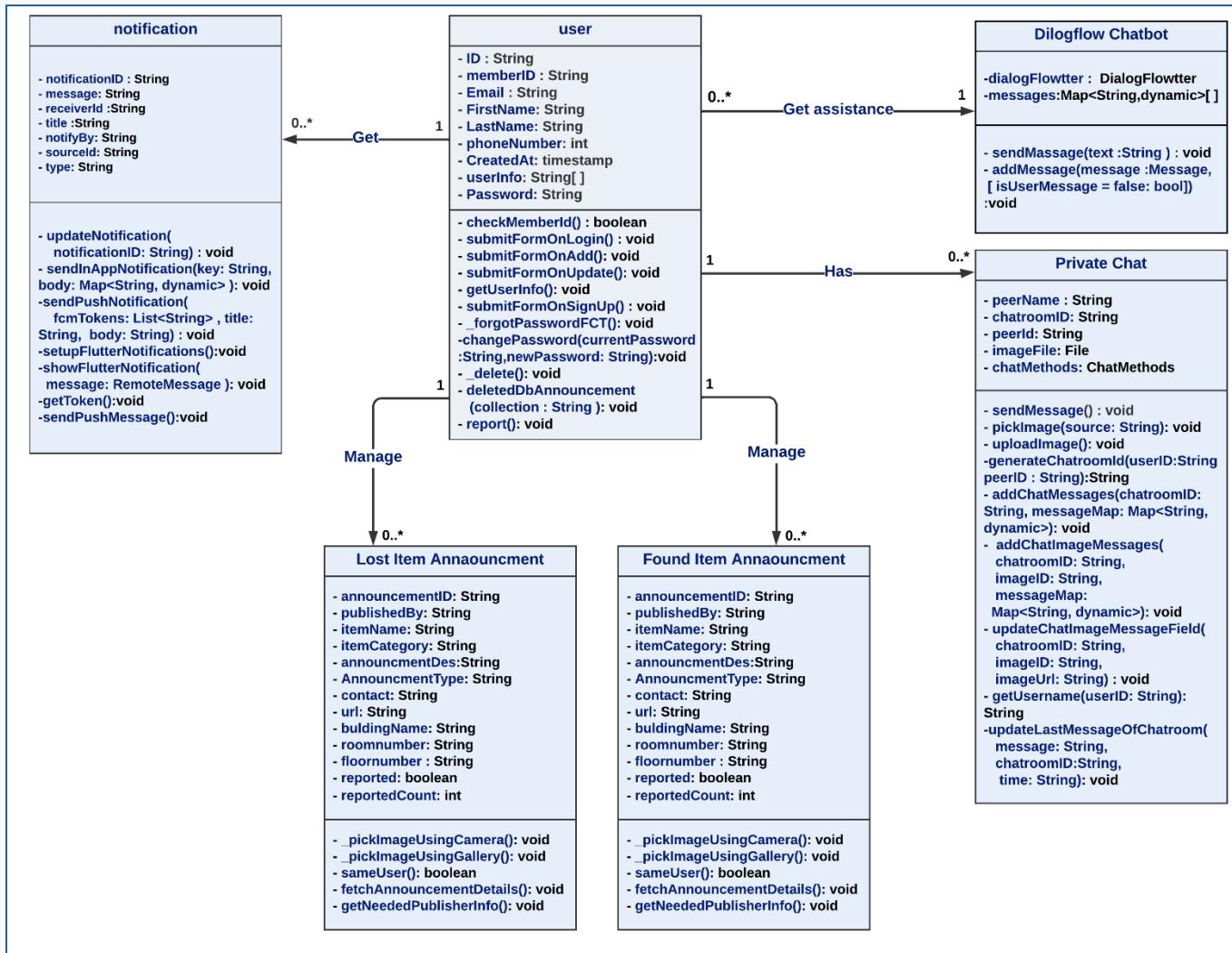


Figure 16 Findly use class diagram.[24]

Figure 16 shows the objects and the relationship between them in *Findly* user application. A user can manage any number of Lost/Found announcements, receive notifications, have private chats with other users, and get assistance from a chat bot.

4.3.2.2 Findly admin class diagram

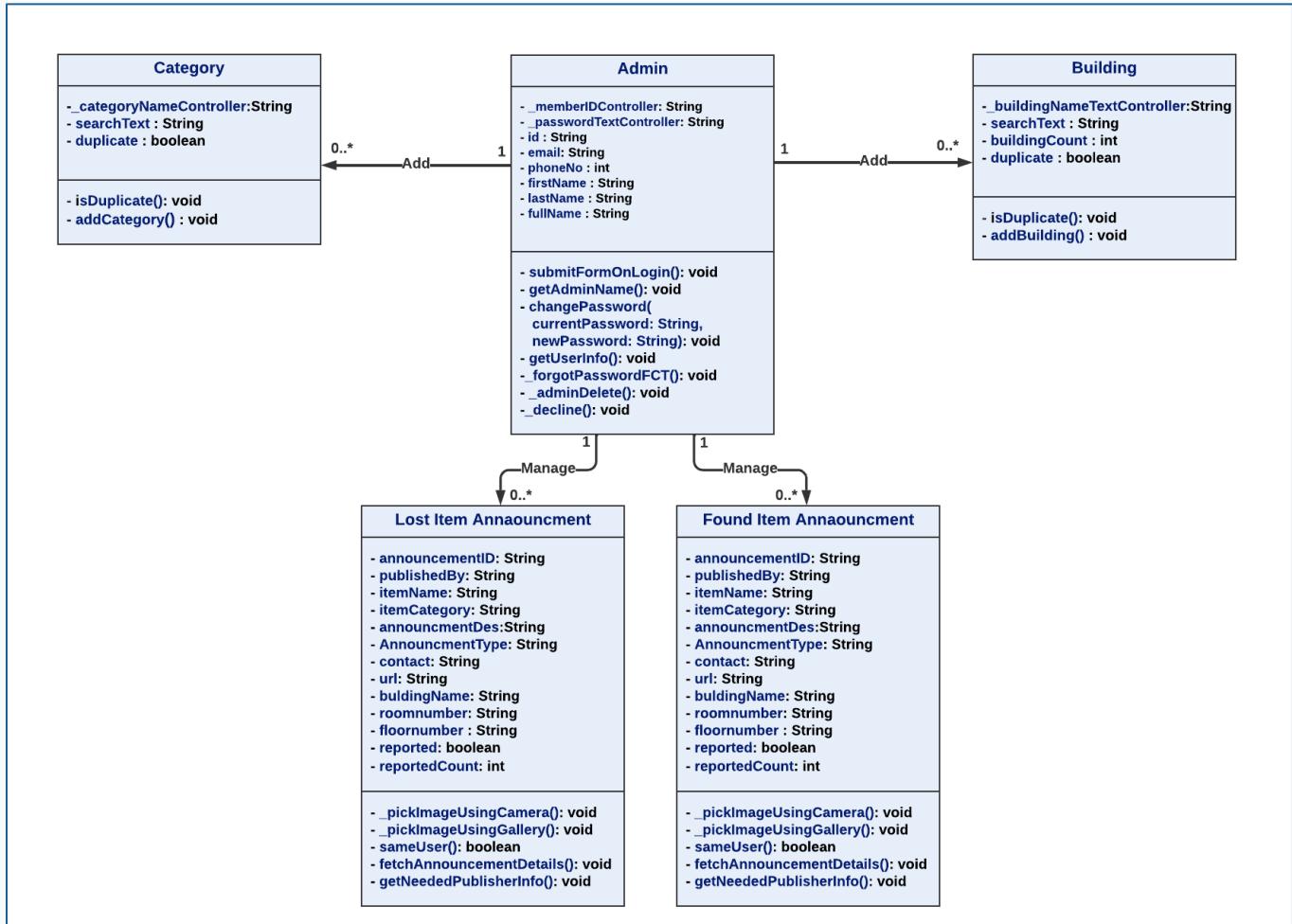


Figure 17 Findly admin class diagram[24]

Figure 17 shows the objects and the relationship between them in admin application, one admin can manage zero or more Lost/Found announcement , add zero or more building name or category.



4.3.3 Component Level Design

4.3.3.1 Add announcement flowchart.

Table 3 Add announcement component.

ID	7		
PBI	As a user, I want to be able to announce my lost/found item so that people can help me reclaim my item back or I can help them reclaim their items.		
User story tasks estimated in hours	User interfaces.	Backend.	Total hours
	6 hours.	30 hours.	36 hours.

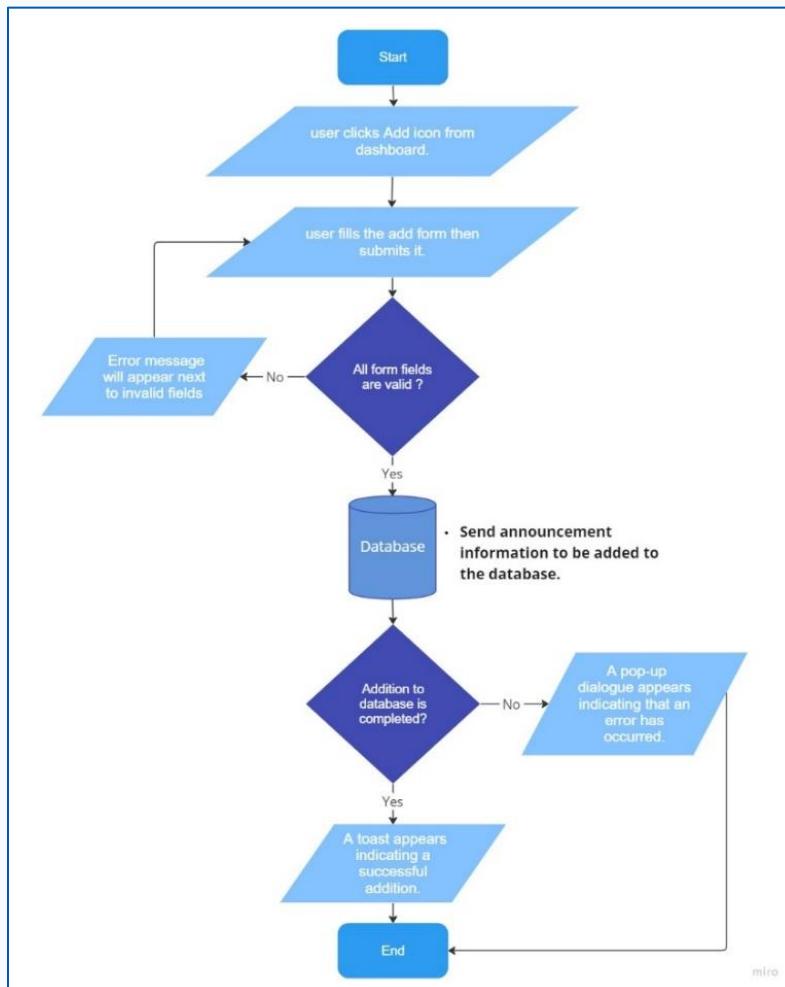


Figure 18 Add announcement flowchart [23].



4.3.3.2 Private chat flowcharts

Table 4 Private chat component – first flow.

ID	13		
PBI	As a user, I want to contact the item's founder/owner using a private chat so that we will have a better way of communication.		
User story tasks estimated in hours	User interfaces.	Backend.	Total hours
	9 hours.	29 hours.	38 hours.

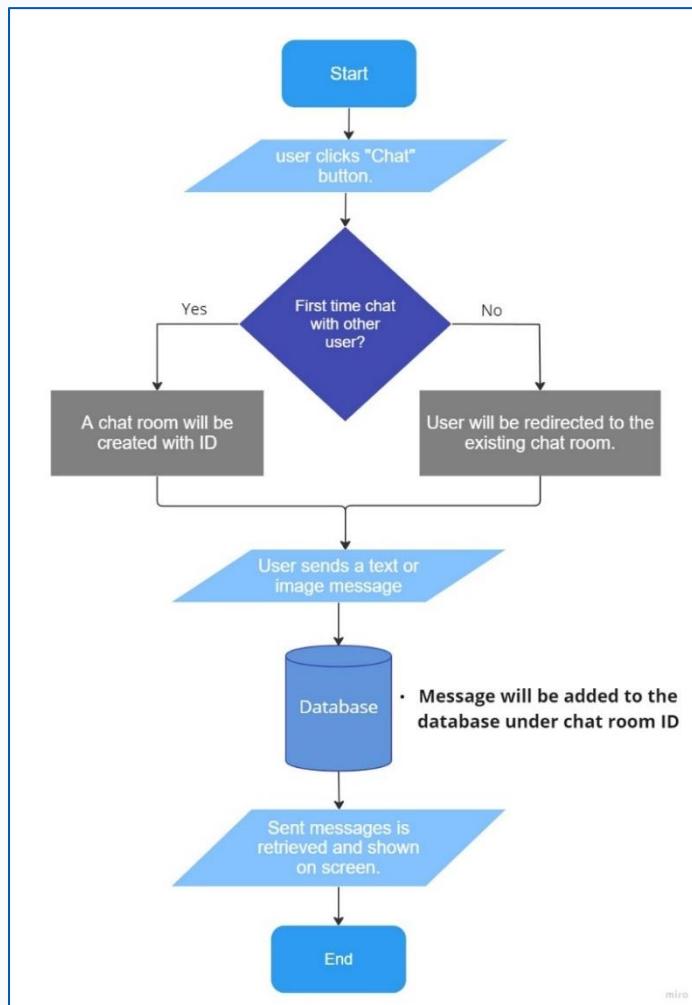


Figure 19 Private chat flowchart - first flow [23].

Table 5 Private chat component – second flow.

ID	14		
PBI	As I user, I want to view my chat history so that I can keep track of the people I am talking to about different items.		
User story tasks estimated in hours	User interfaces. 2 hours.	Backend. 15 hours.	Total hours 17 hours.

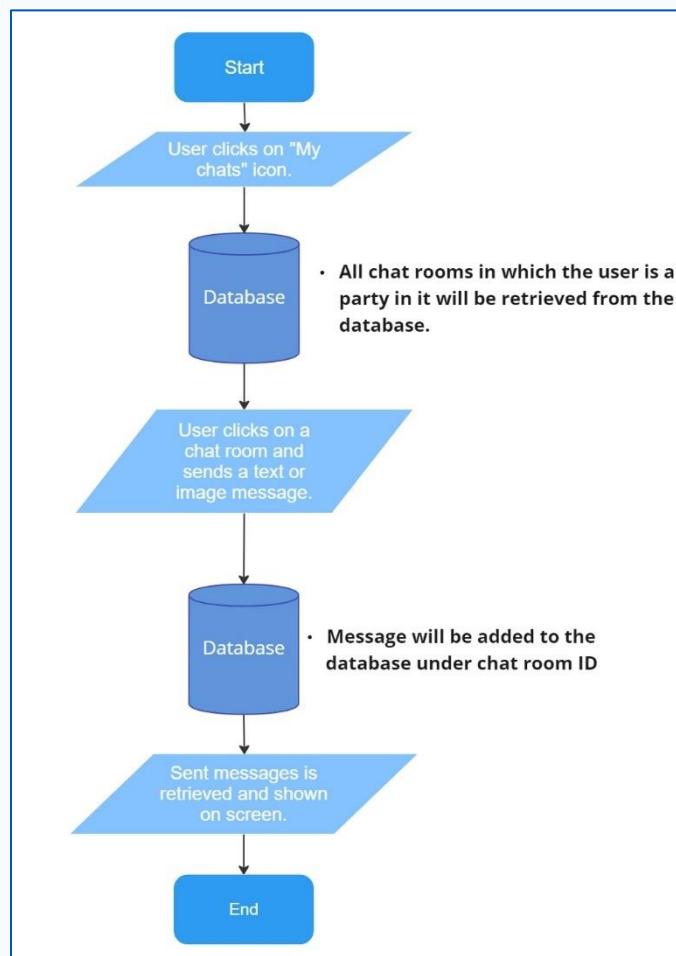


Figure 20 Private chat flowchart - second flow [23].

Figures 19 and 20 show two different flows of the private chat feature linked that is associated with two user stories with IDs 13 and 14 as illustrated in tables 4 and 5. The users will be able to create a new chatroom or open an existing one from the “Announcement details screen” as figure 19 demonstrates. Additionally, users will have the ability to chat with users that already have chatrooms with her by entering the “Chats history” screen, and then follows a similar flow of exchanging messages after selecting a certain chatroom which is shown in figure 20.



4.3.3.2 Chatbot

Table 6 Chatbot component.

ID	19		
PBI	As a user, I want to talk with a chat-bot so that I can get assistance in choosing item category.		
User story tasks estimated in hours	User interfaces. 2 hours.	Backend. 85 hours.	Total hours 87 hours.

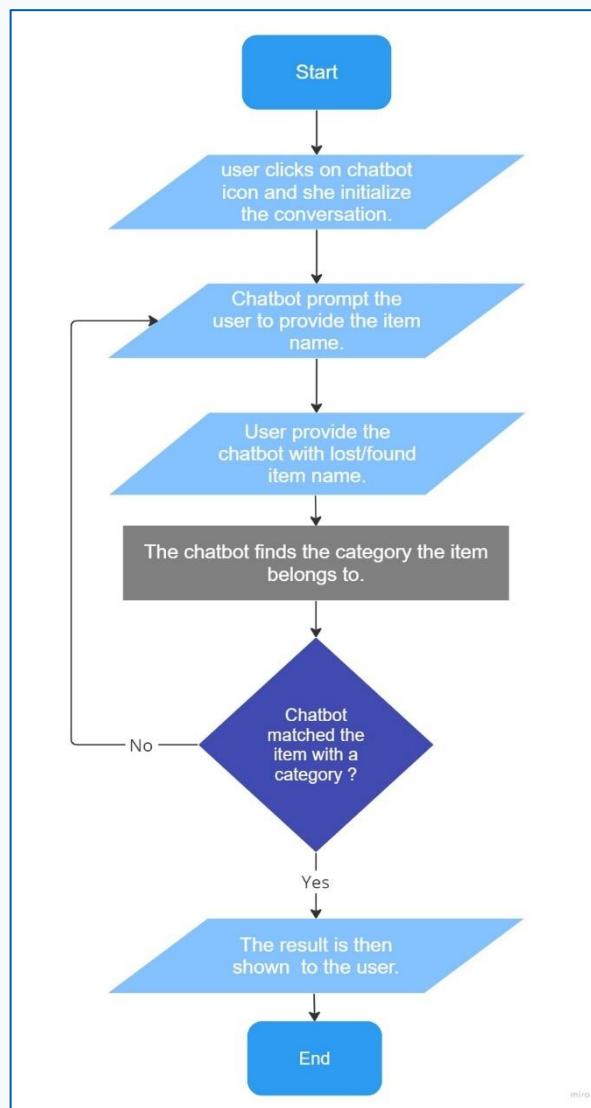


Figure 21 Chatbot flowchart [23].



4.3.3.4 Announcements Notification

Table 7 Announcements notification component.

ID	16			
PBI	As a user, I want to get notified about any new announcements that match the of my item category and has the opposite announcement type so that I will be notified about new announced items that might be considerable.			
User story tasks estimated in hours	User interfaces. 2 hours.	Backend. 124urs.	Total hours	128 hours.

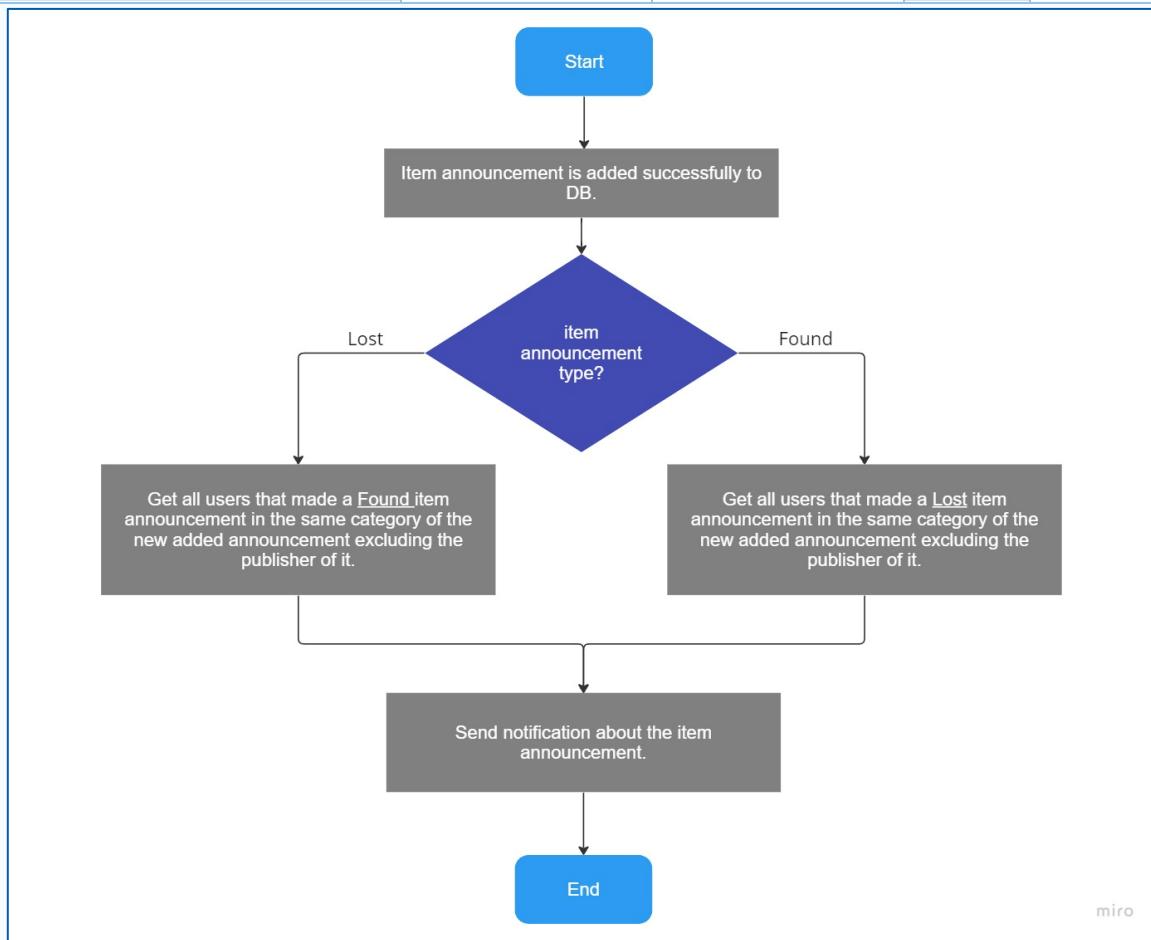


Figure 22 Notification flowchart [23].

4.3.3.5 Admin Reported announcements management

Table 8 Admin reported announcements management component.

ID	33			
PBI	As an admin, I want to delete/decline the reported announcements so that I can provide better content to users.			
User story tasks estimated in hours	User interfaces.	Backend.	Total hours	68 hours.
	13 hours	55 hours.		

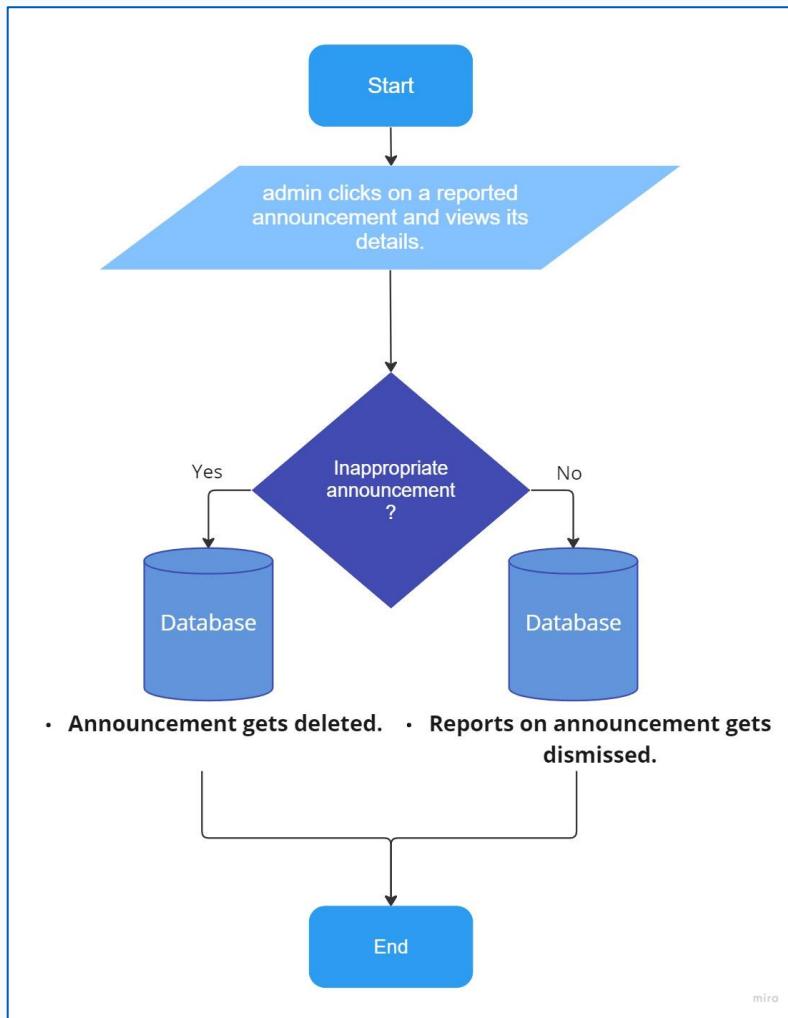


Figure 23 Admin Managing reported announcements flowchart[23].



4.4 Data Design

4.4.1 Data Models

4.4.1.1 ER Diagrams

- Findly ER diagram

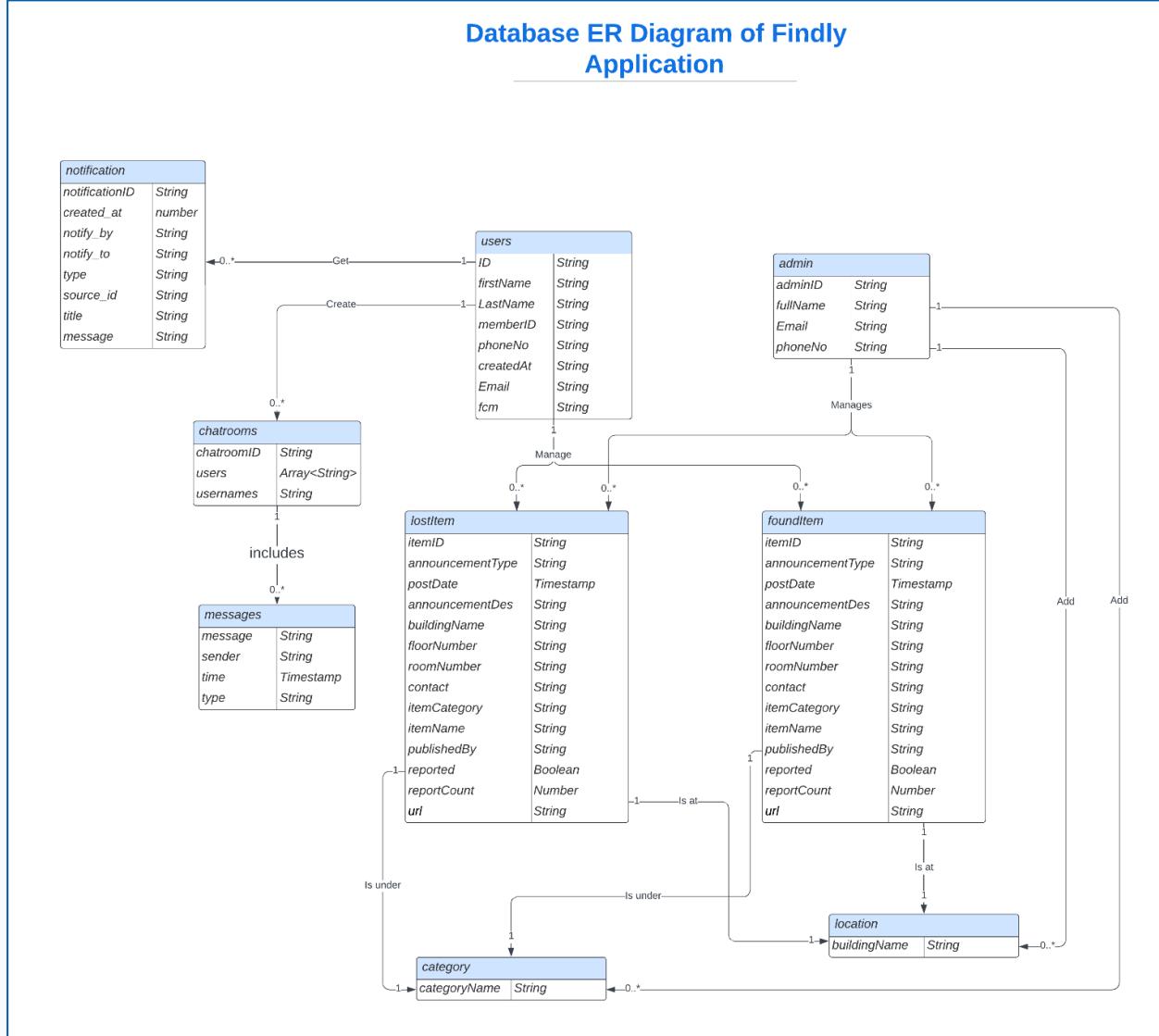


Figure 24 Findly ER diagram[24]

Figure 24 shows the ER diagram for *Findly* application which helps to explain the logical structure of database. *Findly* DB contains a set of entities like user, admin, and notification, a set of attributes like: ID, itemID ,and buildingName, also, it shows the relationships between the entities.

- KSU Member ER diagram

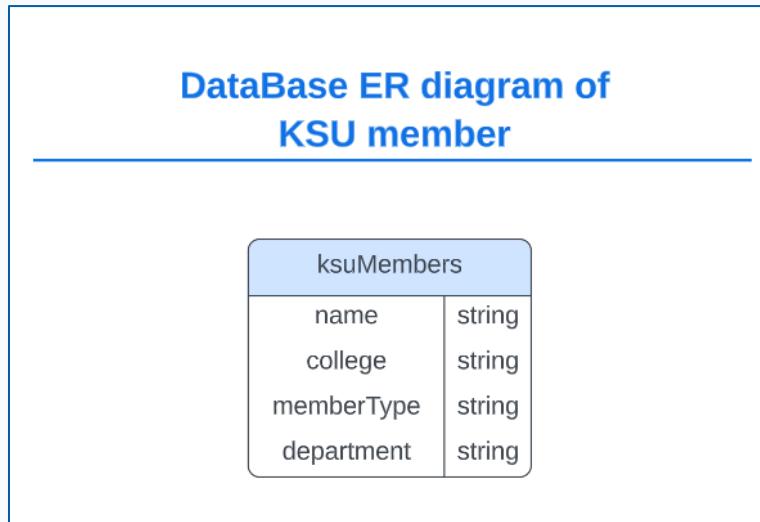


Figure 25 Findly KSU Member ER diagram[24].

As shown in figure 25, we made a database that simulates the KSU database to ensure the user is enrolled to the KSU university. Each user has an "ID" which is the document ID, as an attribute each user has "name", "college" and "department" where she studies or works, and "member type" which could be a student or a faculty member or administration employee.



4.4.1.2 Non-Relational Data model

- *Findly Non-Relational Data model*

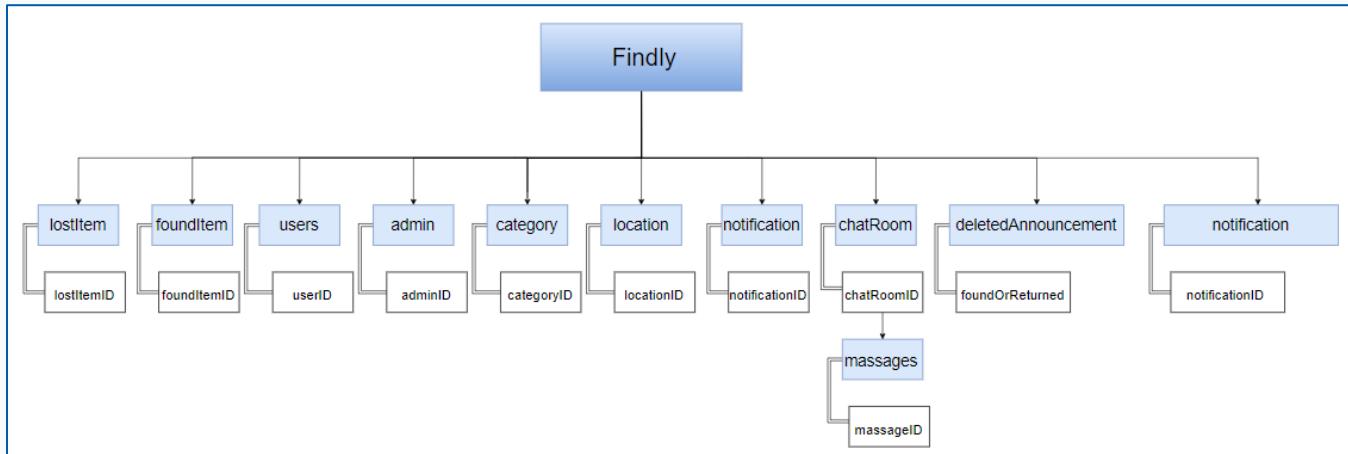


Figure 26 Findly Non-Relational Data model[21].

Figure 26 shows the non-relational data model that can be represented as a tree-like structure of collections, documents, and their attributes for the *Findly* application database.

Each collection has a document ID to distinguish between one document and another, for example: **userID**, **chatRoomID**, and **notificationID**. Moreover, each document has a set of attributes as shown before in the ER diagram figure 24.



- KSU Non-Relational Data model

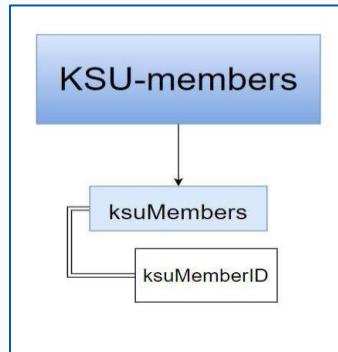


Figure 27 Findly KSU Non-Relational Data model.[21]

Figure 27 shows the non-relational data model of the KSU members database, it can be represented as a tree-like structure of collection, document, and its attributes for the KSU database.

It has one collection which has a set of documents, each document has a document ID "ksuMemberID" to differentiate between KSU members. Moreover, each document has a set of attributes, and they are as shown before in the ER diagram figure 25.



4.5 Interface Design

4.5.1 User Sitemap

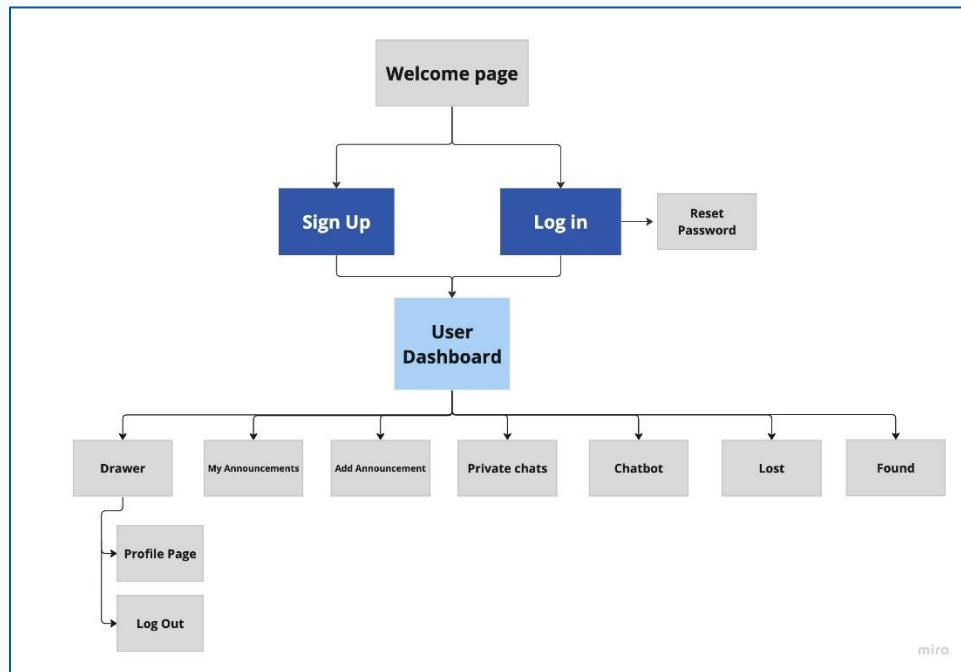


Figure 28 user sitemap [23].

Figure 28 shows the flow of the *Finfly* users' application. It starts from the welcome screen, that relatively navigates the user to “Log in” screen or “Sign up” screen. After logging in/Signing up successfully, the user will be directed to her dashboard, where the user can benefit of the application features provided like view lost/found announcements, her own announcements, add announcement, view her profile page, use the private chat and chatbot, and log out from the drawer.



4.5.2 Admin Sitemap

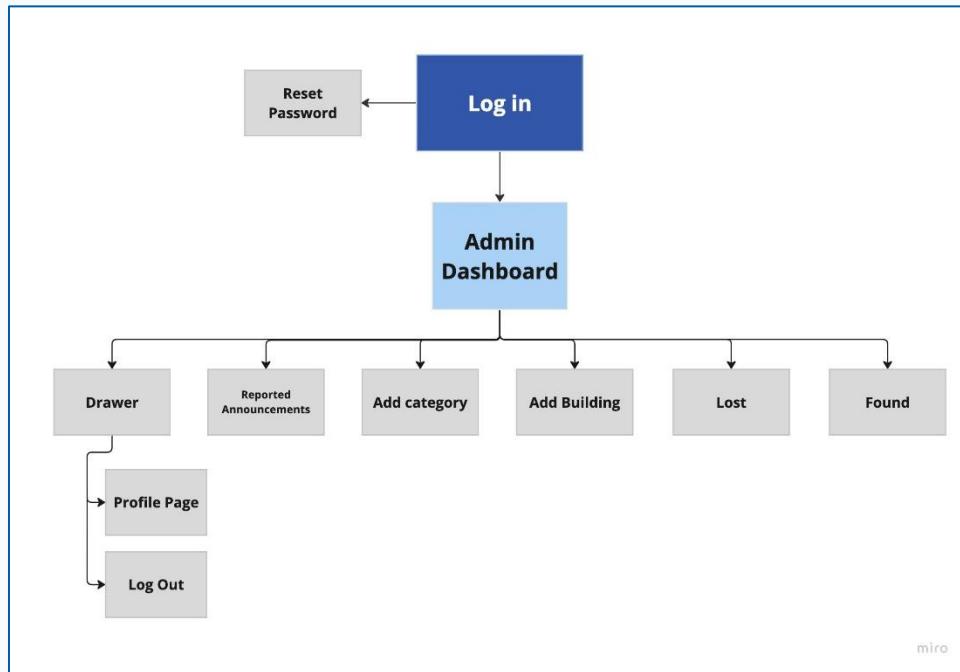


Figure 29 Admin sitemap [23].

Figure 29 shows the flow of the *Findly* admins' application, where it starts from the “Log in” screen, where the admin can reset the password as well. After logging in successfully, the admin will be directed to her “Dashboard” screen, where she can view lost or found announcements, manage reported announcements, add building, and view her profile page. And lastly, she can log out from the drawer.



4.5.3 UX guidelines

1- Simple and familiar navigation.

Navigation patterns are familiar to *Findly* users and do not require any explanation.

2- Consistency of App design.

Button sizes, fonts and colors are all maintained consistently across the entire *Findly* application.

3- Simple error handling.

During the signing up, logging in, and adding a lost/found announcement, if the user filled a field in a wrong format or left mandatory fields empty, then the user will be informed about that with an error message.

4- Strive for minimalism.

Findly applications focuses on the content that is valuable for the user and removes any element that do not support user task.

5- Feedback for interactions.

When the user adds the lost/found announcement, sign up, and log in successfully they will get meaningful feedback that the process was completed.



4.6 Implementation

After designing our system with initial designs, we started implementing our software product, and through the implementation phase we iteratively updated our system designs, to reflect the application.

First, Flutter is an open-source framework by Google for building beautiful UIs, natively compiled, multi-platform applications from a single codebase, and to create Flutter-based applications, we used Google's Dart programming language. Dart focuses on front-end development, and it can be used to create mobile and web applications.

Coming to what we did to start the implementation, downloaded Flutter SDK to benefit its packages, widgets and functions. We did so by completing the download Flutter framework steps mentioned on Flutter download page on Flutter site [25].

Then, we downloaded android studio by following the steps mentioned on their site [26], to develop Flutter projects, since it is the official Integrated Development Environment (IDE) for Android application development.

Therefore, first we downloaded android studio IDE, then we had to download java language by download adoptium.net and completed the IDE preparation process.

Moving on, when android studio IDE was opened, we went to plugins and Installed Flutter and Dart plugins to use them in android studio IDE.

Finally, to run a Flutter application, we used Android Studio Emulator. And to use it, we must create a virtual device to run our application on it and view and test our software. To create a virtual device, we opened the Device manager and made sure that “Virtual” option is chosen then we click on create device then choose a device and we downloaded R version of android OS, after that we can run our application.

In this section we will be explaining how we connected our Flutter project to Firebase and why we need Firebase for *Findly*.

To begin, we downloaded Android Studio and then added Flutter and Dart as plugins.



Since *Findly* is an application for members on the female KSU campus, so it means that we will have multiple users and each user will have their data, we used firebase cloud to store all their information and to help.

in authentication when a user signs up and logs in.

By completing the following steps, we connected our flutter project to our Firebase:

1. Go to Firebase's website and create an account.
2. Click on "Go to console" then "Add project."
3. Type "*Findly* app" as a project name then click on "continue".
4. Set data sharing settings and Google Analytics terms then click on "Create project".
5. Set up an Android app for Firebase by clicking on the Android icon.
6. Write the package name of the application.
7. Click on "Register the app" and download the config file.
8. Paste the " google-services.json " file inside the "app" folder inside the "android" folder in the project inside "src" folder.
9. In build.gradle that is in the project folder, add "classpath 'com.google.gms:google services:4.3.13'" in the dependencies section and add mavenCentral() in the repositories sections.
past "Add the Google services Gradle plugin" inside the build.gradle "implementation platform'com.google.firebaseio: firebase-bom:31.0.2'))" in the dependencies section.
10. Run the application to make sure there are no errors, and everything is set up correctly.
11. Download `firebase_auth` for authentication by running this in the command line with flutter "\$ flutter pub add `firebase_auth`".
12. In the project package's `pubspec.yaml`, add "`firebase_auth: ^4.1.0`" in the dependencies section.
13. Download `cloud_firestore` authentication by running this in the command line with flutter "\$ flutter pub add `cloud_firestore`
14. In the project package's `pubspec.yaml`, add "`cloud_firestore: ^4.0.3`" in the dependencies section.



15. Download cloud_firestore authentication by running this in the command line with flutter “\$ flutter pub add cloud_firestore”.
16. Run the application again to make sure no errors are present.
17. In the project package's pubspec.yaml, add “firebase_storage: ^11.0.3” in the dependencies section.
18. Run the application again to make sure no errors are present.
19. Go back to firebase console and click “Next” then on “Continue to console” to finally finish setting up Firebase Firestore.

We followed the same steps to create a database that simulates the KSU database "KSU-member" to ensure the user is enrolled to the KSU university.

While developing our application we faced some challenges, some of which are worth mentioning, such as:

How to link the user with her announcement since the database type is not familiar to us as expressed before, and we are being involved with a new programming language and a new IDE which was interesting to explore!

We faced some difficulties in understanding the Flutter framework and Android studio environment.

To solve these issues we went searching, reading on Google, and practicing YouTube tutorials, and online paid courses to improve our level in Flutter. We learned how to use Flutter framework (widgets, reusable parts of the code, managing folders in flutter, structuring the project).

During the team's on-campus meetings that was objected to complete parts of the implementation, when we did run the application on the emulator an error appeared.

The error occurred while we were trying to connect to a service of Firebase Storage service and it failed to find the host, which resulted in issues running the application on the campus. Due to this issue, we had



to complete the implementation process after we connected to our database outside the campus. Find the error message in Figure 30.

```
===== Exception caught by image resource service =====  
The following SocketException was thrown resolving an image codec:  
Failed host lookup: 'firebasestorage.googleapis.com' (OS Error: No address associated with hostname, errno = 7)
```

Figure 30 connection error



4.6.1 Private chat implementation

Table 9 Private chat implementation

Feature name	Private chat
PBI	PBI No.13 : As a user, I want to contact the item's founder/owner using a private chat so that we will have a better way of communication.
Function	createChatRoomAndSendUserToConvScreen()
Description	This function creates a one-to-one chat room and transfer the users to it if the users are chatting for the first time. Also, transfer the users to an existing chat room if they chatted before.
Code segments	<pre> 142 //Creates Chat Room Then send the User to the 143 // conversation or chat screen to exchange messages 144 createChatRoomAndSendUserToConvScreen() async { 145 //get the current user id 146 User? user = auth.currentUser; 147 String uid = user?.uid.toString(); 148 149 //Users Id List in the form of String 150 List<String> users = [uid, widget.publisherID]; 151 152 String myName = await chatMethods.getUsername(uid); 153 String peerName = widget.publisherID; 154 String userName = "({myName}) {peerName}"; 155 156 //generating the chatroom ID 157 String chatroomID = await chatMethods.generateChatroomID(uid, widget.publisherID); 158 159 //to check if it is an old user 1 chatted with 160 await chatMethods.getChatroomID(); 161 162 if (chatroomExists == true) { 163 Navigator.push(164 context, 165 MaterialPageRoute(166 builder: (context) => PrivateChatScreen(167 widget.publisherID, 168 chatroomID, 169 widget.publisherID, 170), // PrivateChatScreen 171), // MaterialPageRoute 172); 173 } 174 175 //chatroom Info 176 final time = DateTime.now().millisecondsSinceEpoch; 177 Map<String, dynamic> chatroomMap = { 178 "users": users, 179 "chatroomID": chatroomID, 180 "userNames": userNames, 181 "lastMessage": lastMessage, 182 "lastMessageTime": time, 183 }; 184 185 chatMethods.createChatRoom(chatroomID, chatroomMap); 186 187 if (mounted) return; 188 Navigator.push(189 context, 190 MaterialPageRoute(191 builder: (context) => PrivateChatScreen(192 widget.publisherID, 193 chatroomID, 194 peerID: widget.publisherID, 195), // PrivateChatScreen 196), // MaterialPageRoute 197); 198 } 199 } 200 </pre>
Function flow	A unique ID is generated for each chatroom for two users using their IDs. On line 159 we check for existing chat room, and if it exists the user will be transferred to it, if it doesn't, a new chat room will be created. And each chatroom has several fields including “lastMesseage” and “lastMessageTime” in lines 178 and 179 which will help in sorting them. After creating the chatroom, the user will be redirected to it.

4.6.2 Dialogflow chatbot implementation

Table 10 Dialogflow chatbot implementation

Feature name	Findly Chatbot
PBI	PBI No.19: As a user, I want to talk with a chat-bot so that I can get assistance in choosing item categories.
Function	sendMassage()
Description	This function basically sends the user messages to the chatbot and detect the chatbot responses in order to show it on the screen.
Code segments	<pre> 114 sendMessage(String text) async { 115 if (text.isEmpty) { 116 debugPrint('Message is empty'); 117 } else { 118 setState(() { 119 addMessage(Message(text: DialogText(text: [text])), true); 120 }); 121 122 DetectIntentResponse response = 123 await dialogFlowtter.detectIntent(queryInput: QueryInput(text: TextInput(text: text))); 124 if (response.message == null) return; 125 setState(() { 126 addMessage(response.message!); 127 }); 128 } 129 } </pre>
Description	First, we check if the message is empty, if not, we will add it to the messages list in line 119, then in line 122 we detect the chatbot response to the user message and we extract the text response and store it also.



4.6.3 Notifications implementation

Table 11 Notifications implementation

Feature name	Notifications
PBI	<p>PBI No.16: As a user, I want to get notified about any new announcements that match my item category and have the opposite announcement type so that I will be notified about newly announced items that might be considerable.</p> <p>PBI No.17: As a user, I want to get private chat notification so that I will get notified when I get new messages.</p>
Function	buildInAppNotification()
Description	This function builds a notification to be seen to the user in the application.
Code segments	<pre> 9 static Map<String, dynamic> buildInAppNotification(String notificationID, String message, 10 String receiverId, String title, String notifyBy, String sourceId, String type,) { 11 ↴ 12 ↴ Map<String, dynamic> body = { 13 'notificationID': notificationID, 14 'type': type, 15 'message': message, 16 "source_id": sourceId, 17 'is_seen': false, 18 'notify_to': receiverId, 19 'notify_by': notifyBy, 20 'created_at': DateTime.now().millisecondsSinceEpoch, 21 'title': title, 22 }; 23 ↴ 24 } </pre>
Function flow	The notification is built using a map. Each notification has several fields most importantly “type” either chat or announcement notification, “source_id” which represents the item announcement ID or the chat room ID, “notify_to” th receiver ID, along with the notification ID.



4.6.4 Admin category implementation.

Table 12 Admin category and building addition implementation.

Feature name	Admin category addition and building
PBI	PBI No.31: As an admin, I want to be able to add new categories or building names, so that I can add more options to the users to make the application more efficient.
Function	addCategory ()
Description	This function is used to add a new item category to the application.
Code segments	<pre> 57 void addCategory() async { 58 final bool isValid = _addCategoryFormKey.currentState!.validate(); 59 if (isValid) { 60 61 try { 62 setState(() { 63 _isLoading = true; 64 }); 65 await FirebaseFirestore.instance.collection("category").doc().set({ 66 "categoryName": _categoryNameController.text.trim(), 67 }); 68 setState(() { 69 _isLoading = false; 70 }); 71 72 GlobalMethods.showToast("Category has been added successfully!"); 73 _categoryNameController.clear(); 74 75 } catch (error) { 76 debugPrint(error.toString()); 77 GlobalMethods.showErrorDialog(78 error: "We are sorry,something went wrong!", context: context); 79 } 80 } 81 } </pre>
Function flow	This function is called when an admin clicks on category addition button, after clicking for duplication. Lines 65 to 66 show the addition code to the database, and the function shows a feedback message (toast) in line 72 indicating a successful addition. If any error occurs it will be caught in the catch block and an error dialog will appear in line 77 and 78.



4.6.5 Admin deletion of reported item announcements implementation

Table 13 Deletion of reported item announcements implementation.

Feature name	Admin deletion of reported item announcements
PBI	PBI No.33: As an admin, I want to delete/decline the reported announcements so that the admin manages them.
Function	_adminDelete()
Description	This function is called when an admin views a reported item announcement and decides to delete it.
Code segments	<pre> 525 void _adminDelete(){ 526 String collection = announcementType == "lost" ? "lostItem" : "foundItem"; 527 FirebaseFirestore.instance 528 .collection(collection) 529 .doc(widget.announcementID) 530 .delete(); 531 String notificationID; 532 533 FirebaseFirestore.instance 534 .collection("notifications") 535 .where('source_id', isEqualTo: widget.announcementID).get().then((value) async => { 536 value.docs.forEach((element) { 537 notificationID = element['notificationID'].toString(); 538 FirebaseFirestore.instance 539 .collection("notifications") 540 .doc(notificationID) 541 .delete(); 542 }) 543 }); 544 if (!mounted) return; 545 } </pre>
Function flow	After clicking the delete button. The function begins with extracting the type of the announcement, then starting from line 527 through line 530 the function proceeds to delete that specific announcement by its ID from its collection based on its type. Following that, the function will extract all the notifications that are related to the deleted item announcement and deletes them to void logical errors on the users' side.

GitHub link :[GitHub - Faiiot/2022-GP1-5](#)



5
**SYSTEM
EVALUATION**

5 System Evaluation

5.1 Experimental Results

Not applicable for *Findly* application.

5.2 User Acceptance Testing

We will document the user acceptance testing (UAT), which is a phase of software development in which the software is tested in the real world by its intended audience.

Tests were conducted with 20 users that meet the user criteria clarified in section (4.2.1) who were randomly selected in KSU female campus to test the application and then answer a questionnaire that measured the ease and smoothness of the application.

The test experiment was designed as follows:

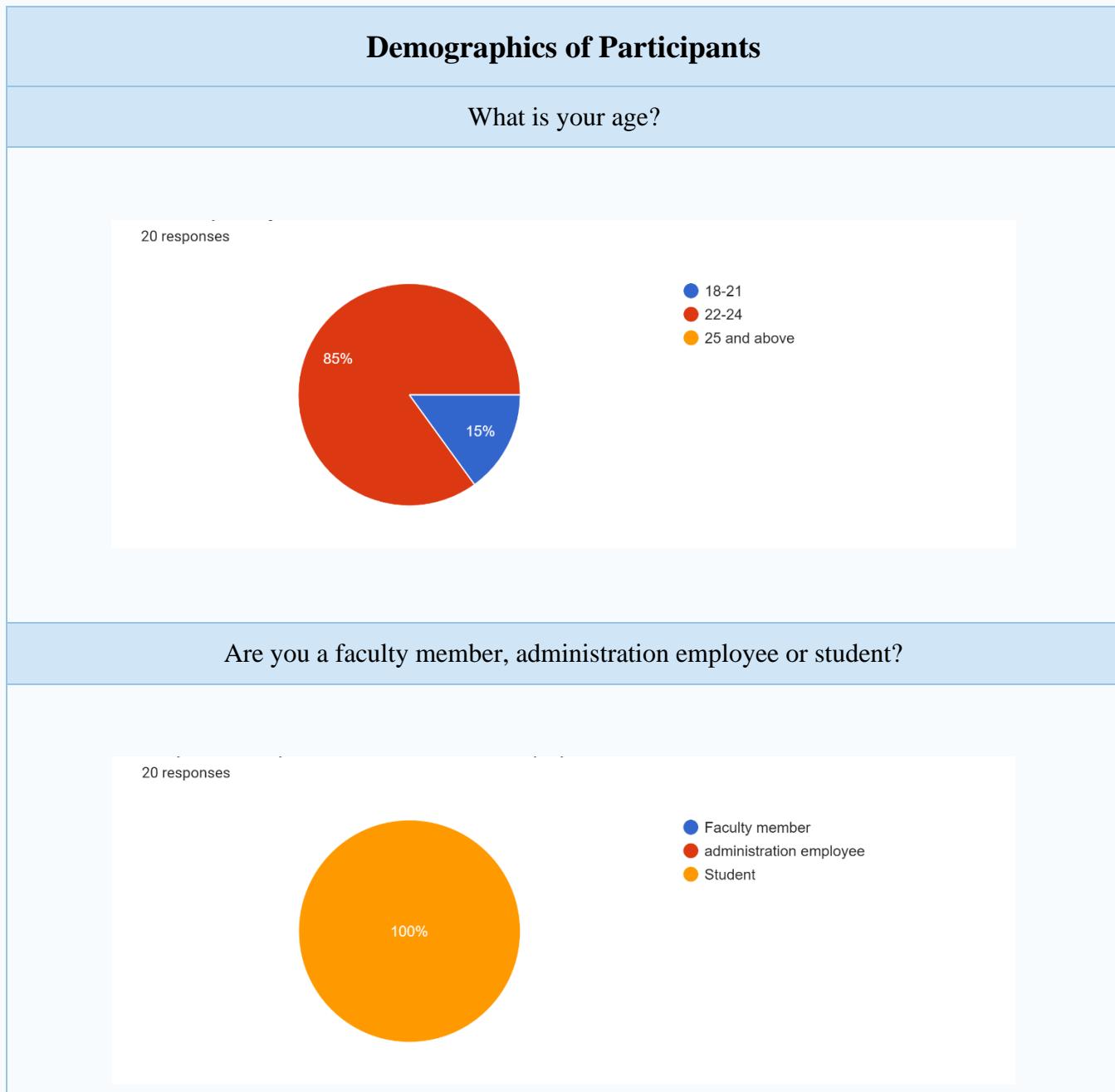
- We divide the testing into two parts, one for the *Findly* user application and the other *Findly* admin application.
- The system was tested with 20 participants, 15 for user applications and 5 for admin applications.
- The participants were provided with an Android Studio Emulator.
- Two questionnaires were distributed to the participants after the testing session, one asking for their feedback on the *Findly* application, and the other asking for their demographics.

During each testing session, we introduced ourselves and explained our application to the participants. We also encouraged the participants to think aloud throughout the session. The participants started the testing by completing all tasks which were clarified to them.

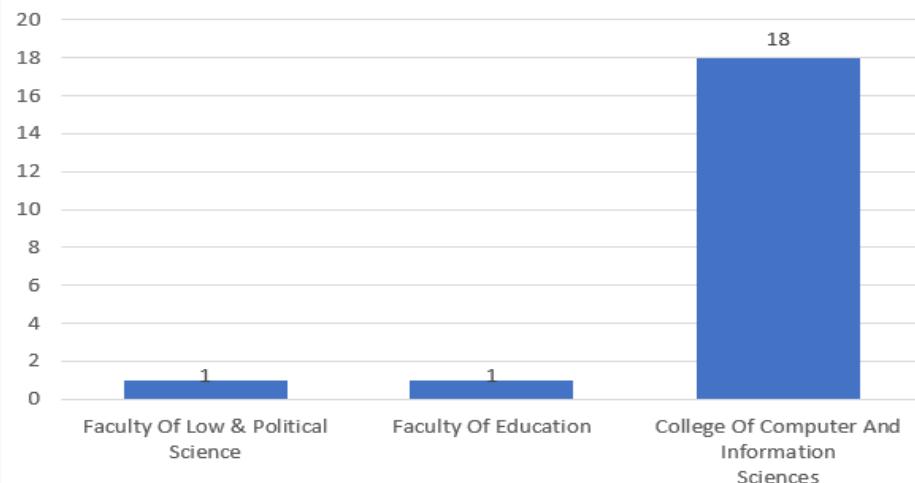


5.2.1 Demographics of Participants

Table 14 Demographics of participants.



Which college are you from?



What is your native language?

20 responses

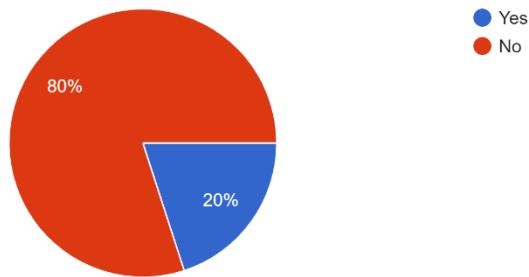
Arabic
English

100%



Are you an old Findly tester?

20 responses



5.2.2 Questionnaire Results

The results were based on closed-ended questions: 1-5 scales, multiple choices, yes/no questions, and open-ended questions that focus on allowing the user to describe something in their own words. 1 means "very easy" and 5 means "Very complicated". All respondents rated the ability to add an announcement as "very easy" (1) except for three who rated it "somewhat easy" (2). Additionally, all users found it easy to find what they were looking for in the dashboard. Most found navigation (13/15) and error message clarity (13/15) to be very easy, while only two found navigation to be "somewhat easy." The private chat feature was the most appreciated, and all users found it easy to contact announcement publisher. Most users (14/15) found the Lost & Found items screen organized, and more than half expressed a likely intention to use the app in the future. According to the open-ended question, we asked the users if they could improve one thing about the app these were their answers:

- provide the Arabic language.
- train the chatbot to provide more services.
- Making sure that the lost item belongs to the user for security concerns.



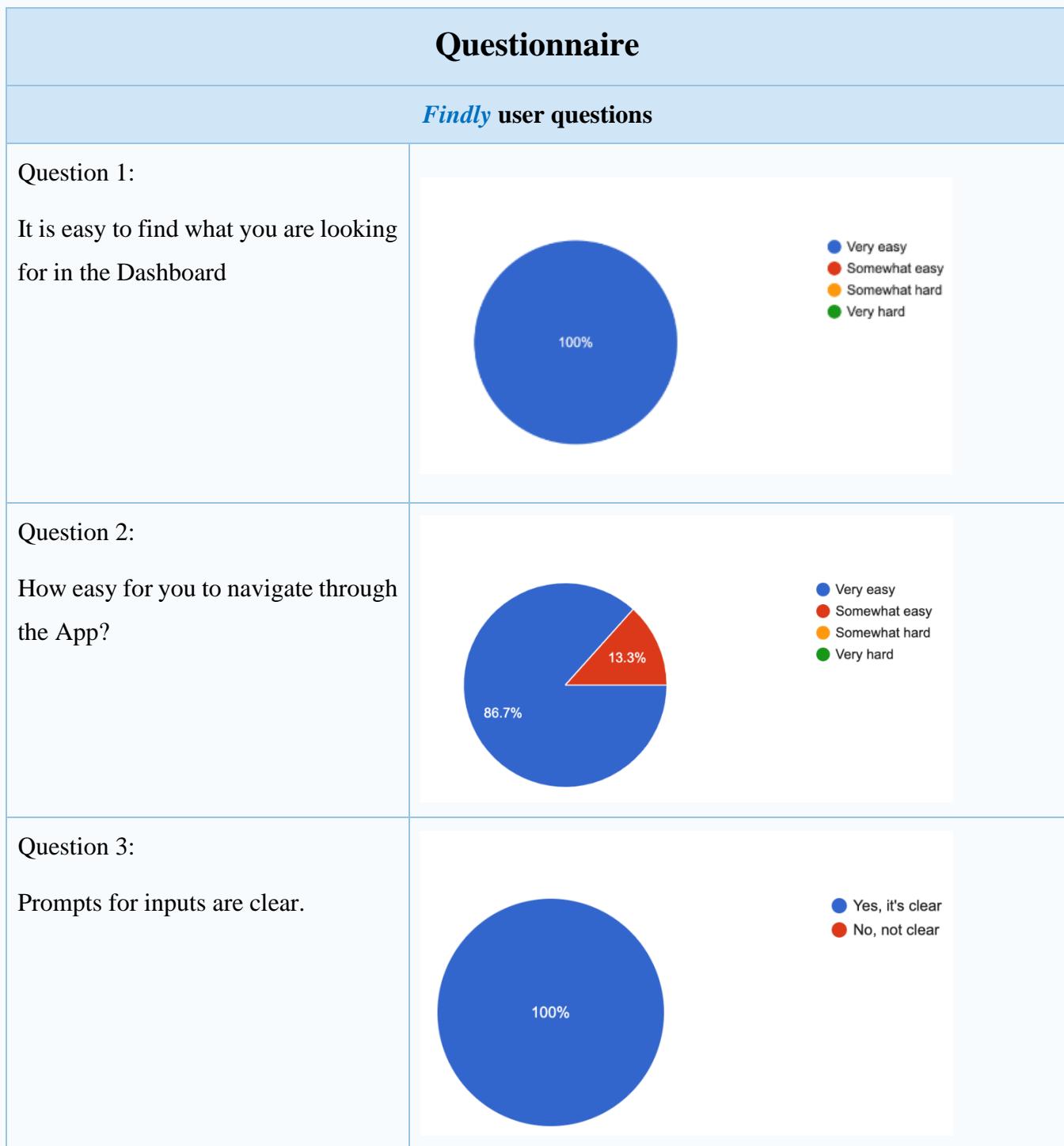
- improve the interface but in the same organization.
- The app is flawless and performs just as it should.

Moreover, 13 out of 15 users rated our app with a score of 5 out of 5 and are very likely to recommend our app to a friend. You can find the actual questions in appendix D.

The questionnaire results of the admin application showed that all admins found what they were looking for in the Dashboard, with clear prompts for inputs. Navigation through the app was found to be easy by 4/5 admins, and the Lost & Found/reported announcements screen was organized for 3/5 admins, with 2 answering “Maybe”. All 5 admins agreed that adding a building name and deleting a reported announcement was “very easy”. Regarding the ease of use, 4/5 agreed that it was the best thing about our app compared to its features and interface design (3/5). 2 admins found its management experience to be “Excellent”, 2 found it “very good” and 1 found it “Good”. Lastly, 1 admin asked that the app be provided in Arabic language. Table 15 visualizes each question’s results (see the questionnaire in Appendix D).

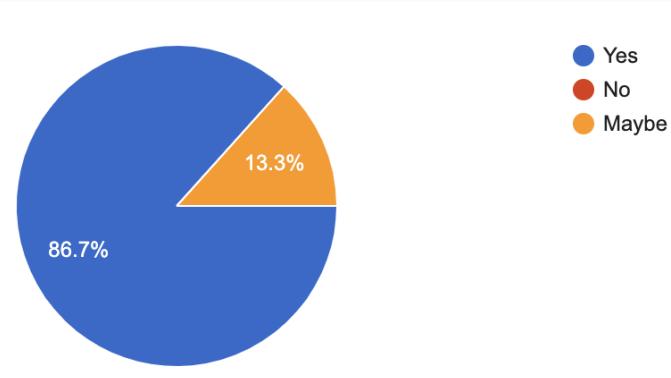


Table 15 Questionnaire results



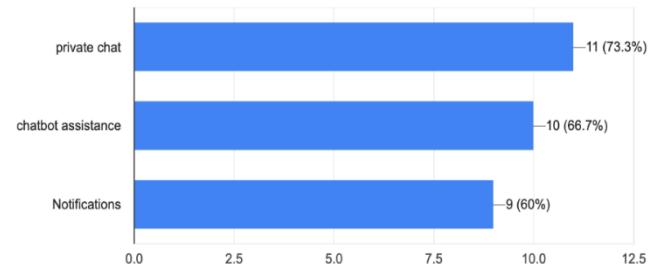
Question 4:

Was the error messages in the app helpful to you ?



Question 5:

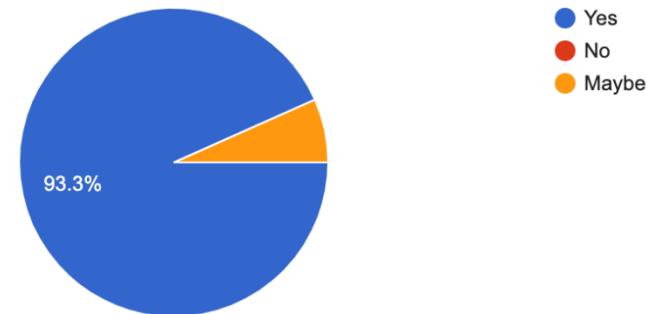
What feature of our App is the most important to you?



Question 6:

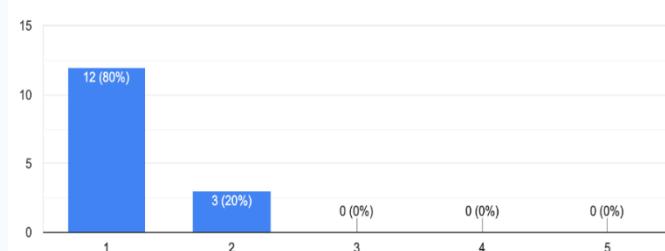
Does the Lost & Found items screen look organized to you?





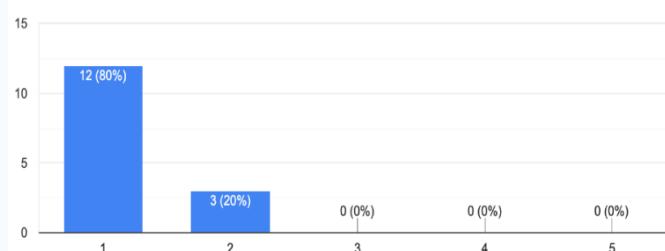
Question 7:

On a scale of 1 to 5, how easy was to add an announcement?



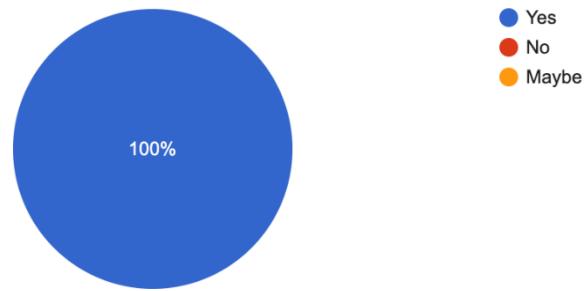
Question 8:

On a scale of 1 to 5, how easy was to edit an announcement?



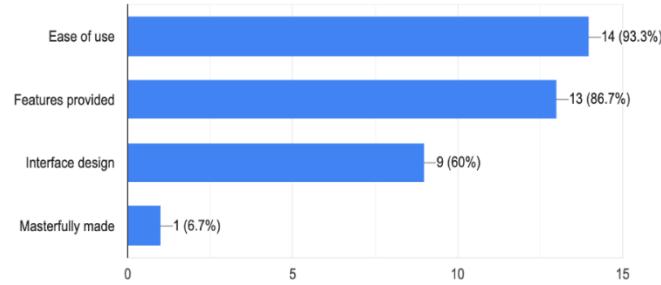
Question 9:

It is easy for you to get in touch with the announcement publisher.



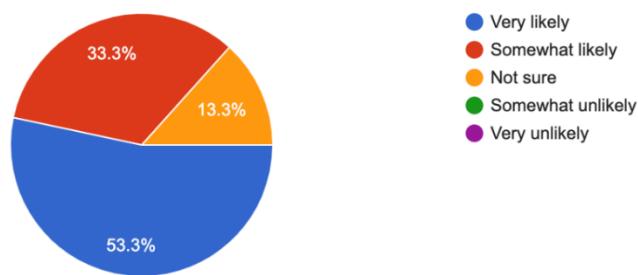
Question 10:

What do you find best about our product?



Question 11:

How likely are you going to use our application?



Question 12:

If you could improve one thing about the app, what would it be?

- The app is perfect
- Nothing
- Improve the interface a little bit, but in the same organisation
- It could provide an Arabic language



I liked the bot very much😊, I hope to train it to provide more services in answering more and more questions to beneficiaries

Making sure that the lost item belong to the user

Nothing because the app does what it's expected and the interface is organized and looks appealing

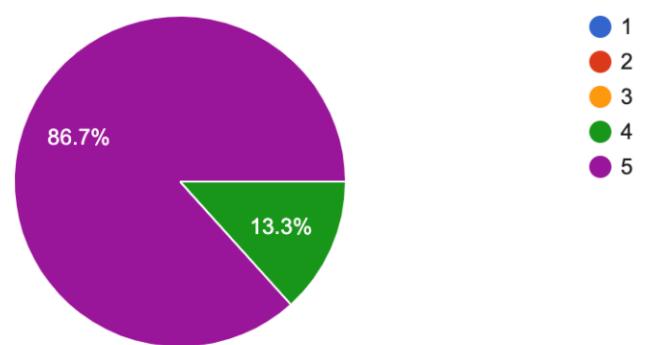
Nothing it's very clear and easy to use

Interface

nothing

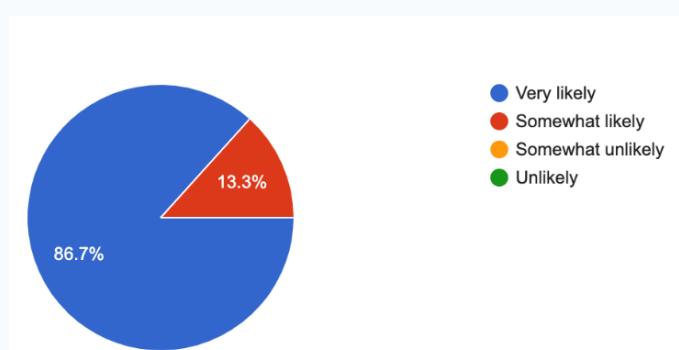
Question 13:

If review our application with a score out of 5, what score would you give us?



Question 14:

How likely are you to recommend our product to a friend?



Admin questions

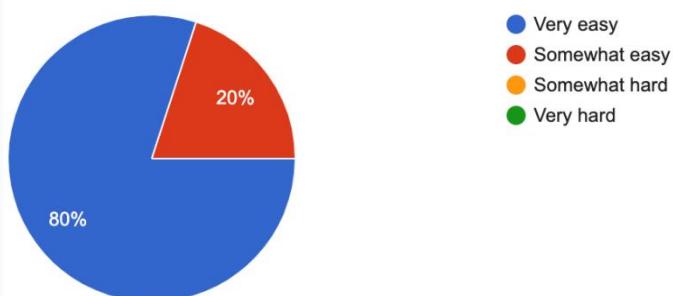
Question 1:

It is easy to find what you are looking for in the Dashboard



Question 2:

How easy for you to navigate through the App?



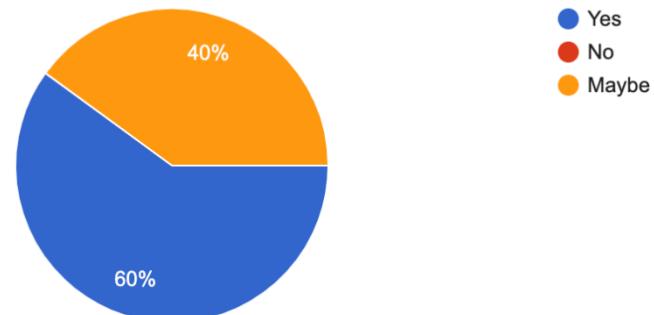
Question 3:

Prompts for inputs are clear.



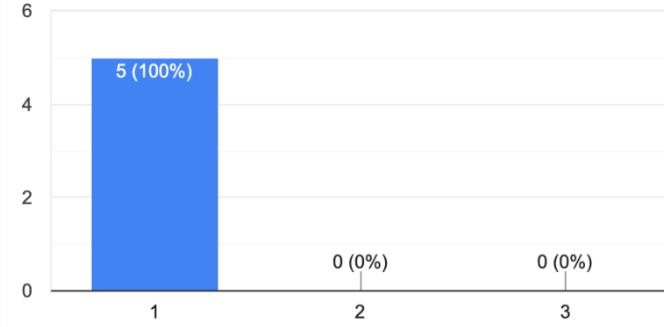
Question 4:

Does the Lost & Found/reported announcements screen look organized to you?



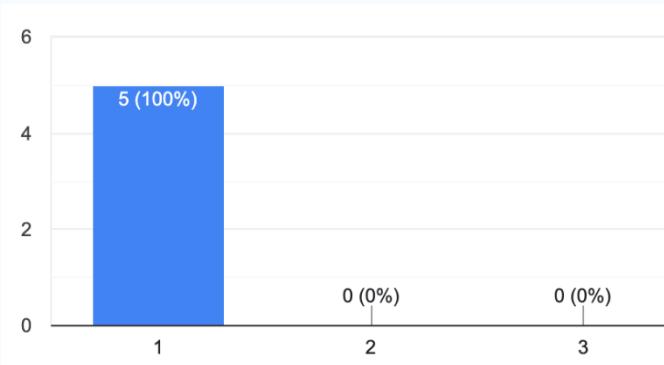
Question 5:

On a scale of 1 to 5, how easy was it to add a building name?



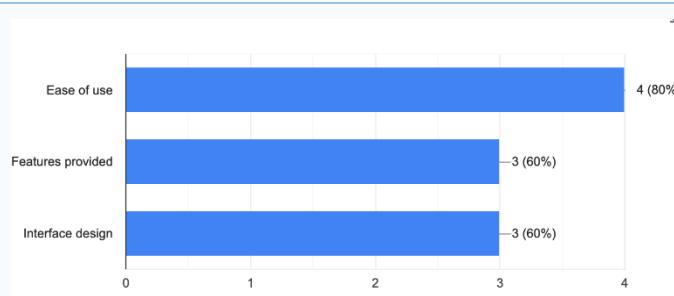
Question 6:

On a scale of 1 to 5, how easy was it to delete a reported announcement?



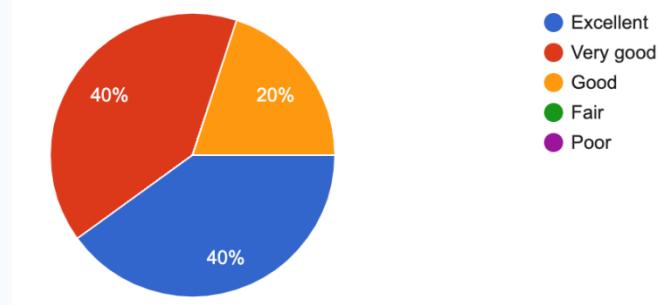
Question 7:

What do you find best about our product?



Question 8:

As an administrator, how was the management experience in Findly Admin Application?



Question 9:

If you could improve one thing about the app, what would it be ?

 Nothing, everything are good

Provided with Arabic language

.Nothing

Nothing, it was perfect

Nothing, its great



5.3 Quality Attributes (NFR testing)

Table 16 Quality attributes.

User story	Quality Attribute	Measure	Results
As a user, I want the application to be easy to use so that it will increase my satisfaction level when using it.	<p>Learnability:</p> <p>Usability of an application is determined by five parameters, including learnability.</p> <p>Learnability is a measure of how easy or fast users can understand and use the application's main features. A learnable application will require less time and training to master [29].</p>	<p>We computed the time it takes the users of <i>Findly</i> to complete the main features which includes users and admins as follows:</p> <p>Users need 10-20 minutes to:</p> <ul style="list-style-type: none"> - Add announcement. -Edit announcement. - <i>Findly</i> chatbot. - Private chats. - View, search, and filter lost/found announcements. 	<p>The users started the test by signing up then logging in to the dashboard where all main features are accessible, then we gave them the freedom to start at any feature, and we calculated the total time needed to complete all of them.</p> <p>15 users and 5 admins did the tests on their applications.</p>



		<p>Admins need 8-12 minutes to:</p> <ul style="list-style-type: none"> - View, search, and filter lost/found announcements. - Manage reported announcements. - Add new category/building. 	<p>Users:</p> <p>Minimum: 13 minutes.</p> <p>Maximum: 22 minutes.</p> <p>Average: 17.5 minutes.</p> <p>14 user application testers passed the test (93.33%).</p> <p>Admins:</p> <p>Minimum: 6 minutes.</p> <p>Maximum: 11 minutes.</p> <p>Average: 8.5 minutes.</p> <p>All admin application testers passed the test (100%).</p>
As a user, I want the application not to sign me up until I create a strong password.	Security: the degree to which a software system safeguards the information or	The system prevents registering with a weak password. It must include an	The user started the test by clicking the password field in the sign-up form then the



<p>password so that I keep my data protected.</p>	<p>data so that users or other systems have the degree of access to these data based on the authorization level. [30]</p>	<p>uppercase and lowercase and numbers and special characters. It also must not be less than 8 characters.</p>	<p>password validator will dynamically change according to her input.</p> <p>When the user submits the form with a password that doesn't match the rules, then an error message will appear on the field requiring her to enter a strong password.</p> <p>15 did the test on their application and they all successfully completed the test.</p> <p>*Note: Admins are provided with their credentials.</p>
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<p>As a user, I want the application to be available 99% of the time so that I will have access to the services unless there is some update.</p>	<p>Availability: Ensure the continuous operation and uptime of the application is at least 99%.</p>	<p>Compute the availability of the application through random test sessions on different timeslots. Also, ensuring Service level agreement (SLA) of <i>Findly's</i> providers.</p>	<p>our providers are: -Firebase: To host the database, authentication system, and other application services. Firebase uptime is 99.95% [31]. -Dialogflow: We used Dialogflow to build and train our chatbot agent. It has an uptime percentage of 99.9% [32]. Both providers offer uptime that is more than 99%. For the random timeslots testing, we did a total of 15 tests and 5 tests for users and admin</p>
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			applications respectively. The tests included more than 1 device performing the main features of the applications, and the application passed all the tests with no downtime.
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5.4 Discussion

The UAT and NFR results showed that the *Findly* application was successful, as users were satisfied with its advantages and objectives and had no difficulty learning them.

Moreover, we asked the testers by giving them open-ended questions that focus on allowing the user to describe something in their own words. As some of the testers suggested that we improve the registration experience by giving the user hints about the requirements for the password. We considered her opinion as shown in figure 31 and 32. An attempt will be made to optimize the user interface and offer an Arabic language option. Also, all non-functional requirements (Learnability, Availability, and Security) were successfully confirmed. Both the user and the admin had a good experience with *Findly*, taking an average of 17.5 and 8.5 minutes to complete respective main features. *Findly* was determined to be available 24/7, which was another crucial quality attribute it should have. Also, users were restricted by password requirements to secure their account.

Finally, after reviewing user and admin feedback, it was overwhelmingly positive. Nearly all testers agreed that the application successfully solved the problem. They were satisfied with the results.



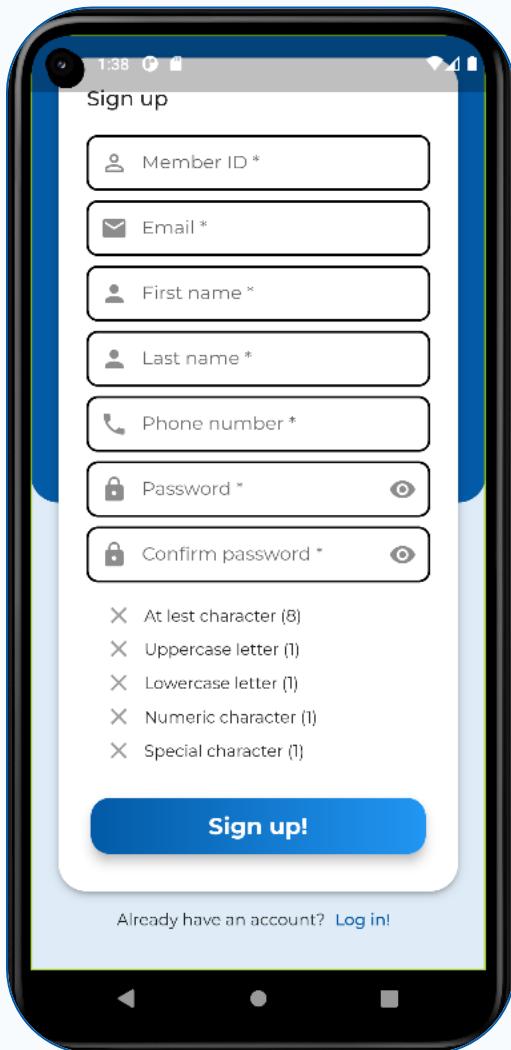


Figure 31 Password hint in sign up screen

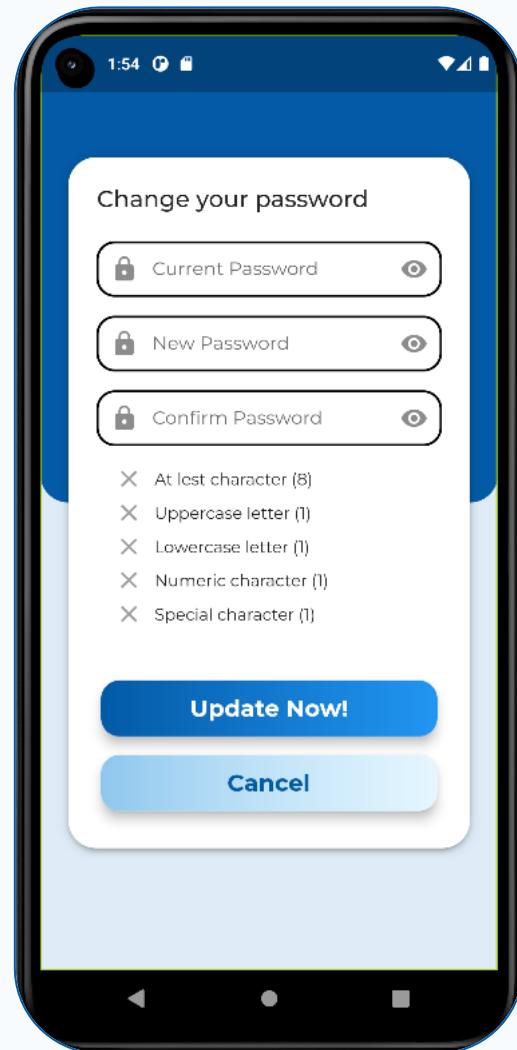


Figure 32 Password hint in change password screen



6 CONCLUSIONS AND FUTURE WORK

6 Conclusions and Future Work

This document shows the steps that were undertaken to produce the *Findly* android mobile application. We started by understanding our problem and performed domain analysis to produce a solution characteristic that will efficiently help the users, and then we dived deeper to gain a better understanding of our solution to the defined problem where we dedicated research on the used technologies in *Findly*. Followingly, we built the product backlog and started the design stage of the development where we architected the system and designed the components of the application. Afterward, we eventually implemented the application and evaluated it with real targeted users gaining feedback that got analyzed to define future steps that could improve *Findly*. The application was developed with Dart language under Flutter framework and was integrated with Dialogflow and Firebase with the help of other tools such as Jira, GitHub, Zoom, Teams, and Microsoft Excel.

Locally, *Findly* offers individuals of the KSU female campus a mobile application that helps gather lost and found items through the announcements system, which will simplify the lost item reclaim experience. Also, our application works toward providing a platform that facilitates and reduces the administration work of lost and found office, due to the difficulties that they face, such as: the flood of lost items, poor communication channels with the items' owners, and long item reclaim periods. Therefore, we are seeking to automate their system through *Findly* application which can significantly decrease their workload.

Globally, this solution can inspire even outside the university community such as in places where there exist large gatherings of people and items, for example airports, entertainment places, and shopping malls. Moreover, according to Statista, the population of Saudi Arabia in 2022 was 36.17 million, 5.3% higher than in 2021 and 2020 (35.46 million and 35.01 million, respectively) [33]. Additionally, in the second quarter of 2022, the number of tourist arrivals increased by 575.4%. This increase can come with issues such as crowded areas and lost items. This is where *Findly* becomes an inspirational solution to such issues



by customizing the system to fit each case or by globalizing the application to fit them all. Also, it strives to increase the number of returned items.

The most challenging part of this project was the necessity to quickly adapt to work with a new environment, which is Android Studio IDE. In addition, since each member was responsible for a distinct task, we found it tough to share the project through GitHub for easier collaboration and integration of our codes without any errors or conflicts. We also encountered certain difficulties when developing certain features because there weren't enough resources available; as a result, it took us some time to locate the correct resources and develop the feature.

To implement *Findly* chatbot, Dialogflow is preferred over Rasa for certain reasons. With Rasa, you can build conversational agents that understand natural language and use machine learning. Therefore, it can be used as an alternative to Dialogflow. Comparatively, Rasa seems almost barebone. Without any technical experience, Dialogflow provides everything needed to build an advanced AI chatbot. Without writing a single line of code, developers can start and end their conversational agents without downloading and installing libraries. Additionally, Dialogflow doesn't require hosting and comes with monitoring and debugging tools. Also, the integration of the Dialogflow agent is much more convenient in our case where it is provided by Google and Firebase and Flutter, resulting in higher compatibility and simpler integration.

One of *Findly*'s limitations is that it is implemented to only serve female campus individuals in King Saud University. Another limitation is that it only supports the English language. In addition, item delivery and tracking are not supported.

Our project contributed to enhancing communication by helping the users to find their lost items or announce finding an item on campus.



We aim for the application to be adopted by our university by allowing us to get to its database, to be an official online platform for the lost and found office in the university. Also, we will be considering serving several universities in Saudi Arabia, and we strive to support the Arabic language to make *Findly* a bilingual application that supports two main languages which are English and Arabic. For Found items there will be Cabinets associated with the item announcement ID and finder ID to put the item so users will avoid taking the item outside the campus with them.



7

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Apart from the efforts of our team, the success of the project depends largely on the encouragement and guidelines of many others. We take this opportunity to express our gratitude to the people who have been instrumental in the successful completion of this project.

We would like to express our special thanks to our mentor, Dr. Sanaa Ghouzali, for her time and efforts she provided throughout the graduation project. Your useful advice and suggestions were very helpful to us during the project's completion.

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We would like to thank every teacher that has taught us IT courses. Our thanks to CIS college, we are feeling proud of being one of its students.

Finally, we also extend our heartiest thanks to our families, friends, and well-wishers for being with us and extending encouragement throughout the project.

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[HTTPS://SYNDICODE.COM/BLOG/12-SOFTWARE-ARCHITECTURE-QUALITY-ATTRIBUTES/](https://SYNDICODE.COM/BLOG/12-SOFTWARE-ARCHITECTURE-QUALITY-ATTRIBUTES/)

[31] SERVICE LEVEL AGREEMENT FOR HOSTING AND REALTIME DATABASE | FIREBASE

[HTTPS://FIREBASE.GOOGLE.COM/TERMS/SERVICE-LEVEL-AGREEMENT](https://FIREBASE.GOOGLE.COM/TERMS/SERVICE-LEVEL-AGREEMENT)

[32] DIALOGFLOW SERVICE LEVEL AGREEMENT SLA | GOOGLE CLOUD

[HTTPS://CLOUD.GOOGLE.COM/DIALOGFLOW/SLA](https://CLOUD.GOOGLE.COM/DIALOGFLOW/SLA)

[33] SAUDI ARABIA - TOTAL POPULATION FROM 2018 TO 2028

O'NEILL

[HTTPS://WWW.STATISTA.COM/STATISTICS/262467/TOTAL-POPULATION-OF-SAUDI-ARABIA/](https://WWW.STATISTA.COM/STATISTICS/262467/TOTAL-POPULATION-OF-SAUDI-ARABIA/)

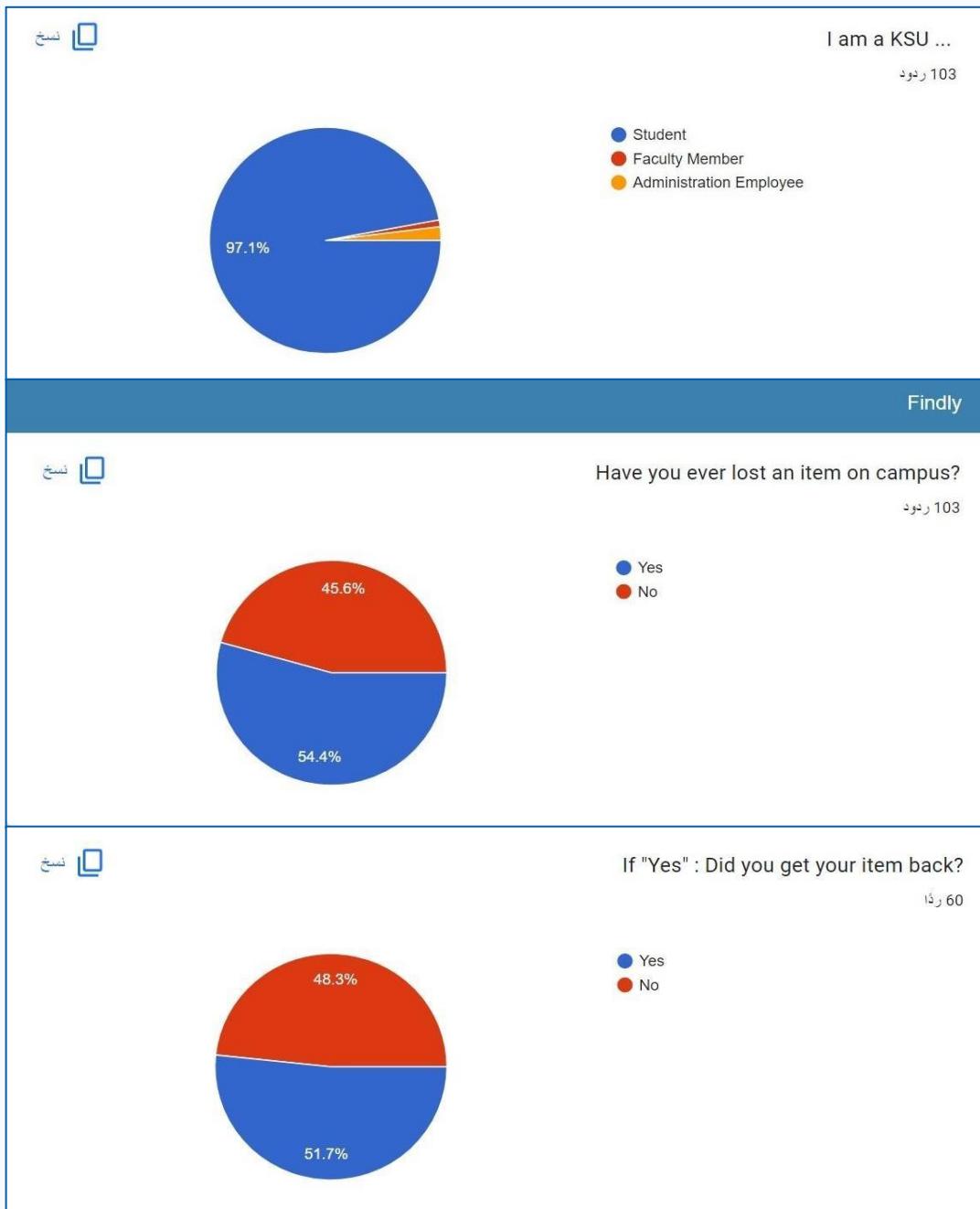


9
APPENDICES

9 Appendix

Appendix A

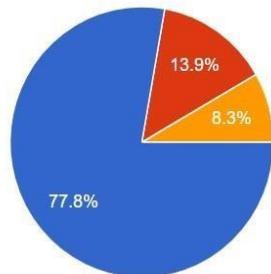
Requirements Elicitation Questionnaire detailed analysis and graphs:



نسخة

If "Yes": How long did it take to get it back?

رد 36

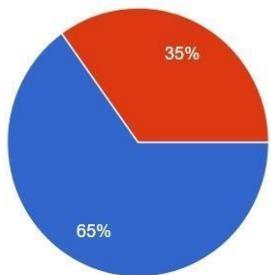


- A week or less.
- A month or less.
- More than a month.

نسخة

Have you ever found a lost item on campus ?

رد 103

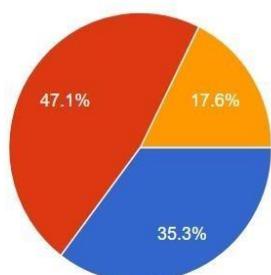


- Yes
- No

نسخة

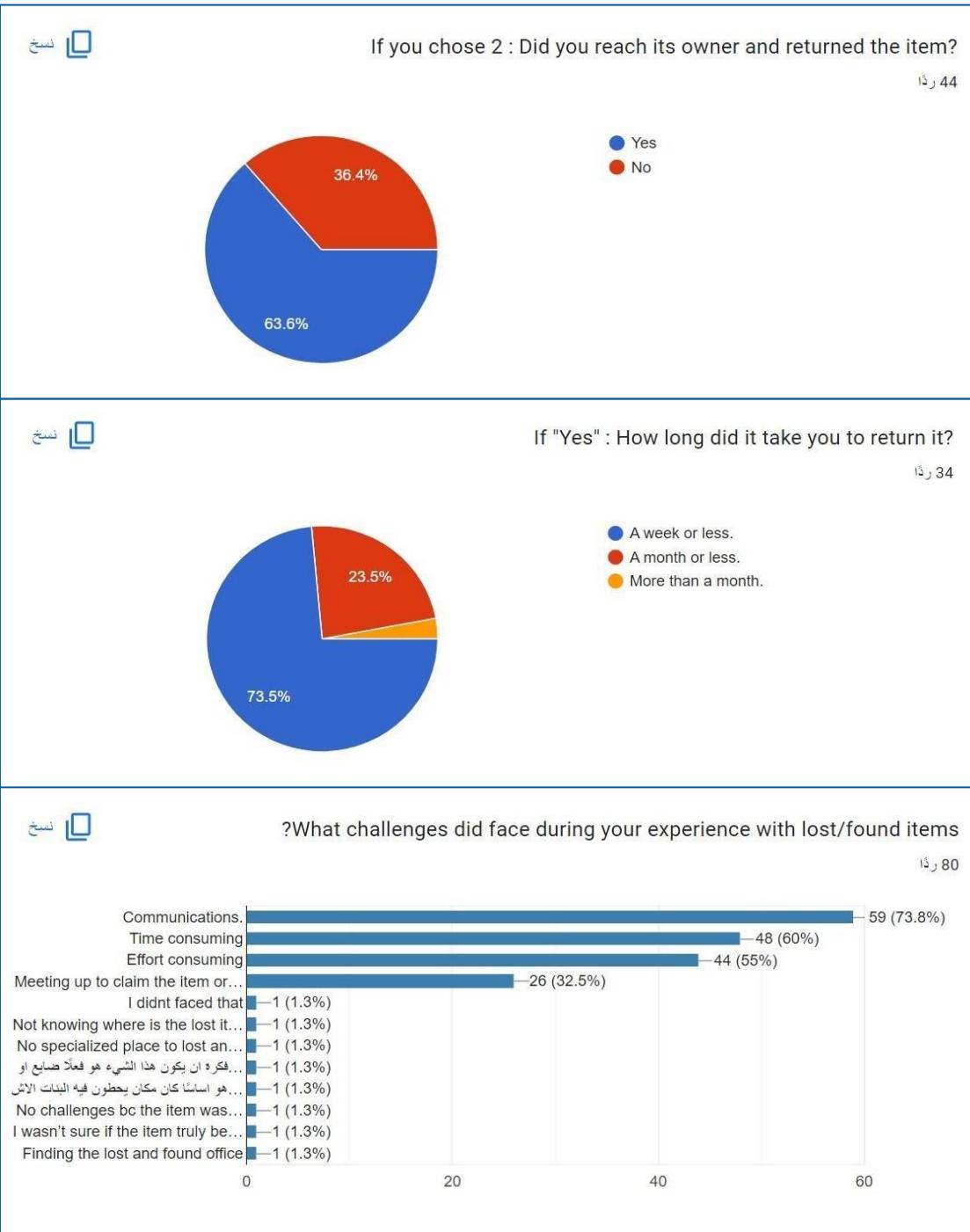
If "Yes" : What did you do about it?

رد 68



- 1- Left it.
- 2- Used social media applications or the college lobby board to find its owner.
- 3- Took it to the lost and found office.





Findly

نسخ [] Do you think that creating an application to facilitate the process of announcing about lost and found items on campus might help return items their owners

103 ردود

Response	Percentage
Yes.	83.5%
Maybe.	16.5%
No.	0%

Answer the following questions if your answer to the previous question was "Yes" or "Maybe" please

نسخ [] ?Would like to keep records of your announcements and chats

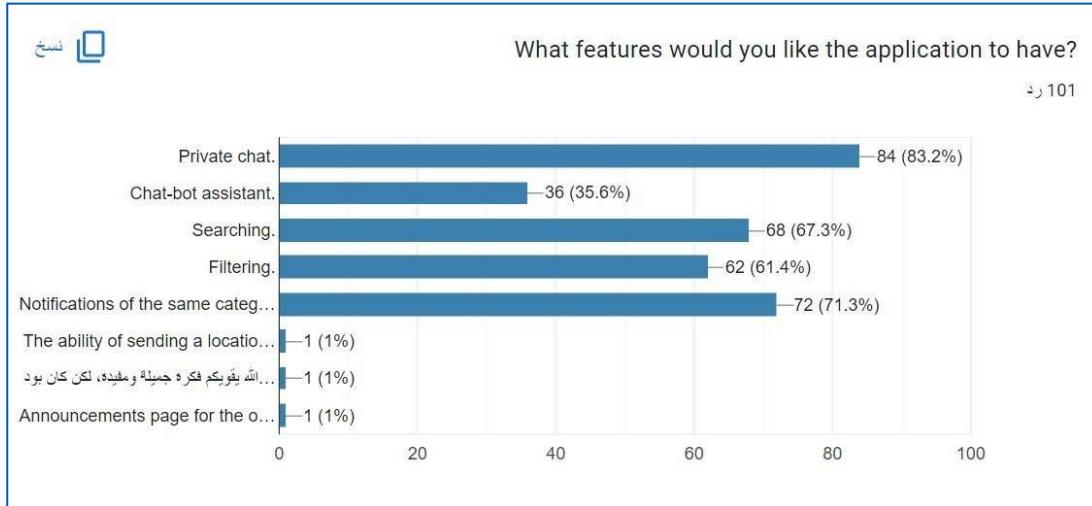
103 ردود

Response	Percentage
Yes	84.5%
No	15.5%

نسخ [] What would like to use as a communication channel to exchange information about the lost/found item

103 ردود

Communication Channel	Percentage
Email	5.8%
Phone	27.2%
Private chat (in the application)	67%



According to the questionnaire's results we found the following findings:

1. The first question was added to ensure that all required categories of KSU members did contribute to the questionnaire.
2. It showed that 54.4% of the users have lost an item on campus, which is considered as a high percentage.
3. 48.3% of the users that have lost an item did not get their items back, which is an unsatisfactory indication that it is a real problem that need to be solved.
4. 13.9% of the users who fortunately got back their lost items, it took them a month or less to get them. Also, 8.3% of them got their lost item after more than a month which can be considered a long period of time and time-consuming.



5. 65% of the users have found a lost item on campus yet only 17.6 of them took the lost item they found to the lost and found office which can indicate how effort- and time consuming it is to do so. In addition, 35.3% of the users left the item, and 47.1% of them used social media applications or college lobby board to announce about the item to find their owner.
6. 36.4% of the users who announced about a lost item they found using social media applications an college lobby did not succeed to reach the items owner which is concerning, and 73.5% of them returned the found item in a period of week or less but 23.5% returned the item in a period of a month or less and it took more than a month for 2.9% of them.
7. To what is related to the challenges they faced during the experience with either lost/found items 73.8% of the users declared that "Communication" was a real challenge, along with the experience being "Time-consuming" and "Effort-consuming" with percentage of 60% and 55% respectively.
8. The users were asked if creating an application to facilitate the process of announcing lost and found items on-campus might help return lost items to their owners and the majority of them agreed since the "Yes" choice has
9. 83.5% of selections and "Maybe" got 16.5% and "No" had 0%, which can reveal that it is a good solution to be suggested and developed.
10. The users were also asked about their preference of keeping a record of their



announcements and chat and they voted for "Yes" with a percentage of 84.5%.

11. As the desired communications channel, we questioned the user about the most desired communication method they would like and the result revealed that 67% of them chose the "Private chat", and the "Phone" came second with a percentage of 27.2%, and the "Email" came last.
12. 82.4% preferred the application to use "Arabic" as its language. And 17.6% chose "English".



Appendix B

Requirements Elicitation interview detailed:

Interview 1:

Table 17 Interview 1

Name of the interviewer	Fai Bin Khidhr.
Type of the interview	On campus.
Date of the interview	September 28 th 2022.
Name of the interviewee	Mrs.Randaa Alghanem.
Role	Head of the Student Affairs (females).
Interview's content	
Questions	Answers
1- Have you ever lost an item of yours on campus? And did you get it back?	No.
2- Have you ever found lost items on campus? And what did you do about them?	Yes, I would keep them in my office and try to keep them safe until the owners would come and ask about their items since we do not have a platform approved by the university that is specialized to this matter, there was a service on "Nafithati" they terminated it and it is known that when someone loses an item on campus they can go to the Students Affairs of the Security (lost and found) office.
3- Were you able to return the items to their owners? And how long did it take to return the items to their owners?	Yes, the majority of the items were returned to their owners, some items take days, and some take a week or more, and I even have some lost items that we haven't found their owners in years.
4- What challenges did you face during your experience with lost/found items?	The communication was the main issue, how can I reach the members either students or employees and to share that we have this lost item and its information. Also, how can I make sure of the identity of the person and if the item really belongs to her.



5- do you think that creating an app to facilitate the process of announcing about lost and found items on campus might help return items their owners?	Absolutely, I would recommend every one on campus to use in case the lost or found an item.
6- If you agree, what features would you like the application to have?	I think offering a communication method just for this issue would be time-effective. Also, including category in the form of the lost or found item would be helpful
7- if there was an application that helps KSU members and guests find their lost items or announce about finding an item on the campus would you like to have an account on it to save your record and chat?	Yes, actually considering my responsibilities and the amount of items I have at my office I think keeping a record of it will be helpful and I may be communicating to different item losers.



Interview 2:

Table 18 Interview 2

Name of the interviewer	Fai Bin Khidhr.
Type of the interview	Online.
Date of the interview	September 29 th 2022.
Name of the interviewee	Rawan Alqarni.
Role	Student.
Interview's content	
Questions	Answers
1- Have you ever lost an item of yours on campus? And did you get it back?	Yes, I have, and I did get it back.
2- If yes, what did you do when you lost your item? And how long did it take to get it back?	I informed all my university colleges via a WhatsApp group that I have lost an item, I got it back after 3 days.
3- Have you ever found lost item on campus? And what did you do about it?	Yes, I have handled it over to the lost items' office.
4- Were you able to return the items to their owners? And how long did it take to return the items to their owners?	No, because I didn't know the owner of the item, so I just handle it to the lost items' office.
5- What challenges did you face during your experience with lost/found items?	You cannot know exactly the person that lost an item to contact her, also there's no other solution to find your lost item rather than going to physical lost office or asking people around you.
6- do you think that creating an app to facilitate the process of announcing about lost and found items on campus might help return items their owners?	Yes, definitely, because as I said in my previous answer, we need more than just typical ways to report lost/found items, so a technical solution would be a great idea.
7- If you agree, what features would you like the application to have?	If a lost item is found in a certain place, I think this place should be specified either by map or another way, so that the owner can know the place where she/he lost the item.



8- if there was an application that helps KSU members and guests find their lost items or announce about finding an item on the campus would you like to have an account on it to save your record and chat?	For students I think they should register and have accounts, but not necessarily for guests since they don't visit the university on a regular basis.
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Interview 3:

Table 19 Interview 3

Name of the interviewer	Fai Bin Khidhr.
Type of the interview	On campus.
Date of the interview	September 29 th , 2022.
Name of the interviewee	Mrs.Munira Alarfaj.
Role	Safety and security supervisor.
Interview's content	
Questions	
1- Have you ever lost an item of yours on campus? And did you get it back?	No.
2- Have you ever found lost items on campus? And what did you do about them?	Yes, we would place an announcement of the found item and it shall be placed at the place of where it was found, if it is in a building or a cafeteria, and include communication information in the announcement.
3- Were you able to return the items to their owners? And how long did it take to return the items to their owners?	Yes, some items take hours and other take to a week or more. A number them took more than a month.
4- What challenges did you face during your experience with lost/found items?	Knowing the identity of the owners if they didn't ask or searched about their item, and if they did so the doubt that they are the real owners was a real issue.
5- do you think that creating an app to facilitate the process of announcing about lost and found items on campus might help return items their owners?	Yes.
6- If you agree, what features would you like the application to have?	The ability to include more details about the item and images in the announcements.



- 7- if there was an application that helps KSU members and guests find their lost items or announce about finding an item on the campus would you like to have an account on it to save your record and chat?

Yes, the history is important , it will give us the ability to know the time taken from when the item was announced as lost to the time it was returned to its owner if it was.

Appendix C

Démographiques of participants questionnaire :

What is your age? *	<input type="radio"/> 18-21 <input type="radio"/> 22-24 <input type="radio"/> 25 and above
Are you a faculty member, administration employee or student? *	<input type="radio"/> Faculty member <input type="radio"/> administration employee <input type="radio"/> Student
Which college are you from? *	Short answer text <hr/>



What is your native language? *

Arabic

English

Are you old findly tester? *

Yes

No

Appendix D

User feedback questionnaire after testing :

Findly User application survey

* It is easy to find what you are looking for in the Dashboard

Very easy

Somewhat easy

Somewhat hard

Very hard

* ? How easy for you to navigate through the App

Very easy

Somewhat easy

Somewhat hard

Very hard



* .Prompts for inputs are clear

Yes, it's clear

No, not clear

* ? Was the error messages in the app helpful to you

Yes

No

Maybe

* ?What feature of our App is the most important to you

private chat

chatbot assistance

Notifications

أخرى:



* ? Does the Lost & Found items screen look organized to you

Yes

No

Maybe

* ? On a scale of 1 to 5, how easy was it to add an announcement

5 4 3 2 1

very complicated very easy

* ? On a scale of 1 to 5, how easy was it to edit an announcement

5 4 3 2 1

very complicated very easy



* .It is easy for you to get in touch with the announcement publisher

Yes

No

Maybe

* ?What do you find best about our product

Ease of use

Features provided

Interface design

أخرى:

* ? how likely are you going to use our application

Very likely

Somewhat likely

Not sure

Somewhat unlikely

Very unlikely



* ? If you could improve one thing about the app, what would it be

إجابتك

* ? If review our application with a score out of 5, what score would you give us

1

2

3

4

5

* ? How likely are you to recommend our product to a friend

Very likely

Somewhat likely

Somewhat unlikely

Unlikely



Admin feedback questionnaire after testing :

Findly Admin Application

* It is easy to find what you are looking for in the Dashboard

Very easy

Somewhat easy

Somewhat hard

Very hard

* ? How easy for you to navigate through the App

Very easy

Somewhat easy

Somewhat hard

Very hard

* .Prompts for inputs are clear

Yes, it's clear

No, not clear



* ? Does the Lost & Found/reported announcements screen look organized to you

Yes

No

Maybe

* ? On a scale of 1 to 5, how easy was it to add a building name

5 4 3 2 1

very complicated very easy

* ? On a scale of 1 to 5, how easy was it to delete a reported announcement

5 4 3 2 1

very complicated very easy



* ?What do you find best about our product

Ease of use

Features provided

Interface design

أخرى:

* As an Administrative , how was the management experience in Findly Admin ? Application

Excellent

Very good

Good

Fair

Poor

* ? If you could improve one thing about the app, what would it be

إجابتك

