



FAYDH | فَيْض

A Mobile Application for Reducing Food Waste in Saudi Arabia

IT 497: Graduation Project Report Product Release-2

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فيض | FAYDH

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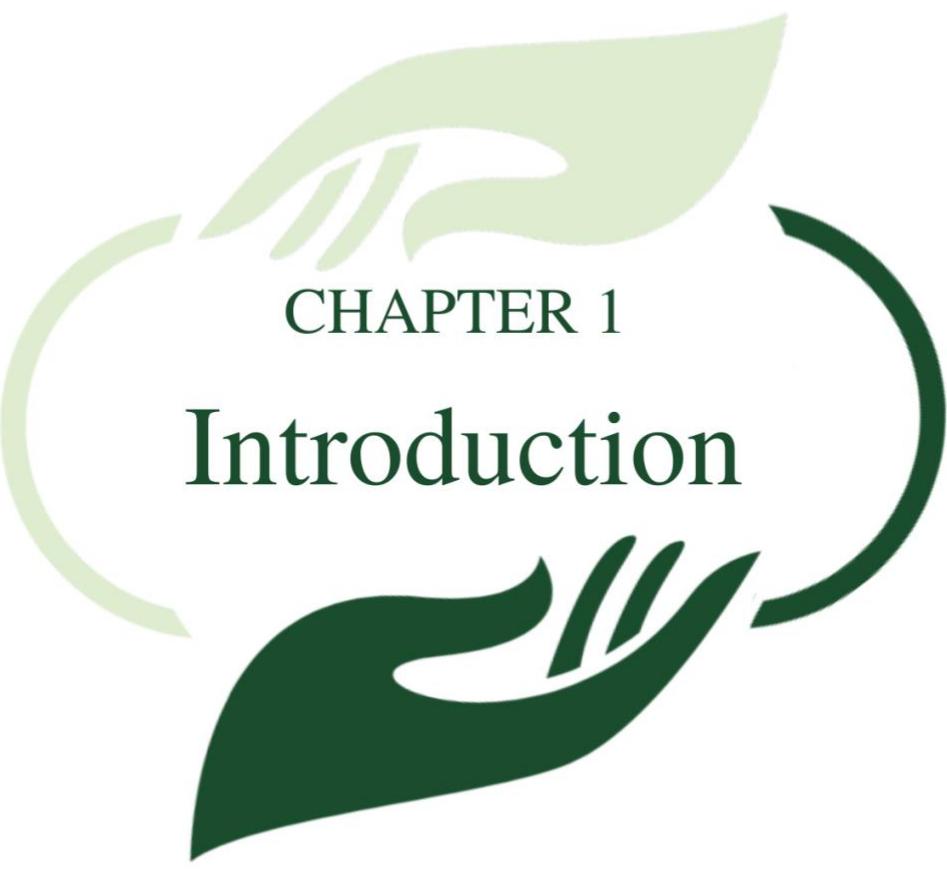
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Abstract (English): Food waste is one of the most issues facing both global and local impacts. Every year, 2.5 billion tons of food is wasted [60], leading to substantial economic and environmental losses. We aim to take steps to reduce food waste and its detrimental effects. And raise awareness to reduce food waste for a greener future. After doing extensive research into the impacts of food waste, we employed an agile approach to design and develop the product in the best way. 'Faydh' is an Arabic mobile application that provides individuals and food-related businesses in Saudi Arabia with a straightforward way to distribute surplus food to charitable organizations and people in need to that food. We studied existing food-sharing applications and there are no effective food waste-minimizing applications available in Saudi Arabia. In conclusion our application got mostly positive feedback and has passed the usability testing successfully where the users found it easy to use and helpful and it is ready to launch.

الخلاصة: يعتبر هدر الطعام من أكثر المشكلات التي تواجه التأثيرات العالمية والمحلية. في كل عام ، يُهدر 2.5 مليار طن من الغذاء [60] ، مما يؤدي إلى خسائر اقتصادية وبينية كبيرة. نهدف إلى اتخاذ خطوات للحد من هدر الطعام وأثره الضار. ورفع مستوى الوعي للحد من هدر الطعام من أجل مستقبل أكثر حضرة. بعد إجراء بحث مكثف حول آثار مخلفات الطعام ، استخدمنا نهجاً رشيقاً لتصميم المنتج وتطويره بأفضل طريقة. "فيض" هو تطبيق عربي للهاتف المحمول يوفر للأفراد والشركات ذات الصلة بالأغذية في المملكة العربية السعودية طريقة مباشرة للتوزيع فائض الطعام على المنظمات الخيرية والأشخاص المحتاجين لذلك الطعام. لقد درسنا تطبيقات مشاركة الطعام الحالية ولا توجد تطبيقات فعالة لتنقیل هدر الطعام متاحة في المملكة العربية السعودية. في الختام حصل تطبيقنا على تعليقات إيجابية واجتاز اختبار قابلية الاستخدام بنجاح حيث وجد المستخدمون أنه سهل الاستخدام ومفيد وجاهز للإطلاق.

Keywords: Surplus food; donate; food waste.



CHAPTER 1

Introduction

1 Introduction

Food wastage is one of the most prevalent global problems. Since roughly one-third of the food produced worldwide for human consumption every year, which is approximately 1.3 billion tons, gets lost or wasted [1], much of which is perfectly edible and nutritious. Meanwhile, 800 million people go to bed hungry every night. In other words, 1 in 9 people on the planet is starving or malnourished [2]. Each could be sufficiently fed on less than a quarter of wasted food [2]. With all of that, Saudi Arabia ranks among the top food wasters in the world [5]. According to a recent study conducted by the Saudi Grains Organization (SAGO), more than 33 percent of food is wasted in KSA, not only costing the country SR40 billion (\$10.6 billion) annually but also posing severe threats to its socio-economic structure and environment [3].

Since Saudi Arabia is not a country ideal for agricultural growth, it is not capable of producing enough food to feed its citizens due to its harsh and hot temperatures, low rainfall, limited arable lands, lack of fertile soil, absence of permanent water bodies, and diminishing water resources [4]. Saudi Arabia, therefore, depends heavily upon exports from other countries to meet its food requirements. Although domestic production of food commodities is insufficient in this country, the amount of food wasted is enormous. Currently, food waste is one of the prime issues threatening food security in Saudi Arabia [5][6]. Two main factors contribute to food waste in Saudi Arabia: the first one is that lots of surplus food is being produced by businesses and households. It gets thrown away because there is no convenient way to redistribute it, and there is a general lack of public awareness about the negative impacts of food waste and how to reduce it.

Faydh “فَيْض” is an Arabic Mobile Application that is going to offer individuals and businesses (restaurants, bakeries, cafeterias, grocery stores, etc.) in Saudi Arabia an easy and simple way to give away their surplus food to organizations (charities, food banks, etc.) and people in need of it to prevent it from getting wasted. Faydh “فَيْض” also gives people a space to raise awareness about food wastage by posting Article links, pictures, blog posts, etc., on the app. That is Why we think the idea of Faydh “فَيْض” very much needs to be implemented here in Saudi Arabia since sustainability is one of Vision 2030 goals, and such a food waste reduction application does not exist so far. Furthermore, a technical solution to this problem will be the most effective since almost everyone uses their phones daily. Instead of them making an effort to go out and

search for someone who needs food, we decided to make a platform for the givers and takers to reach each other in a matter of seconds.

1.1 The problem

Wasting food raises social questions, particularly given the current global financial crisis, rising food prices, and international food shortages. These social costs should be measured regarding losses to human welfare or quality of life. Even if just one-fourth of the food currently lost or wasted globally could be saved, it would be enough to feed 870 million hungry people in the world, 12% of the world's current population [1]. We are all responsible for food waste and its health, environmental, and economic consequences. Living a life with more responsibility to conserve food is obedience to Allah the Almighty and compliance with the government's directives. Saudi Grains Organization conducted a nationwide field study on 3700 samples as part of the National Transformation Program that targeted 19 food commodities into eight groups. The study shows that each individual wastes 184 kgs a year and that flour and bread waste accounts for 917 thousand tons annually. In contrast, 557 thousand tons of rice, 22 thousand tons of meat, 13 thousand camel meat, 41 thousand tons of beef, 444 thousand tons of poultry meat, and 69 thousand tons of fish have been wasted annually. On the other hand, vegetable waste exceeds 335 thousand tons annually, except for some vegetables such as zucchini and potatoes, as the amount of waste came to 38 thousand and over 200 thousand tons, respectively [7].

One of the reasons, if not the main one, for food wastage in Saudi Arabia is buying more food than what is actually needed, which comes with different factors. For instance, cultural factors, here in Saudi Arabia, people think offering more food to guests in wedding buffets or to family and friends at small gatherings is considered generosity, and it's frowned upon if you don't provide enough food. And people are left with huge amounts of food that will most likely be wasted if not given away.

And for many people in Saudi Arabia, food waste has become a habit: buying more food than we need at markets, letting fruits and vegetables spoil at home, or taking more significant portions than we can eat. Facilitating the distribution of surplus food to individuals who can use it and raising public awareness about the negative impacts of wasting food can significantly help to reduce food waste in KSA. However, there do not appear to be any existing apps for this purpose [8].

Most people don't realize how often they waste food and the negative impacts it can have on food security, the environment, and climate change. Reducing food loss and waste could benefit them, their families, and the world, now and in the future. Safe and wholesome food that is currently thrown away could help feed hungry people and reduce food insecurity today. Feeding America and its network of food banks each year rescue around 3.6 billion pounds of food. This number represents only a tiny percentage of food that could have been donated but ended up in a landfill [9].

1.2 The solution

We will develop a mobile application that allows individuals and businesses to donate surplus food and share content to raise food awareness. Food providers will be able to post the food and information related to it (such as the quantity, expiration dates, and pick-up times), view statistics related to their surplus food (such as how much surplus food they have produced over time, how much was picked up, and how much was thrown away) as well as remove the foods that have been picked up. The food consumer will be able to search for the food, reserve the food they want and specify the picked-up details (such as quantity and time). In addition, all logged-in users can post content to raise awareness about food waste, such as links to publications outlining its negative impacts and suggestions for avoiding food waste. These will help to increase food awareness, reduce food wasting instead of throwing it away and feed hungry people by donating excess food to community sites. The users can also report the other users if they post inappropriate contents. The application administrator will be able to block such users and remove awareness content and food post ads to control and manage the system.

1.2.1 Objectives

- **Product (customer focus-value):**

Food waste is acknowledged to be a huge problem worldwide and has become a trending topic in the international discourse on food security. The recovery of food surplus has also gained more attention in recent years [10]. Allowing individuals and businesses (restaurants, bakeries, cafeterias, grocery stores, etc.) to share surplus food with individuals and organizations (charities, food banks, etc.) will help prevent waste.

The product will allow individuals and businesses that have surplus food to:

- Sign up.
- Post surplus food and related information (such as the quantity, the expiry dates, and pick-up periods).
- Remove any food that has expired.
- View statistics related to the food they've posted.
- View a list of all food donation posts they have with their status.
- Edit their profiles
- Post content to forum and view forum to raise awareness about food waste (such as the negative impacts of wasting food and food preservation tips).
- Reports inappropriate forum content

It will also allow individuals and charitable organizations who can make use of surplus food to:

- Sign up.
- Search through all the food that has been posted.
- Select some food, and then they can arrange to pick up details.
- View Reserved food list
- Edit their profiles

- Post content to forum and view forum to raise awareness about food waste (such as the negative impacts of wasting food and food preservation tips).
- Reports inappropriate forum content and food posts ads.

It will also allow the administrator to:

- Remove inappropriate awareness content.
- Block violating users.
- Approve / decline businesses accounts.
- View reported contents (food posts ads & forum contents) and violating users
- View blocked users list
- View all users list.

It will also allow all the users to:

- Sign in / Sign out
- Forgot password

1.2.2 Scope

The mobile food donation app called Faydh “فَيْض” will only support the Arabic language. The App aims to assist users who have extra food and want to donate it to people or organizations (charities, food banks, etc.).

“FAYDH” Will be constrained to Saudi Arabia for now and will not support buying and selling of food (only free sharing for now); besides, it will display the statistics on surplus food (such as how much surplus food they have produced over time, how much was picked). In addition, Faydh “فَيْض” Will share information regarding food waste, as well as references to helpful resources to spread awareness of its detrimental impacts. It will be developed for the Android platform.

The technologies, platforms and languages that we used :

Table 1 Software Tools

Software Tools	
Name	Description
Flutter	is an open-source framework by Google for building beautiful, natively compiled, multiplatform applications from a single codebase [11].
Microsoft Visual Studio	is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code[12].
Android Studio	is the official Integrated Development Environment (IDE) for Android app development [13].
Figma	is a powerful design tool that helps you to create anything: websites, applications, logos, and much more [14].
GitHub	is a software development platform [15].
Stack Overflow	is a developer-focused community where users can ask and answer questions [16].
Jira	is a project management tool that is compatible with the agile methodology [17].
Firebase	is a set of hosting services for any type of application. It offers NoSQL and real-time hosting of databases, content, social authentication, and notifications, or services, such as a real-time communication server[52]

1.3 Product vision

For businesses and individuals

Who produce surplus food and need a way to easily distribute it instead of throwing it away

AND For organizations and individuals Who need to use the surplus food

The Faydh “فَيْض” is a mobile application

That allows the businesses and individuals to share their surplus food with organizations and individuals who can use that food to prevent it from being wasted and raises their awareness about food waste.

Unlike other existing food-sharing apps and food awareness sites that are in English and other languages and do not cater to Saudi Arabia

Our product is in Arabic, is primarily targeted toward Saudi Arabia, and is electronically available, making it easily accessible to both food providers and consumers.

1.4 Methodology and approach

We began our application development process by utilizing the agile methodology, starting with extensive research on the global and local effects of food waste. We studied existing food-sharing applications, interviewed our potential users to determine their goals and needs, and identified the problem that our application would aim to solve.

From there, we established design requirements and began designing the application user interface. This involved creating wireframes, prototyping, and user testing. We also developed and tested the software, ensuring the application was functional, user-friendly, and could meet our users' expectations.

To further ensure the application was robustly designed and developed, we conducted interviews and surveys to receive real-time user feedback and iteratively improved the application based on this feedback.

1.5 Main contribution

Food waste is a major challenge facing global and local economies, environments, and societies. Every year, an estimated 2.5 billion tons of food is wasted[60], leading to massive economic and environmental losses. This has caused the United Nations to recognize food waste as one of its sustainable development goals.

Also, in Saudi Arabia where the culture of serving plentiful amounts of food can lead to large amounts of food going to waste. Faydh, is aiming to combat this through digital transformation and technology, connecting those who have excess food with those who are in need. Through this, Saudis can donate their excess food to benefit people and charities, reducing food insecurity and helping to address the global issue of food waste.

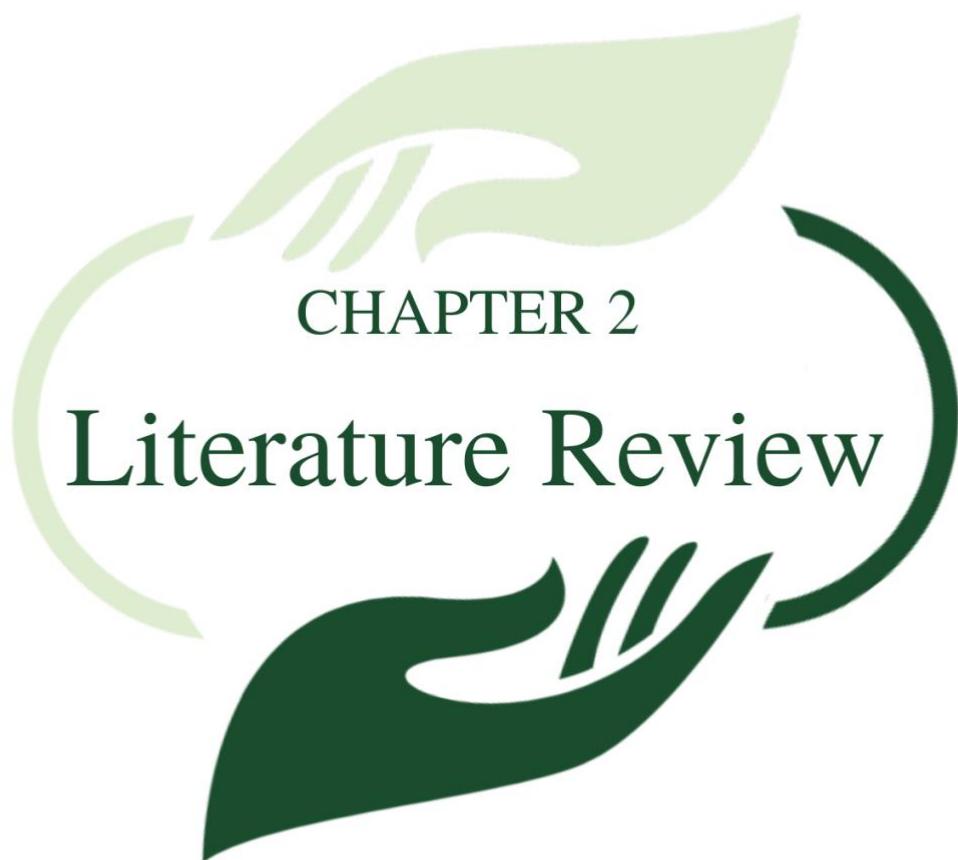
We are keen to support the Arabic language to be used within the Kingdom of Saudi Arabia since most food waste reduction applications that reside in Saudi Arabia are very simple and very lacking in features compared with the other applications residing in different countries (refer to literature review section).

As students and members of society, it is our responsibility to contribute to the advancement of knowledge and the development of new technologies.

A food waste reduction mobile application has the potential to make a major global and local impact in Saudi Arabia. By helping to reduce the amount of food waste, this application can help to reduce overall costs for food production. Additionally, faydh can help to promote a more sustainable and eco-friendlier lifestyle by encouraging users to utilize the app and reduce the amount of food waste they generate by posting their surplus food and share it with others. Faydh can help to create a more sustainable future.

This document includes a detailed explanation of our project, in this section we talked about the problem and the solution we provide with its scope and objectives. we also talked about our product vision and the methodology and approach we worked with and our main contribution. and in Section 2 Literature review we present the background of our problem and the competitors in the market. and after that in section 3 we discuss the way our system is designed its methodology and its requirements and in chapter 3.2.3 you can find all users interactions summarized in a use case diagram, and for detailed user stories you can find them in chapter 3.2.4 Roadmap and product backlog. and in chapter 3.3 we discussed the system

design in 3.4 we included data design diagrams to show what database we used and how it's organized after that in 3.5 we show the interface design using a site map. After that we discussed the implementation with its tools, libraries, major features, and challenges we went through in chapter 3.6. Next in section 4 is the system evaluation with user acceptance and NFR testing. In section 5 we concluded the document and future work. After that in section 6 we expressed our gratitude to the people who supported the make of this system. Lastly, you can find all references and appendixes in chapter 7 and 8 respectively.



CHAPTER 2

Literature Review

2 Literature Review

In this chapter, we provide background research over the food waste problem globally and in Saudi Arabia, you can also find the competitive product analysis section where we did comprehensive research about 8 of our competitors and then compared each one of them with our mobile application.

2.1 Background

In this section, we gathered various sources about food waste, its causes, and its negative global impacts. We are here concerned with revealing the magnitude of Saudi Arabian food waste, along with the Subsidized and cultural factors leading to surplus food. We also discussed the Problems and limitations of food distribution despite having many charity organizations distributing surplus food and how people in Saudi Arabia are aware of food waste.

2.1.1 Food waste

Food waste occurs along the entire spectrum of production, from the farm to distribution to retailers to the consumer. Food "waste" refers to food that is fit for consumption but consciously discarded at the retail or consumption phases. Wasted food has far-reaching effects, both nationally and globally [18]. These wasted foods are hampering our mother nature, and we are bearing its consequences such as landslides, water and air pollution, and deforestation, which is created in the process of production of food. Food wastage is not only a problem for the nation but also for the public.

- Causes

There are many causes leading to food waste, such as:

- **Overproduction in food-related businesses:** this occurs when chefs overestimate the number of sales they expect for a particular dish. They prepare more food than is needed and throw out whatever isn't used at the night's end [19].
- **Poor Planning:** Without meal plans and shopping lists, consumers often make inaccurate estimates of what and how many ingredients they will use during the

week. Unplanned restaurant meals or food delivery can also lead to food at home going bad before it can be used [20].

- **Misunderstandings about the meaning of "best before" and "use by" date labels:** these labels lead to edible foods being thrown away. The "best before" date is about the quality of the food and not the safety of eating it. Meanwhile, the "use by" date on food is about safety. It is the most important date to remember. You can eat food until and, on the use,-by date but not after [21].
- **Buy one, get one free promotion:** this promotion may lead to impulsive buying and excessive buying. Some people are fascinated by these offers and take the initiative to buy while they initially only need one product, and sometimes they don't need it at all.
- **Lack of knowledge and misinformation on food waste's environmental, social, and financial impacts:** Lack of awareness and knowledge about the effect of food waste is one of the main reasons which leads to make a significant impact on our environment. Wasted food isn't just a social or humanitarian concern—it's an environmental one. When we waste food, we also waste all the energy and water it takes to grow, harvest, transport, and package it. And if food goes to the landfill and rots, it produces methane—a greenhouse gas even more potent than carbon dioxide [22].

- Negative impacts

Food production, transportation, storage, and cooking require energy, fuel, and water. Each of these emits gases that contribute to global warming. Non-consumed food accounts for 8–10% of global greenhouse gas emissions. All the resources—land, energy, labor, and capital—used to create the food will be wasted when it is lost or destroyed. As a result, cutting back on food waste will cut gas emissions.

Food requires a lot of water to grow and produce it. By wasting food, we are wasting precious water supplies [23]. It takes:

- 100 buckets of water to produce just one loaf of bread
- 54 buckets of water to rear one chicken breast

- six buckets of water to grow one potato
- one bucket of water to grow one tomato [23]

Although producing enough food is worldwide, nearly a billion people suffer from hunger and malnutrition. Many developed countries throw away tons of food that will consume in developing countries—these foods are thrown away even though they are still of good quality and safe [24].

2.1.2 Food waste in Saudi Arabia

Saudi Arabia ranks number one in the world in wasting food, according to a report by the Ministry of Environment, Water, and Agriculture in 2018. The report revealed that around 30 percent of food produced is wasted, amounting to over SR49 billion annually. The average Saudi wastes 250 kg of food annually compared to the global average of 115 kg [25].

The Saudi Food Bank announced since the start of Ramadan in 2018 its latest initiative of providing 1,740,000 meals to needy families by 360 volunteers. Throughout the year, the organization saves an average of 9,000 meals daily. So far, it has served 6 million meals. Their visits to hotels, food courts, weddings, and other occasions have saved around 6 million meals so far [25].

Saudi Grains Organization's study shows that each individual wastes 184 kgs a year and that flour and bread waste accounts for 917 thousand tons annually, while 557 thousand tons of rice, 22 thousand tons of meat, 13 thousands of camel meat, 41 thousand tons of beef, 444 thousand tons of poultry meat and 69 thousand tons of fish have wasted annually [25].

Meanwhile, health problems among Saudis are prevalent, where 59.4 percent of the population suffers from overweight and obesity problems, and 23.9 percent are diabetics [25].

- Factors leading to surplus food

Cultural and economic factors leading to surplus food; Up to 70% of the food in KSA is lost during special celebrations [26]. Arabs are generous in hospitality; the provision of food is a gesture of welcome to guests. Even if a family might have little food to spare, visitors are often fed with the surplus. People in the KSA usually buy food in bulk and prepare more food than they could consume, with significant quantities going to waste. As part of the culture, Saudis love setting up lavish food tables during Eid festivals, weddings, parties, or informal get-

togethers. They love to organize abundant banquets where wasting food is an indispensable feature [26]. Saudi Arabia is viewed as a food-secure country, with a solid fiscal balance and significant oil reserves that feed its population. The Saudi government uses price caps and provides subsidies to food producers and retailers to enable them to provide food to consumers at low prices. In particular, the government regulates the prices of staple foods such as milk and provides support to food producers and retailers by compensating the private sector for narrow profit margins.

Since food items and groceries are abundantly available to all in KSA and are highly subsidized, the residents take food for granted. According to a recent survey, about 78% of food purchased in KSA is discarded each week to make room for new groceries [27].

- Distributing surplus food

One of the primary resources is charitable organizations that help to reduce wasted food in Saudi Arabia. They are racing to provide their services to beneficiaries through various means using best practices by giving away the gathered food to the people in need. Are some of the notable non-profit organizations open to donations:

Khiyrat (خيرات): is a small non-profit organization that aims to curb food waste. They are most known for gathering leftovers from individuals, restaurants, hotels, and private functions and distributing them to people who need them [28].

Alber (البل) charity: They receive the excessive amount of surplus food from individuals, transport it and store it safely, and then they distribute it to the needy [29].

Ekram (إكرام) : Is a charity organization that collects surplus food and distributes it to honor the blessed food and feed the needy [30].

Even though they offer great help, they still have some problems/limitations; for instance, they don't work round the clock as most Saudi gatherings end very late at night. People don't consider those charities and think throwing away food is the easier choice. Also, looking for organizations (charities, food banks, etc.) is time-consuming, and people find difficulties looking for someone or some organization to take their food. Additionally, they lack

technological resources to facilitate food distribution to reach more people (providers and consumers). Most food distribution apps and websites are unavailable in Saudi Arabia and do not support the Arabic language.

- Food waste awareness

The lack of awareness regarding the continuous waste of vast amounts of food extends to the general population in Saudi Arabia and corporate organizations. Reducing waste produced by such establishments can significantly improve their profitability and contribute to the emerging sought-after goals of Corporate Social Responsibility. When individuals change their behavior and act more accountable manner, they can save their own money while simultaneously contributing to the environmental and economic goals of the nation [31]. Also, the Islamic teachings, which call on Muslims to share extra food with the needy, conflict with actions of food waste. The Saudi Arabian standard view of someone seeking to conserve food is likely to be frugal and unpleasant; therefore, changing wasteful practices will require a considerable cultural shift by raising awareness or holding campaigns about the negative impacts of food wastage.

2.2 Competitive Product Analysis

In this section, we provided comprehensive research about our competitors. The first step was identifying our competitors and the features they provide.

Then we included a small comparison table showing what they are offering and lacking. Finally, we provided a summary of what the competitors lack and provide. Also, a summary declares our application features and compare them with other existing applications.

2.2.1 Food waste reduction applications



1- HipMeal

HipMeal [32] is an IOS and Android mobile application for individuals who search for a food companion, love to share delicious meals, and want to be a part of the fight against food waste by reducing household kitchen waste by giving out extra food. It is available in Morocco. Application interfaces are provided in (Figure 1, Figure 2)

HipMeal main features:

- 1 Support Arabic and English, and Spanish languages.
- 2 Donate surplus food.
- 3 Edit profile.
- 4 Add food donation posts.

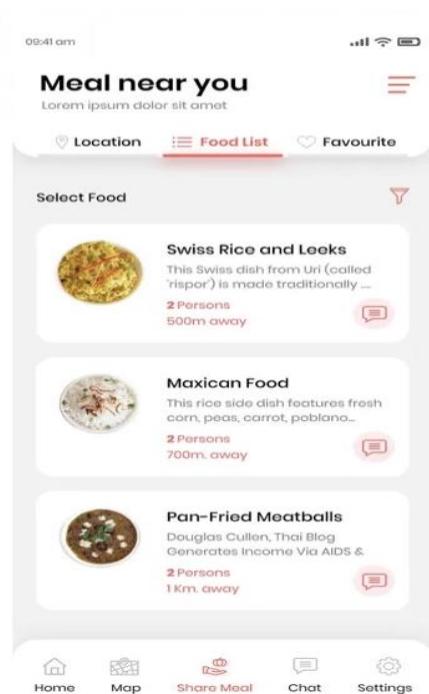


Figure 1 HipMeal FoodList Interface[40]

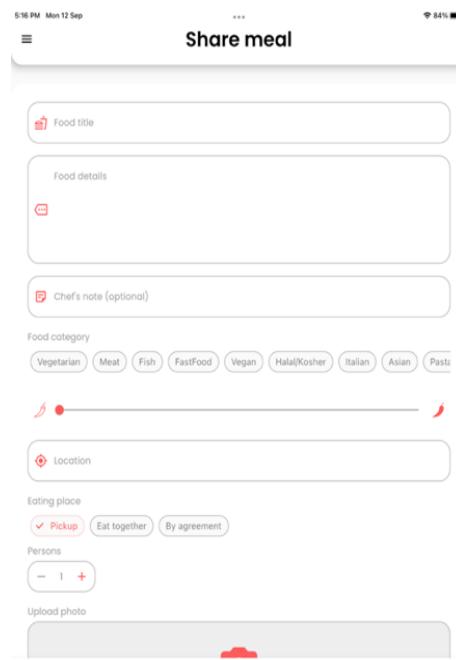


Figure 2 HipMeal Add donation post Interface[40]



2- Food Sharing

Food Sharing [33] is an IOS and Android mobile application that helps individuals share food and reduce the amount of food they throw away by posting the food with its description and the pickup time. It is available in England. Application interfaces are provided in(Figure 3, Figure 4 and Figure 5)

1. Food Sharing main features:
2. Support English, Russian, and Ukrainian languages.
3. Donate surplus food.
4. Has a search feature.
5. Edit profile.
6. Add food donation posts; the user must fill out a short description and photo and provide an address.
7. It has a chat feature.

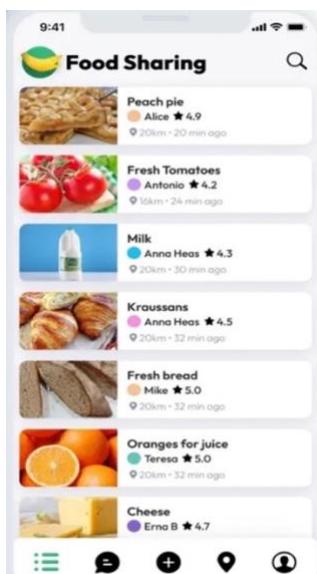


Figure 3. FoodSharing FoodList Interface[41]



Figure 4. FoodSharing Food Description[41]

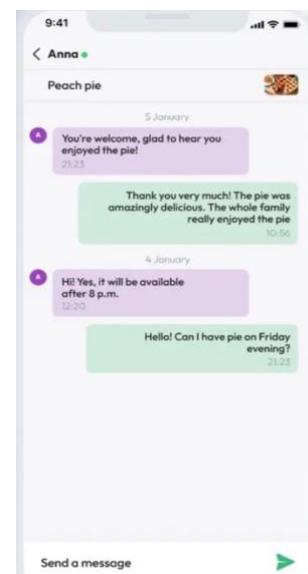


Figure 5. FoodSharing Chat Feature[41]



3- Munch

Munch [34] is an IOS and Android mobile application where businesses like restaurants, bakeries, and other food service providers sell unsold high-quality food at a discount. It is available in Romania. Application interface are provided in (Figure 6 and Figure 7).

Munch's main features:

- 1 Support Hungarian and English Romanian Czechia languages.
- 2 Buy surplus food from businesses at a discounted price.
- 3 Has a search feature.
- 4 Edit profile.
- 5 Add food posts for sale.

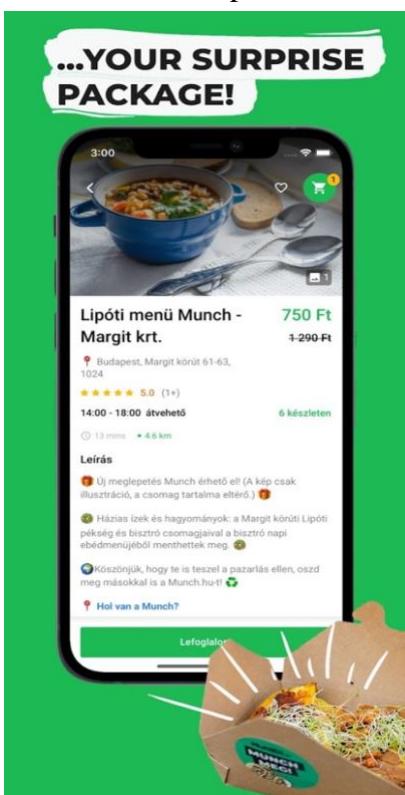


Figure 6 Munch Food description Interface [42]

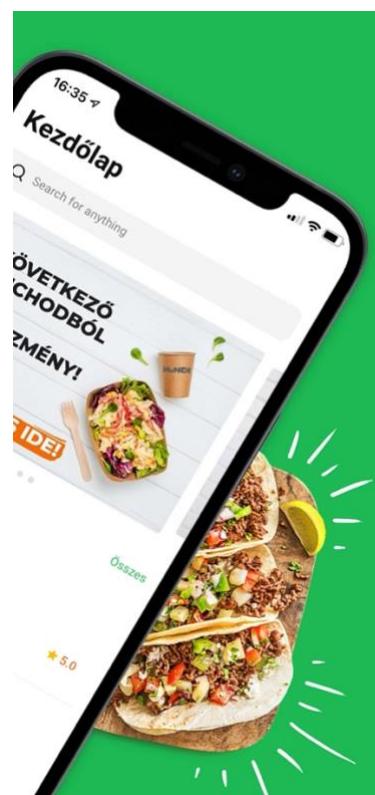


Figure 7 . Munch Search Function Interface [42]



4- Too Good To Go

Too Good To Go [35] is an IOS and Android mobile application that lets customers buy and collect Surprise Bags of food directly from businesses at a great price. The app is available in many regions (US, UK, Switzerland, Sweden ..etc.). Only available for businesses. Application interface are provided in (Figure 8 and Figure 9).

Too good to go main features:

- 1 Supports English Basque, Catalan, Danish, Dutch, French, Galician, German, Italian, Norwegian Bokmål, Polish, Portuguese, Spanish, and Swedish Language.
- 2 Buy surplus food from businesses at a discounted price.
- 3 Has a search feature.
- 4 View statistics about money saved.
- 5 Edit profile.
- 6 Add food posts for sale.

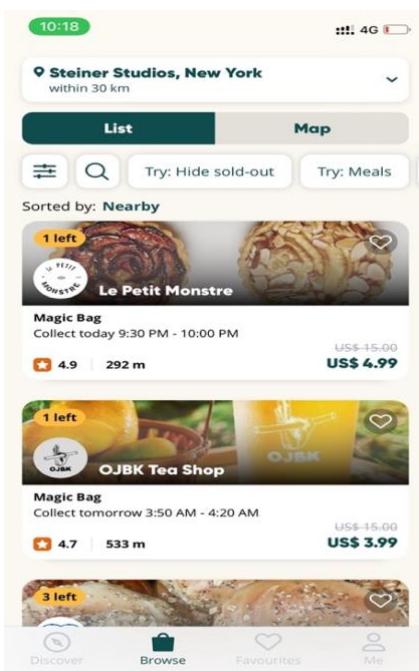


Figure 8. Too good to go browse interface [43]

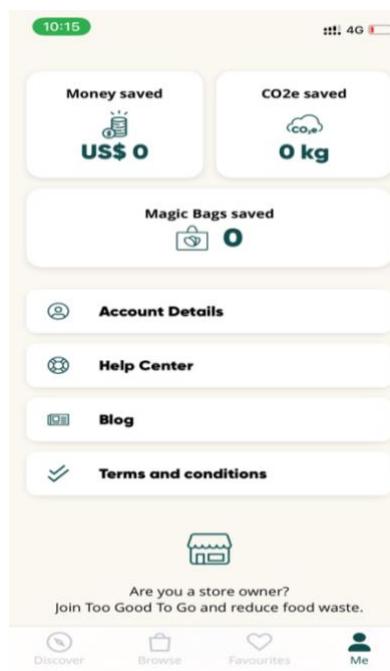


Figure 9. Too good to go profile interface[43]



5- Tekeya

Tekeya [36] is an Android mobile app that allows people in Egypt to buy surplus high-quality food with high discounts from businesses or for individuals to donate them to needy people. Application interface are provided in (Figure 10 and Figure 11).

Tekeya's main features:

- 1 Support Arabic and English languages.
- 2 Buy surplus food from businesses at a discounted price.
- 3 Delivery option.
- 4 Donate surplus food.
- 5 Has a search feature.
- 6 Edit profile.

Add food posts for sale and food donation posts.

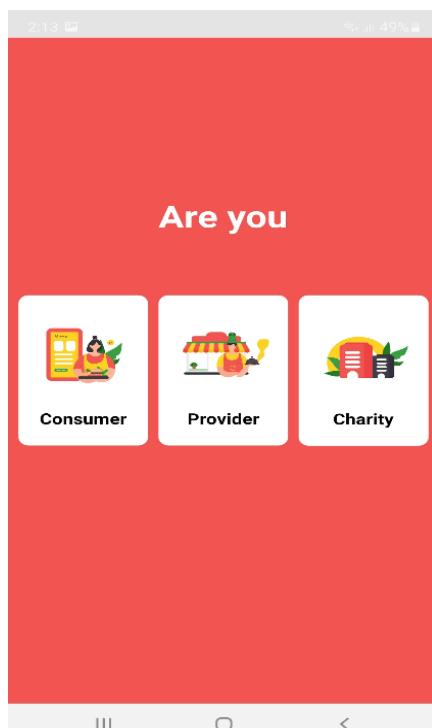


Figure 10 Tekya Main Interface [44]

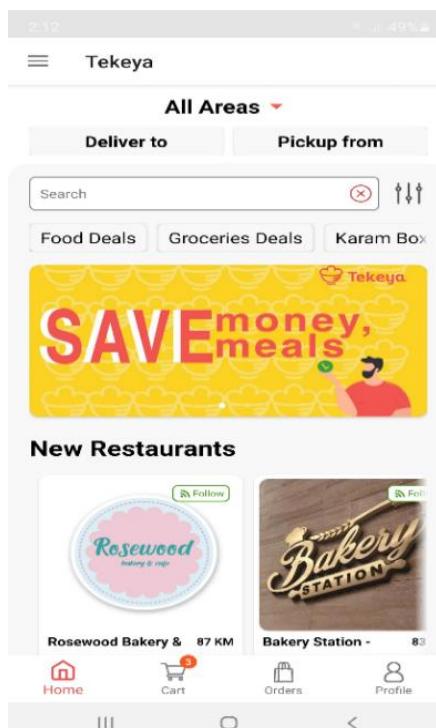


Figure 11 Tekya HomePage Interface [44]



6- All is Good

All is Good [37] is an IOS and Android mobile application for reducing food waste by buying it from businesses at a high discount. It is available in Europe and North America. Application interface are provided in (Figure 12 and Figure 13).

All is Good main features:

- 1 Supports English, Spanish, French, And Portuguese.
- 2 Buy surplus food from businesses at a discounted price.
- 3 Delivery option.
- 4 Has a search feature.
- 5 Add food posts for sale.
- 6 Edit profile

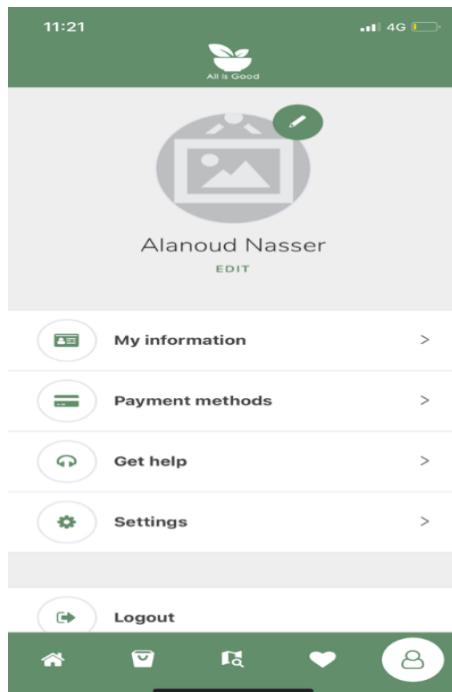


Figure 12 All is Good Profile Interface[45]



Figure 13 All is Good HomePage Interface[45]



7- Hifz Al-nea'm- حفظ النعم

Hifz Al-nea'm [38] is a very simple IOS mobile application that consists of forms to collect the item and personal(name, address, phone number) information from food or clothes providers so that it can be saved to the charity's database. It is only available in Saudi Arabia for individuals only. Application interface are provided in (Figure 14 and Figure 15).

حفظ النعم - Hifz Al-nea'm main features:

- 1- Supports Arabic.
- 2- Allows donations.

Since the app is simple, it doesn't have many features other than sending information to the charity.



Figure 14. Hifz Alnea'm HomePage Interface[46]

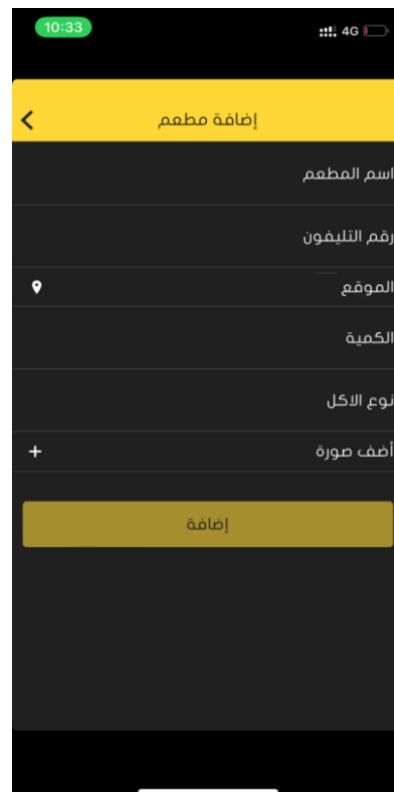


Figure 15. Hifz Alnea'm Add food donation info Interface[46]



فائض 8-

فائض [39] is a really simple Android mobile application; It's HomePage provides a different type of charity organizations (Bread, Feasts, Clothes, paper, electronics, furniture) and shows a map of the nearest charity organization to the user's current location based on the chosen type. It's currently only available for organizations in Saudi Arabia. Application interface are provided in (Figure 16 and Figure 17).

فائض Main features:

- 1- Supports the Arabic language
- 2- The users can find charity organizations around their area.

Since the app is simple, it doesn't have many features besides the map.



Figure 16. فائض HomePage for food organization types[47]



Figure 17. فائض Map Interface[47]

2.2.2 Comparison Table

The table below is a comparison table of all the eight competitors of our applications with our application. It shows the features our application includes and the ones that the other applications have.

Table 2 Comparison between similar applications

Application name Features	فَيْض	HipMeal	Food sharing	Tekeya	Munch	Too good to go	Hifz Al-nea'm	All is good	فائض
Support Arabic	✓	✓		✓			✓		✓
Allows donations	✓	✓	✓	✓			✓		
Allow posting awareness contents	✓								
Post food ads	✓	✓	✓	✓	✓	✓		✓	
Search	✓		✓	✓	✓	✓		✓	
Buy surplus food				✓	✓	✓			✓
View statistics	✓						✓		
Available in Saudi Arabia	✓							✓	✓
Edit profile	✓	✓	✓	✓	✓	✓		✓	
Find charity organization around user's area									✓
Delivery option				✓				✓	

2.2.3 Summary

After analyzing our competitors (Table 4), we noticed the following:

First, we figured that most food waste reduction applications do not support Arabic. Secondly, half of them do not offer food to be donated; instead, you must pay for it. And among the applications we analyzed, none of them has a space for users to post content to raise awareness about the food waste problem. There is another application that offers the users statistics about the surplus food and how much food they saved from going to waste, which is Too good to go; their statistics include how many times you collected the food bags from restaurants. And only two applications are currently available in Saudi Arabia.

Also, almost all of them allow food providers to post food ads (such as descriptions, pictures, and pick-up times). And enable providers and consumers to edit their profiles. We also noticed that many applications have a search feature that allows consumers to search among food lists. Only two applications provide a delivery option for buying discount food.

We, in the “Faydh” application, are keen to support the Arabic language to be used within the Kingdom of Saudi Arabia since most food waste reduction applications that reside in Saudi Arabia are very simple and very lacking compared with the other applications residing in different countries. That’s why we worked on “Faydh” to give individuals and businesses to donate their surplus food by posting food ads; it also gives them statistics about the percentage of the food they saved. It also allows the food consumers to search through the food ads; all users can edit their profiles. In addition to providing a space for posting content that raises awareness about food waste.

CHAPTER 3

System Design and Development

3 System Design and Development

3.1 Methodology

The approach we used while developing Faydh is the agile methodology which is one of the most widely used approaches in software development. It relies on collaboration and iteration to deliver high-quality results. While developing Faydh, we focused on users' feedback to continuously refine the application, so it meets the users' needs and expectations.

The Scrum Framework is a popular agile development framework that is used in software development to structure and organize work. It is based on three core elements: roles, events, and artifacts. The roles are the product owner(Dr. Rabia Jafri Ali), the scrum master(Dr. Maha Alyahya), and the development team(Shaden Alhamad, Jomanah Binfaris, Alanoud Bahathiq ,Shaikha BinAteeq). The events are the sprint planning meeting, the daily standup meeting, the sprint review meeting, and the sprint retrospective meeting. The artifacts are the product backlog, the sprint backlog, and the product increment.

The product owner is responsible for determining the product vision and prioritizing the product backlog. The scrum master is responsible for managing the development process, removing any obstacles, and facilitating communication between the different teams. The development team is responsible for developing the product increment and delivering the product.

The sprint planning meeting where we met with our supervisor/ product owner and review the product backlog, and plan the current sprint, and set goals and timelines. The daily standup meeting is a short daily meeting we do among our development team to update each other on our progress and any roadblocks. The sprint review meeting is the meeting where we review the current sprint with the supervisor/product owner, discusses any changes or improvements, and decides on the next step. The sprint retrospective meeting is a meeting to reflect on the progress of the current sprint, discuss what went well and what could be improved, and plan any changes for the next sprint.

The product backlog is a list of all our application features and requirements that need to be implemented and their status. The sprint backlog is a list of features and requirements for the current sprint. The product increment is a working version of the product that is delivered at the end of each sprint.

Tools such as Jira and GitHub were used during the project to help the team in various ways. Jira was used to create and assign tasks, track progress, and follow up on tasks. GitHub was used for version control and to store code in.

Jira Link: [HERE](#)

GitHub Link: [HERE](#)

3.2 System Requirements

In this section, we provide requirement elicitation of our application using questionnaires and interviews. We interviewed three people: an employee from the food business, an employee from a charity, and individuals. You can also find system users, architecture, use case diagram, and product backlog in the rest of the chapter.

3.2.1 System Users

Four users interact with Faydh application: Businesses, Charities, Individual , and admin.

Any business (restaurants, bakeries, cafeterias, grocery stores, etc.) interested in reducing food waste. They shall be able to donate their excess food by adding the food donation post that includes a description of the provided food and the pickup details. And charitable organizations (charities, food banks, etc.) they shall be able to reserve any food posted by others. Individual is any individual interested in either giving away their surplus food to other people or receiving food from others when in need of it. The admin has the authority to delete awareness posts and food posts or block specific users.

The users can be of any educational level, but they must read and write in Arabic to navigate and interact with the application interface. Regarding technical expertise, the application doesn't need a high level of technical skill to use it. The user should have an internet connection to access the application software Faydh-. Users must be familiar with using smartphones.

3.2.2 Requirements Elicitation and Analysis

In requirement elicitation, we started by collecting information using questionnaires. We sent it to a large group of people to get to know our potential target users more. And gain an overview of the leading causes of food waste in Saudi Arabia, how people and organizations deal with the massive amount of surplus food, and if our application would help reduce food waste and raise individuals' awareness. We interviewed three people who are an employee in a business (Known café), an employee in a charity (حفظ النعمة), and an individual food provider and consumer to discover their experiences with food waste and know their opinions about applications that aim to reduce food waste. The complete questionnaire and interviews are provided in Appendix A and B.

- Interviews analysis

- Business

We interviewed Mr. Salman Alzumia, A 26-year-old male who works as a quality control employee at a very known café. He started working as a quality control professional in 2018.

He told us about his business, which is a café and bakery. The Saudi chain has 13 factories distributed throughout Saudi Arabia, Bahrain, and Germany. It currently has around 300 Branches in Saudi Arabia. When we asked him to estimate how much food gets wasted daily, he told us how the factories make about 300,000 doughnuts daily, which then get distributed to the branches. They only set a waste acceptance rate (Number of doughnuts allowed to be disposed of) of 20% of the doughnuts. He then listed a few causes of why they have this massive amount of food waste. One of their marketing strategies is to have a fully stocked case of doughnuts 24/7 to appetize the customers and make them buy the doughnuts throughout both shifts. He continued by explaining the work of the Area supervisor (an employee in charge of analytics). And how he needs to have an overview of all events and special days in Saudi Arabia to estimate how many products are required in

each of the branches he is in charge of and how errors made in those estimations could lead to huge amounts of waste.

We continued by asking about their method of dealing with the surplus food by the end of the shift/day. He told us that they have local contracts with local shepherds (Cows and sheep) and after the factory gets all the remaining doughnuts from the branches, they destroy them to make them not human edible and send them in huge bags to feed to the animals.

We asked if they use any technologies to deal with leftover food in their branches. Mr. Salman claimed that they do not use technologies other than the ERP (Enterprise Resource Planning) system, which enables food companies to manage and optimize their business processes – from purchasing, accounting, finance, human relations, and production to logistics [48]. They use it to add the number of doughnuts they receive from the factory and the number of leftover doughnuts.

After that, they contact the factory to come to pick up the surplus food. Mr. Salman told us that one of their main challenges is finding local shepherds to give the surplus food to. When we asked if they had any plans for the future, he told us they did not have any.

We finally explained to him in detail about our applications and asked if it would be helpful to them and if he had any suggestions for changes or improvements he would like to be done to our application. He told us that it would be harder for them to use the application as a business because they had tried to distribute food to individuals in their early days. However, some of them sold the remaining doughnuts to smaller cafes and claimed it was from the business itself. So, unless we have a method of ensuring an individual would not sign-up multiple times to reserve multiple food posts from their business, they would not prefer using our application. He also noted the FDA regulations and how we need to check them out before we go ahead and release the application to the public to check what foods are safe and can be donated and what not.

- Charity

Regarding charities, we met Mr. Faisal Al-Wahhabi. He has been the Director of Financial Resource Development and Receipt at the Charitable Society for Preserving Food in Al-Bakiriya for over ten years. At the beginning of our conversation, We asked him about the main goals they currently focus on. He told us that it was self-sufficiency for needy families with limited incomes in all branches through rehabilitation, providing courses, and qualifying them for the labor market.

The food contributors inform the charity beforehand that they are having gatherings by phoning them to take extra food from them, arrange the food, package it carefully, and give it straight to the needy on the same day. We asked him during the interview which group generally Donates food, and he said that most leftover food comes from family gatherings. As for the methods they use to deal with surplus food, they place the food in large containers to get heated

later since they mostly receive food after midnight. Then it gets prepared and distributed to the people in need who are ready to receive the food at any time.

We asked him about the most common categories of individuals who typically Receive surplus food. He responded that needy families are the category that receives the food regularly, particularly families without nationality since they cannot work or receive monthly payments.

Furthermore, we asked him about the number of beneficiaries for whom the charity provides surplus food, and his response was based on the records registered with the charity. They have approximately 690 families, excluding families with no nationalities since they cannot get registered in the records. So, they tend to deliver food to their residential neighborhoods personally.

We also asked about their challenges when receiving and distributing surplus food. Mr. Faisal said they face a large amount of surplus food that remains surplus despite being distributed to needy families; in this case, they resort to feeding it to livestock.

When asked if there is a specific technology they use in receiving and distributing surplus food, he replied that they do not use any advanced technologies other than phone calls or WhatsApp messages. However, a relatively innovative method is contracting with a third-party platform called Manafith, which specializes in giving the needy vouchers. It allows

people to purchase essential foods in limited amounts, which the charity organization is responsible for delivering to this platform.

Finally, we asked him whether the charity had any plans to reduce food waste. He said they have previously interacted with the Ministry of Agriculture, where collaboration with vegetable markets is done by giving huge containers to areas designated for charitable groups. Leftover veggies from the market are collected at the end of the day and delivered to charity recipients.

We ended the interview by asking him if he would be interested in using the app and if he had any suggestions for enhancements to the application. He said that he is very interested as a charity representative in using the application because he is that because a significant portion of the population does neither write nor read, it is fair to include icons to assist them in navigating the program simply and smoothly.

- Individual

We also interviewed Ms. Hend Alshaya, 21, a Saudi who studies IT at KSU. She lives in the university dormitory on weekdays and goes to her family on weekends. Besides her native Arabic, she is also fluent in English. She uses her mobile phone in her daily life, in terms of calling or talking to her relatives, or she also uses mobile applications.

We asked her if she needed food and did not have enough money to buy new food from where she could get her food, and she replied that she might get it from the food left in her dormitory after lunch or dinner. During the interview, we asked her if she had ever communicated with charities and her experience with them. She said yes, she had dealt with them before if they had surplus food after family gatherings or wedding parties and others in their house. In terms of her experience with them, she answered that it is good and okay. However, It needs a little effort regarding the method of receiving food for charities; in terms of communication methods with charities, sometimes they may encounter difficulties in reaching them. We also asked her if she uses technology to receive and donate surplus food, what devices and applications she uses, and what problems she

faces as an individual in using them. She told us that the technology is usually used by calling or chatting through the WhatsApp application. One of the biggest problems she faces is the difficulty of communicating with charities since family gatherings, wedding parties, and others often last until midnight. Charities close a little early, in addition to the fact that some charities are challenging to reach, e.g., there are charities in the neighborhood. However, they are not On Google Maps; it is not relatively well known to the neighborhood's residents, so the neighborhood residents cannot send surplus food. In return, charities do not receive much surplus food.

We finally explained our app in detail and asked her if it would be helpful for her. If she has any changes or improvements that she would like to make to our app, she told us that the app would be beneficial for those who don't have enough money to buy new food and want clean and delicious food. On the donor side, it's good for them to get rid of surplus food correctly and help them reduce their food waste.

- Interview Summary

After Conducting interviews with all three types of potential users (Businesses, Charities, and individuals), we realized that they do not appear to use any technological solution for food waste reduction. Furthermore, the main two problems: 1- finding people to receive this massive amount of food, 2- Communicating with those in need of the food.

The interviews confirmed the enormity of the food waste problem in the local context. They affirmed the need for an app to give a technology solution to put food providers and consumers in one place and allow them to share the food. Moreover, raise people's awareness about the food waste problem.

- Questionnaire analysis

This section summarizes the results of the questionnaire performed with participants who have dealt with excess food and are interested in food waste reduction. An online questionnaire was conducted with 174 female and male participants with education levels ranging from bachelor's to high school to ages 20–50. The questionnaire was completed using Google forms on 22 September 2022 and distributed via social media. The questionnaire's primary purpose was to

focus on the individual's excess food to get an overview of the surplus food situation and how they handle it.

We received 174 responses, and the results indicate that all of them are familiar with using mobile devices and 81% of respondents sometimes buy more food than they need, and 58.6% give the excess food to the animals. We asked the respondents to imagine themselves in a scenario where they are planning a food gathering, and 47.1% of them will prepare more than the exact amount of food that the guests could eat. In addition, 95.4% of respondents believe that the percentage of food thrown away has become widespread. We asked the respondents if they had ever dealt with charity organizations before, and 65.5% answered yes. Also, 35.6% of respondents struggle with donating excess food because they can't find a place to donate or do not know individuals who need food.

Furthermore, 94.8% of respondents are not using any applications to help them deal with excess food, and 5.2% said that they are using applications, but they take time to respond, and there are no delivery options. We asked the respondents if it would be okay to take the extra food from other people or charity organizations, and the percentages are nearly close. 28.2% said yes, 39.2% said maybe, and 32.8% said no. In addition, 81% of respondents think that giving people a space to post content to raise awareness about food waste would be helpful. Also, we asked them an important question about our application: whether they would prefer to use an application that facilitates donating surplus food to charity organizations and individuals. Most of the answers were positive, with 98.9% answering yes! and only 1.1% responding no.

Furthermore, we asked if they had any suggested features to include in the application. The answers were varied and beneficial, like categorizing the food (such as bread, rice, and meat), providing delivery options, and recycling the food. Also, using a Calculator to estimate the amount of food needed on occasions based on the guest's number to help people not to waste. Allow volunteers to deliver food for a nominal amount.

- Questionnaire Summary

From what we gained from the questionnaire, people are conscious that food extravagance has become a significant problem in Saudi Arabia, and they are interested in reducing food waste. Since they currently are not using any food waste reduction application, they would like an application to help them donate the excess food to the right people and places.

3.2.3 User Interactions

- Use Case Diagram

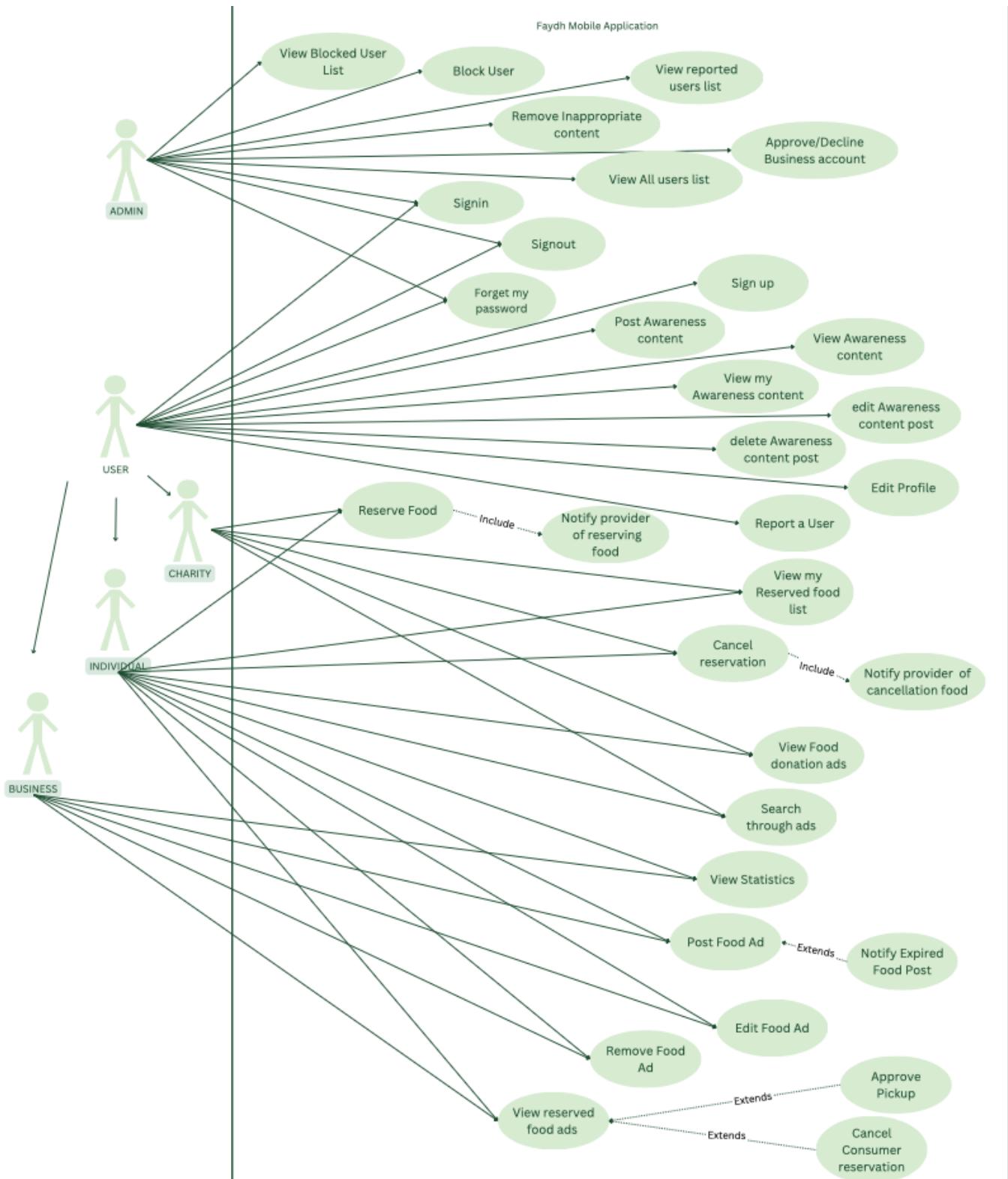


Figure 18 Use Case Diagram

3.2.4 Roadmap and Product Backlog

- Product Roadmap

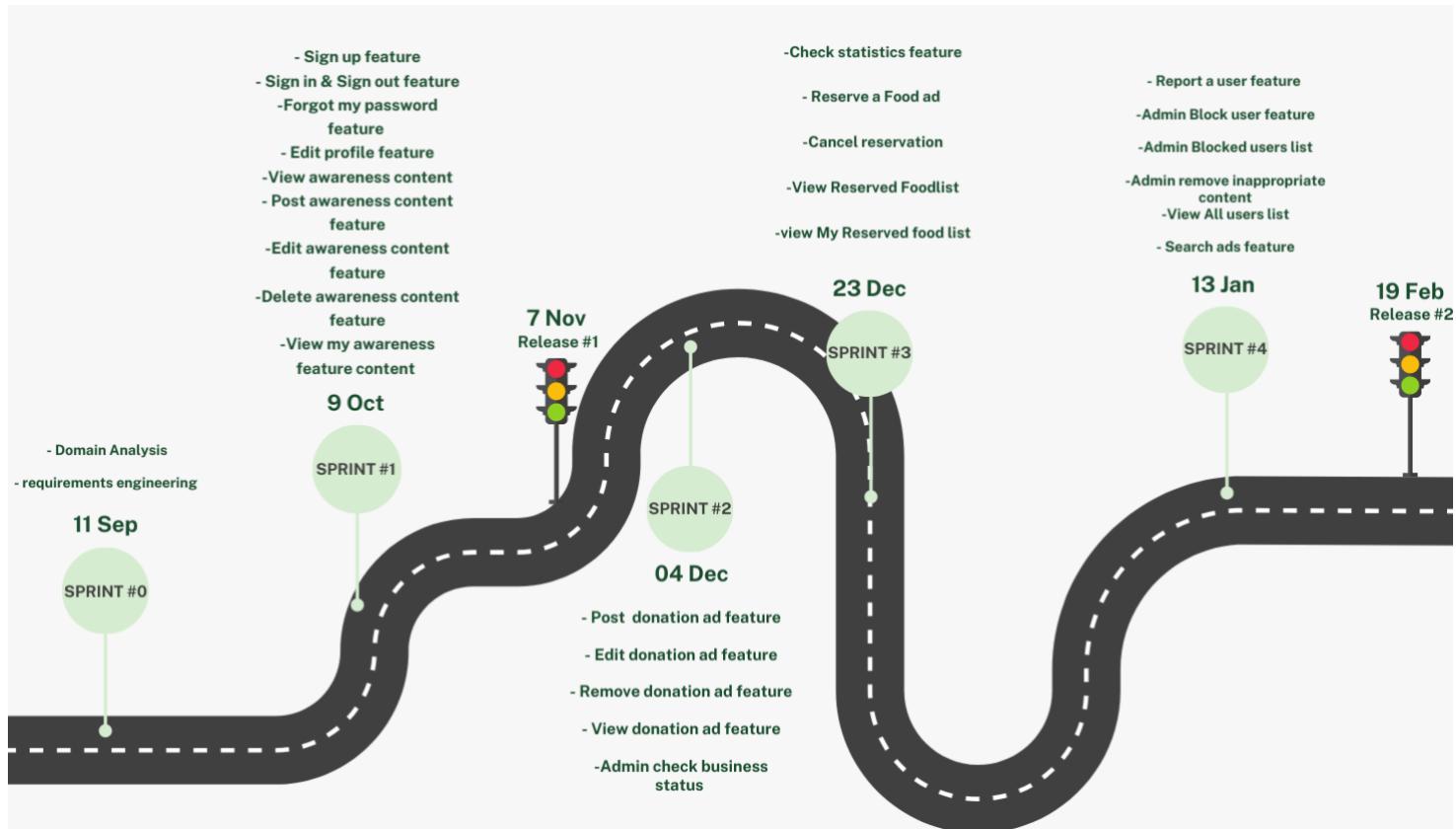


Figure 19 Product Roadmap

- Product Backlog
 - Product Backlog Table

Table 3 Product Backlog Table

ID	PBI (user story)	Size (Story points)	Type (Feature, defect, technical work, knowledge acquisition)	Status	Acceptance Criteria The conditions of satisfaction that must be met for that item to be accepted.
1	As a user I want to sign up to the system by providing an email, username, password and choose the user type so that I will have an account in the application.	2	Feature	Done	<p>1-If I go to the sign-up page and enter an existing email or a username; an error message must appear that specifies the email or username has been used before.</p> <p>2-If I did not fill all fields and click sign up error message will appear.</p> <p>3-If I enter less than 3 letters or more than 15letters for username ,enter invalid email or password does not contain small, capital and special character and less than 8 character error message will appear.</p> <p>3- If I go to the sign-up page, fill in all fields, and enter an unused email and username, then the system should register me.</p> <p>4-If I register as a business commercial registration number and commercial registration number expiration fields should appear and must be filled.</p> <p>5- If a new business signed up, then the system should send a notification to the admin for approve or decline</p>
2	As a user, I want to sign-in with my username and password so that the system can authenticate me, and I can trust it.	2	Feature	Done	1-If I go to the sign-in page, enter my correct email and password, and click sign-in, then all my user's data should be accessible.

					<p>2- If I go to the sign-in page and enter wrong email or wrong password and click sign-in, then sign-in fails with an error message stating that the username or password was invalid.</p> <p>3-If go to the sign in page and my sign in process wasn't successful a message should inform me about the reason. (user blocked, business waiting for approval , business declined)</p>
3	As a user, I want to be able to sign-out so that I can protect my account from unauthorized people.	2	Feature	Done	<p>1-If I select the sign-out option, then the system must redirect me to the login page.</p> <p>2- if I click sign-out, I want a popup to show asking me to make sure I want to sign-out</p> <p>3-If I confirm that I want to sign out, then all my user's data should be inaccessible.</p>
4	As a user, I want to be able to edit my profile so that I can change my information.	2	Feature	Done	<p>1-If I edit my username or phone number, then my information should be updated in the database.</p> <p>2- If I update my username with less than 3 letters or more than 15 letters , phone number with less than 10 numbers error message will appear and information will not be updated in database.</p>
5	As a user, I want to be able to reset my password so that I can change my password when I forget it.	3	Feature	Done	<p>1- If I want to reset my password, then the password should be updated in database.</p>

6	As a user, I want to be able to view awareness content so that I can raise my raise awareness about food waste.	2	Feature	Done	1- If I want to view awareness content, then the system must display content posts.
7	As a user, I want to be able to post awareness content so that I can raise awareness about food waste.	3	Feature	Done	1- If I want to post awareness content, then text area should appear and allowing me to write my comment and upload image. 2-If I post awareness content, then the content that I post must appear with rest of the other contents.
8	As a user, I want to be able to view my awareness content so that I can edit or delete my awareness content.	2	Feature	Done	1- If I want to view my awareness content, then the system must display my content posts.
9	As a user, I want to be able to edit awareness content posts so that I can change the content when it needs to be modified.	2	Feature	Done	1-If I edit awareness content, then the changes should appear to all users.
10	As a user, I want to be able to delete my awareness content so that it doesn't show for other users.	2	Feature	Done	1- if I delete my awareness content, then the content should be deleted from all users.
11	As a Provider, I want to be able to post food donation posts so that I can inform consumers that I have surplus food.	3	Feature	Done	1- If I want to post food ad, then window should appear and allowing me to write description of the food, food type , food quantity, food expiration date, food pick up address, and upload image for the food. 2-If I post food ads, then the ads should appear to all users.

					<p>3-if I post food ads and I did not fill all required fields, then error message will appear.</p> <p>4- If I enter 300 letters for food description, 60 letters for food type, and 20 letters for food quantity the system will not allow me to add more.</p>
12	As a Provider, I want to be able to edit food ad so that I can change the information about food.	2	Feature	Done	<p>1-If I edit food ads (Food Title, Description, Quantity, City, neighbourhood, Exp Date, Food picture), then the changes should appear to all users.</p> <p>2-If I edit food ads and I did not fill all required fields, then error message will appear.</p> <p>3- If I update posted food content with 300 letters for food description, 60 letters for food type, and 20 letters for food quantity the system will not allow me to add more.</p> <p>4-If I want to edit food ads that is reserved the system will not allow me to edit.</p>
13	As a Provider, I want to be able to <i>receive notifications</i> when food is expired so that I know the food is has expired.	3	Feature	Done	<p>1-If the food posted by me in a food ad has expired, then I should receive a notification.</p> <p>2-If the food ad has expired, then food ad should be removed from all users.</p> <p>3- If the food posted by me in a food ad has expired and the food is reserved, then a notification should be sent to the consumer that reserved the food.</p>

14	As a Provider, I want to be able to remove food ads so that I can inform consumers that the food is no longer available.	2	Feature	Done	<p>1-if I remove food ads, then food ads should be removed from all users.</p> <p>2-If I want to remove food ads that is reserved the system will not allow me to remove.</p>
15	As a consumer, I want to be able to view donation food ads so that I can choose the most suitable food for me.	2	Feature	Done	1-If I view donation food ads, the system should display all available donation food ads.
16	As an admin, I want to be able to manage the status of the business's commercial registration number so that I allow them to have an account.	3	Feature	Done	<p>1-If I approve businesses, then the system should allow them to have an account.</p> <p>2-If I decline businesses, then the system should prevent them from having an account.</p> <p>3-If I approve/decline business account the system should send an email informing the business of their accounts status.</p>
17	As a consumer, I want to be able to reserve food so that I can inform provider that I will take that food.	3	Feature	Done	<p>1-If I reserve food, then food must mark as reserved.</p> <p>2-If I reserve food, then the system should inform the provider that the food is reserved.</p>
18	As a consumer, I want to be able to view the reserved food list so that I can see the food I reserved.	2	Feature	Done	1-If I view reserved food list, the system should display the information of the food I reserved and phone number of provider.
19	As a consumer, I want to be able to cancel reservation so that I can inform the provider that I will not take the food.	2	Feature	Done	<p>1-If I cancel reservation, then the food must return to be available and out of my reserved food list.</p> <p>2- If I cancel reservation, then a notification will be sent to</p>

					provider inform him about the cancelation. 3- If I cancel reservation the system should ask me about the cancellation reason (I don't need the food, provider not responding) 4- If I cancel reservation because the provider not responding for the 3 rd time in the application a report should go to the admin
20	As a provider, I want to be able to cancel reservation so that I can inform the consumer that I will not be donating the food	2	Feature	Done	1-If I cancel reservation, then the food must return to be available and out of my reserved food list. 2- If I cancel reservation, then a notification will be sent to consumer inform him about the cancelation. 3- If I cancel reservation the system should ask me about the cancellation reason (I don't need the food, consumer not responding) 4- If I cancel reservation because the consumer not responding for the 3 rd time in the application a report should go to the admin
21	As a Provider, I want to be able to receive notifications when food is reserved so that I can prepare the food for the consumer.	3	Feature	Done	1-If consumer reserve a food, then I should receive a notification .
22	As a Provider, I want to be able to view statistics so that I can see information related to my surplus food.	5	Feature	Done	1-If I view statistics, the system should give me detailed results about (No. of posts, No. of reserved posts, No. of expired posts).

23	As a provider, I want to be able to view the reserved food list so that I can see if the food that I posted is reserved.	3	Feature	Done	1-If I view reserved food list, the system should display the List of those food ads posted by me that are reserved
24	As a consumer, I want to be able to search through food donation posts so that I can see results matching my search.	3	Feature	Done	1-If I search through ads by the food title, then the system must give me result that match my search. 2-If I search through ads and there are no results match my search, then message should appear told me there is no results match your search.
25	As an Admin, I want to view all users list, so I can have an overview of all the users using Faydh	2	Feature	Done	1-If I go to the view users page the system should display all user's information (usernames, emails, user type and phone number.), and to be able to block the users and search for a specific user.
26	As a User, I want to be able to Report any users' posts, so that I can make the faydh community safe and better	3	Feature	Done	1-if I press on the report button the post information (Title, description and image) and the users information (username, email) will be sent to the admin to review the post .
27	As an admin, I want to be able to block users so that I can cancel users' registration who violate the terms and conditions of the application.	2	Feature	Done	1-If I block user, then the user account should be deleted from the application and added to blocked users list. 2- if I block a user an email should be sent to the user to inform them about their account being blocked 3-if I block a user the user should not be able to enter their account

					4-if I block a user all consumers/providers the user has a current reservation from/with should be sent a notification
28	As an admin, I want to be able to view the blocked user list so that I can be aware of users has been blocked.	2	Feature	Done	1-If I want to view blocked user list, then the system must display blocked users usernames, emails, user type and phone number.
29	As an admin, I want to be able to remove forum content so that I can delete reported inappropriate content.	2	Feature	Done	1-If I remove awareness content, then the content should be deleted from all users.
30	As a consumer, I want to see my search result within 5 seconds so that I can make quick decision based on my search.	-	Feature	Done	1 -If I want to see my search result, then the system must response within 5 seconds.
31	As a user, I want the app to be available 98% of the time I try to access it, so that I don't get frustrated and find another application to use.	-	Feature	Done	1- As a user, If I want to use the website, then it must be available about 98% of the time.
32	As a user, I want to have a commonly used UI icons so that dealing with the interface will be easy for me.	-	Feature	Done	1-As a user if I open the application and see the UI icons, then I should know how to use it easily.
33	As a provider, I want the statistics about my donated food to be accurate so that I know how much surplus food I have produced, how much was picked up, and how much was thrown away correctly.	-	Feature	Done	1-As a provider, if I display the statistics, I should see the statistics related to my donated surplus food correctly.

34	As a user, I want my personal information to be secure, so that I keep my information safe.	-	Feature	Done	1-As a user, if I enter my phone number and location, it will not be shared with all users.
----	---	---	---------	------	---

We have successfully implemented all user stories by the end of this release. But we have edited one of the user stories to match the expectation of the application which is the:

- As an admin, I want to be able to remove forum content so that I can delete inappropriate content.

Since the admin is going to have to check all forum content and manually delete all of the inappropriate content from the appropriate content. We have decided to add the report function which was previously suggested and modified the user story accordingly:

- As an admin, I want to be able to remove forum content so that I can delete reported inappropriate content.

3.3 System Design

In this chapter, we will show in detail how our mobile application is designed, how different entities relate to each other together, how the interfaces look, and how the features work by displaying various diagrams.

3.3.1 Architectural Diagram

The architecture that we will use for "فيسن" is MVC architecture. Since "فيسن" has different representations for food providers and consumers, MVC supports different representations of the same data, allowing data to change independently of its presentation and vice versa. When a change is made in one representation, it will show the changes for all views. It will provide an efficient structure for our application because it is easy to develop and maintain and extend and grow [49].

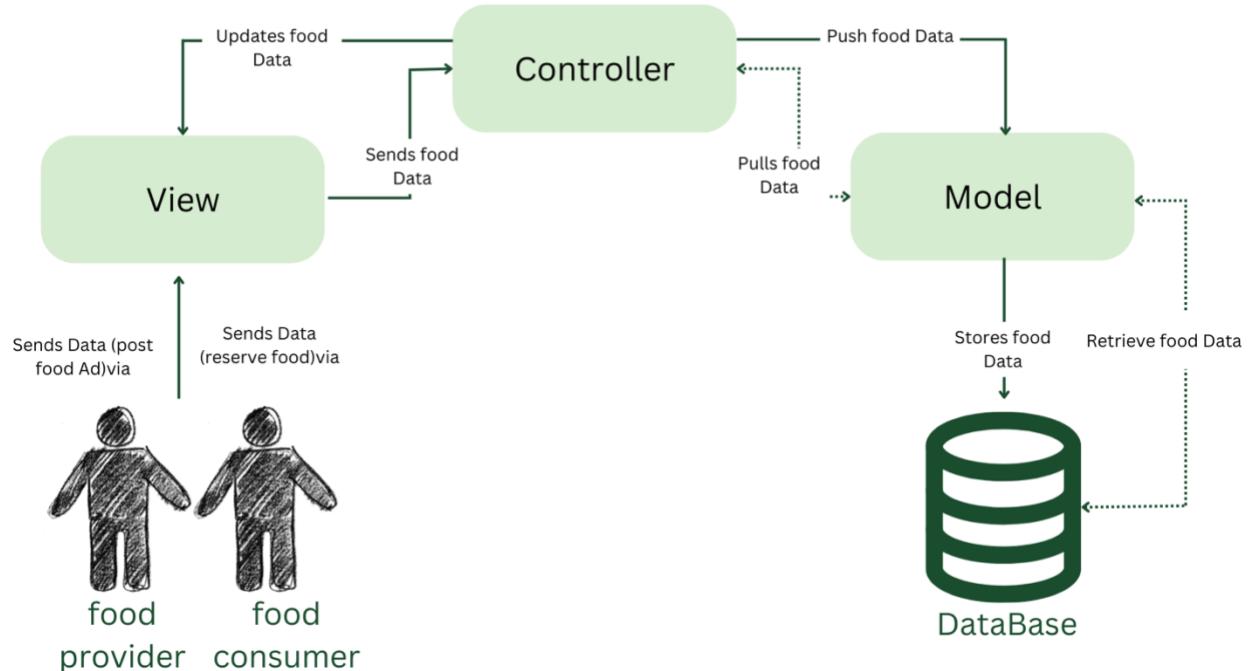


Figure 20 Architectural Diagram

By using this architecture (Figure 20), we will decompose the application into three main components:

Model, View, and Controller, and each component have its role and responsibility in the application. As we demonstrate above, the user interacts with the View Component, a part of the application that represents the presentation of data. It generates a user interface for the user. Views are created by the data collected by the Model Component, but these data aren't taken directly, but through the Controller, so the View only speaks to the Controller. After that

Controller Component enables interconnection between the views and the Model, acting as an intermediary. The Controller doesn't have to worry about handling data logic. It just receives data from View and tells the Model what to do. After receiving data from the Model, it processes it, takes all that information, and sends it to the View. The last component is the Model component, known as the lowest level, which means it is responsible for maintaining data. Handle data logically, so it deals with data. The Model is connected to the database, so anything we do with data. Adding or retrieving data is done in the Model component. It responds to the Controller's requests because it never talks to the database directly. The Model talks to the database back and forth, giving the needed data to the Controller.

3.3.2 Class Diagram /DFD

The class diagram below (Figure 21) describes the structure of the “فَيْضُ” application by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.



Figure 21 Class Diagram

To see the figure in high-quality, click the link [HERE](#)

3.3.3 Component Level Design

We use Activity Diagrams (Figure 22, Figure 23, **Error! Reference source not found.** and Figure 25) to illustrate the flow of control in the FAYDH system and refer to the steps involved in executing a use case. We model sequential and concurrent activities using activity diagrams. So, we depict workflows visually. An activity diagram focuses on the condition of flow and the sequence in which it happens

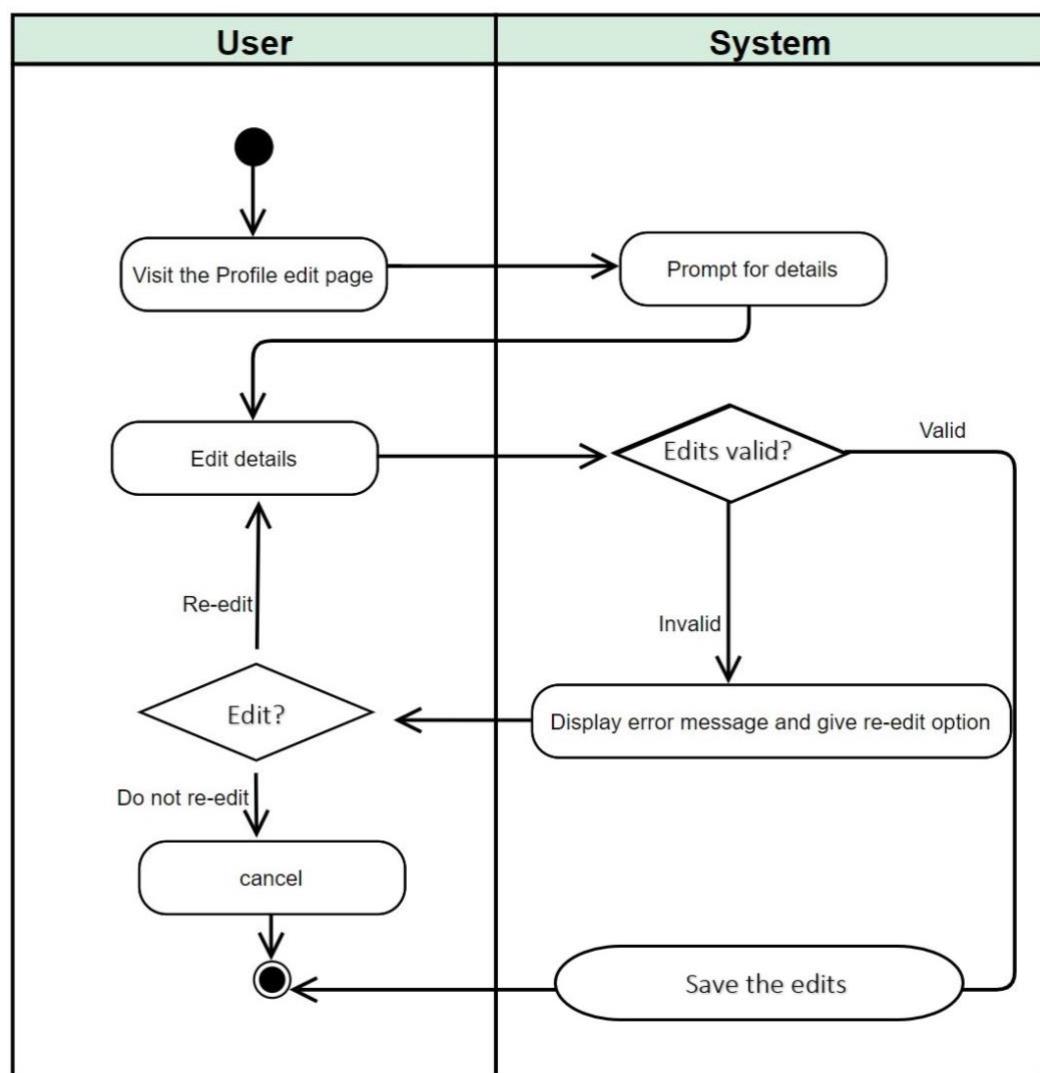


Figure 22 Edit profile

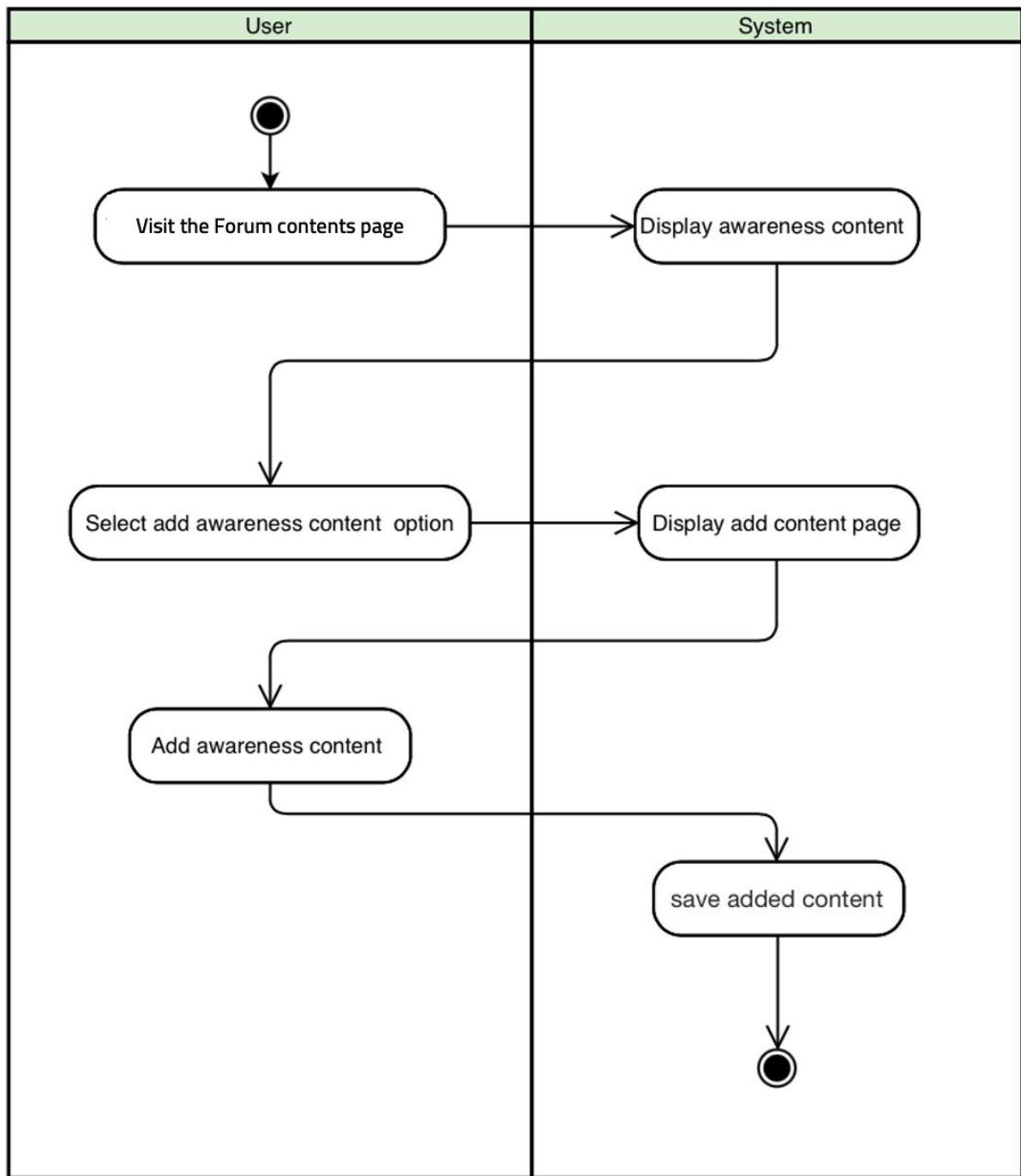


Figure 23 Add awareness content

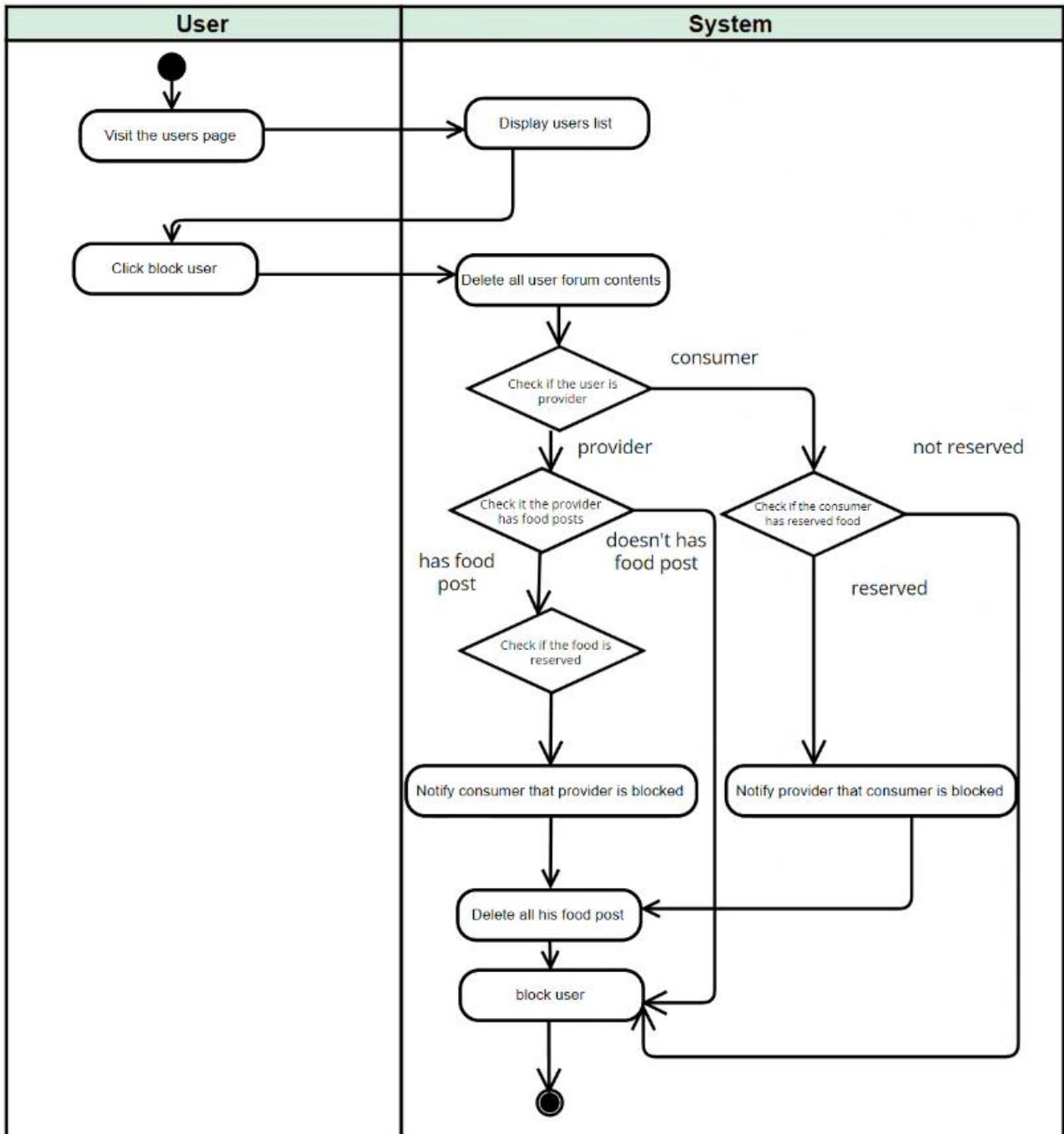


Figure 24 Block user

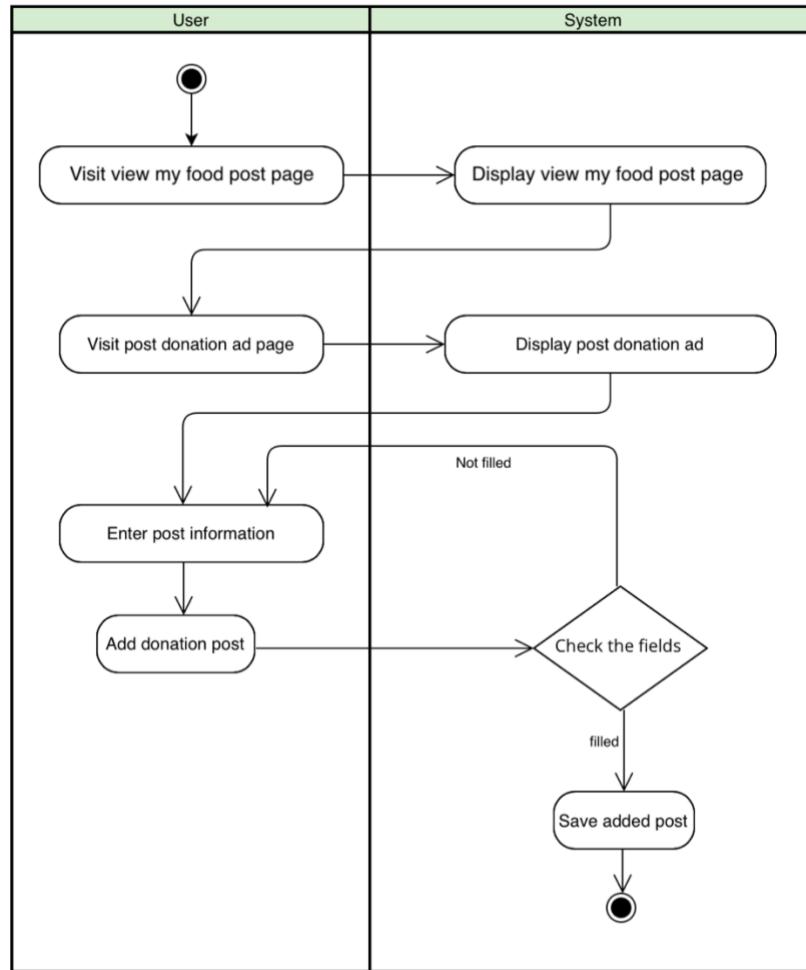


Figure 25 Post donation ad

3.4 Data Design

For the FAYDH database, we will use a NoSQL database (cloud Firestore database) [52]. Since we are constantly adding new features, functions, and data types, it is difficult to predict how the application will grow over time. The NoSQL database can extend and grow easily. We also work with a highly flexible schema design or no predefined schema. So, The data modeling process is iterative and adaptive. Changing the structure or schema will not impact development cycles or create any downtime for the application. Another reason is that NoSQL makes it easy to store all different types of data together without having to invest time into defining what kind of data we are storing in advance [52].

Cloud Firestore is a flexible, scalable mobile, web, and server development database from Firebase and Google Cloud. It keeps our data in sync across client apps through realtime

listeners. It offers offline support for mobile and web so we can build responsive apps that work regardless of network latency or Internet connectivity [52].

3.4.1 Data Models

- ER diagram

The ER diagram below (Figure 26) shows how “entities” such as people, objects, or concepts relate to each other within the Faydh system.

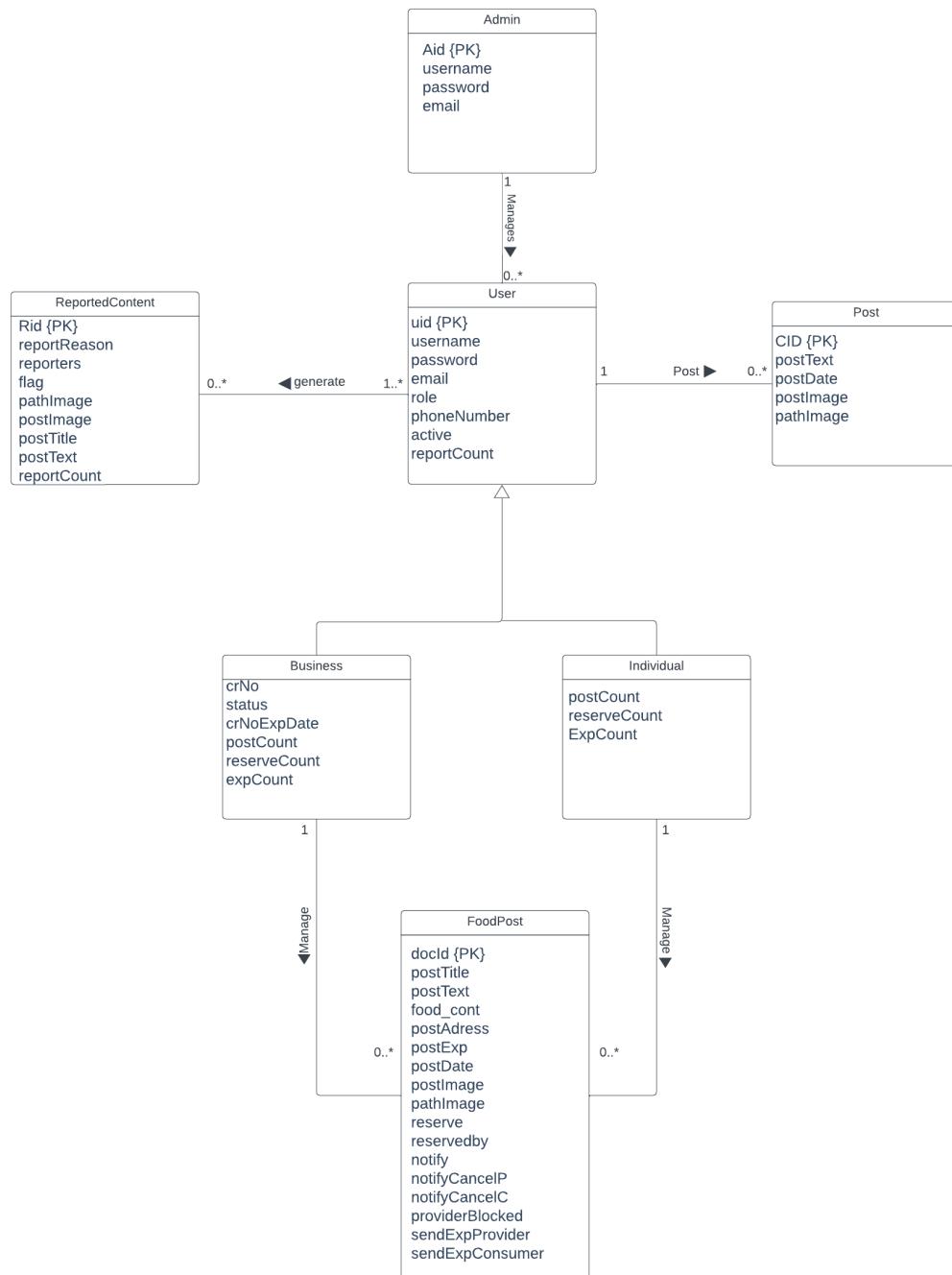


Figure 26 ER diagram

- Non-relational data model

The data model below (**Error! Reference source not found.**) represents an abstract model that organizes data elements in faydh application, the collections, attributes, and how they relate. We used NoSql Firestore as our main database with two collections(for now) one is for the Users and the other is for the forum posts, we didn't make the forum posts embedded to the user document to give the user the freedom of posting as many posts as they want rather than limiting them to avoid reaching the maximum document size(1MB per Document) which is set by firebase.

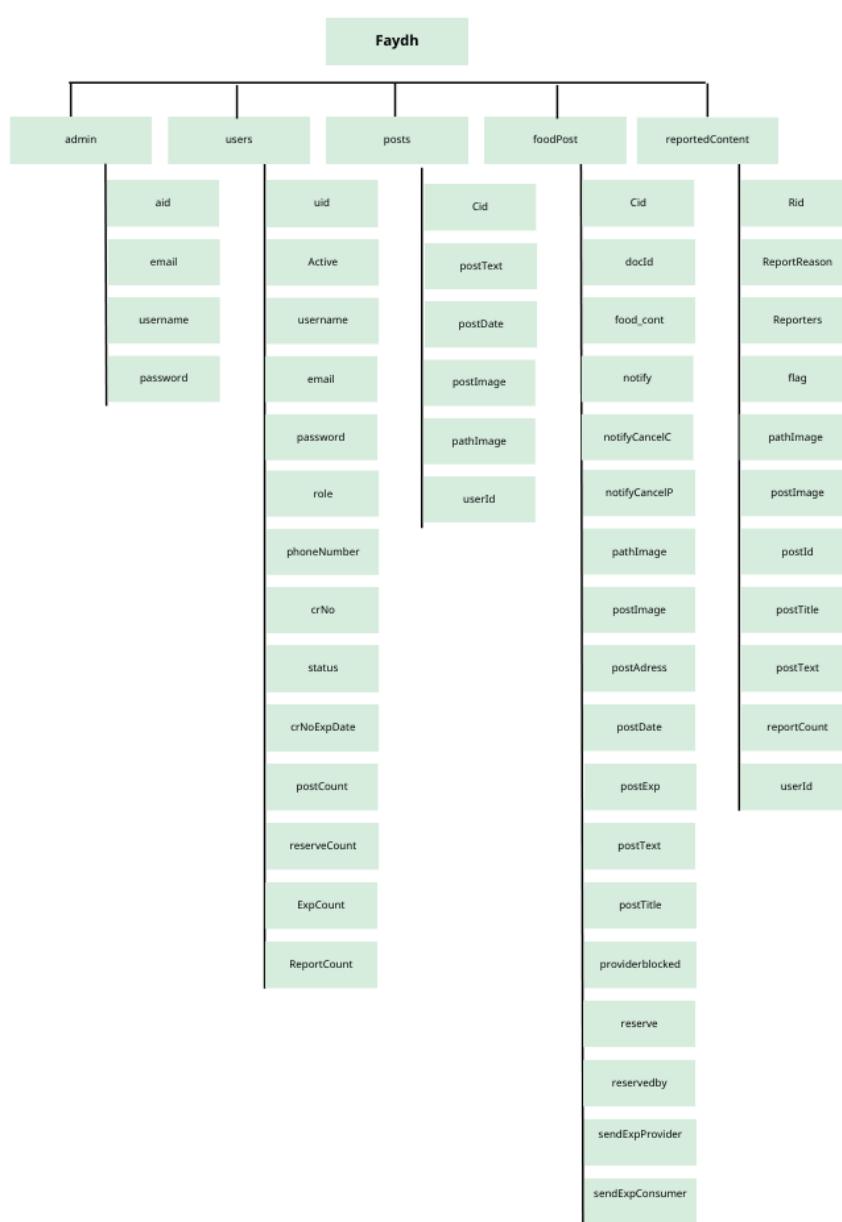


Figure 27 data model

3.5 Interface Design

In this section we included Faydh's sitemap(**Error! Reference source not found.**). And the UX/UI guidelines we followed while designing our application

3.5.1 Site Map

To see the figure in high-quality, click the link [HERE](#)

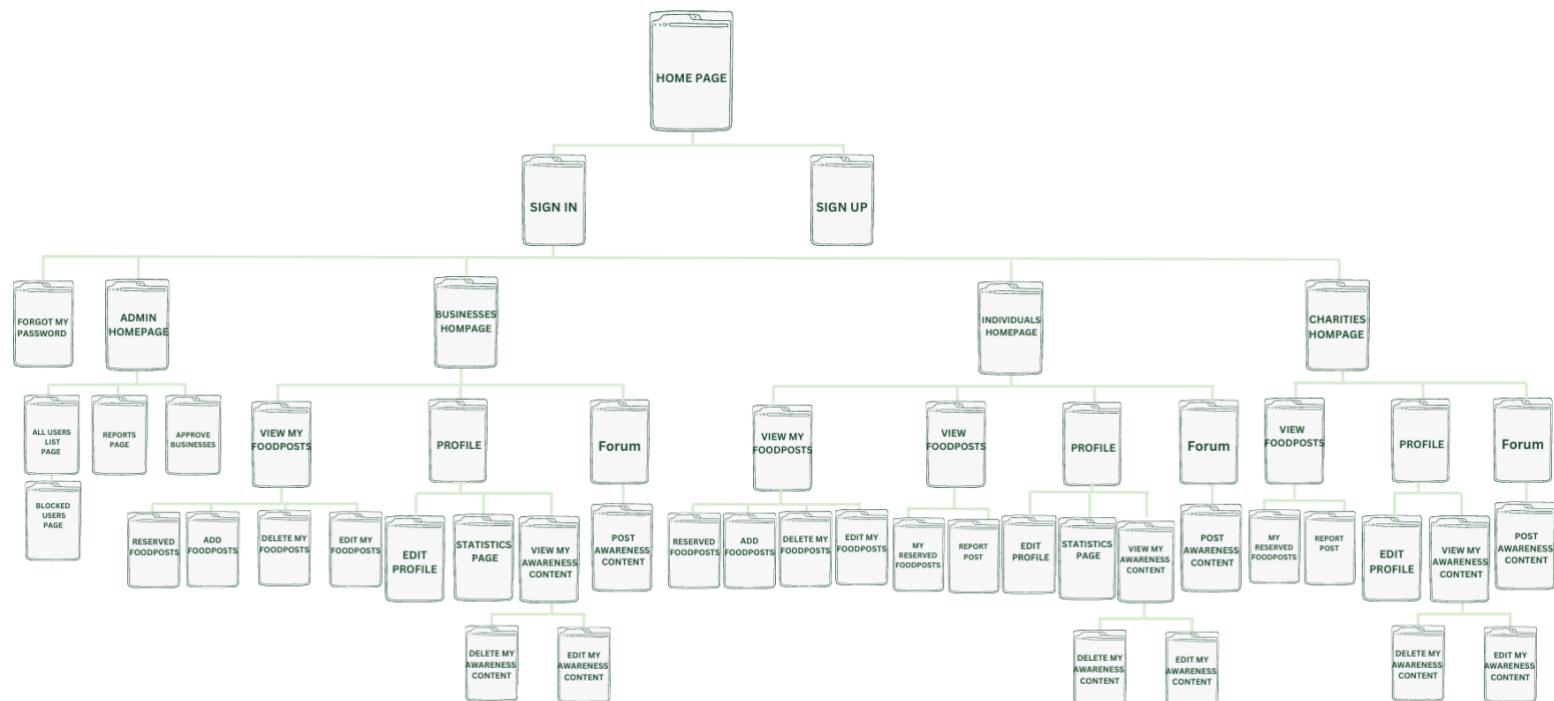


Figure 28 Site Map

While designing our mobile application we focused on some UX/UI guidelines:

- 1- External Consistency: We used similar design patterns (buttons placement) ,icons (main navigation bar) and consistent error messages of other mobile application to follow the user's mental model & pattern familiar to the users.
- 2- Internal Consistency: by maintaining consistency within our application pages by using same icons through out the whole application and using similar user interface components alignment and placement, the application is also designed to have the same theme and color palette.
- 3- Recognition rather than recall: we tried to minimize the user's memory load by making elements, actions, and options visible by putting all possible interactions clear and recognizable to the users and getting rid of all hard to find buttons which gives the user the ability to recognize the placement instead of recalling and remembering . Since the user should not have to remember information from one part of the interface to another.
- 4- Aesthetic and minimalist design: We designed our user interface to be visually pleasing by making a brand identity that includes the logo and a color palette. And we only included elements that support the users' tasks and minimized any unnecessary noise but emphasis on the important elements.
- 5- Error Prevention: while using our mobile application if the user comes up with an error like accidentally editing user profile information, signing out and input errors like empty fields or incompatible types, we tried to design the system in a way that helps the user to avoid such cases(cancellation button).
- 6- Match between system and the real world: our application was designed around speaking the users' language by using clear Arabic titles and error messages. Use words, phrases, and concepts familiar to the user, and make information appear in a natural and logical order.

3.6 Implementation

We started by gathering information about designing a good user-friendly interface, we decided to go for a bottom-up approach to work on the implementation by dividing the user stories(functions) that we will work on among the team members.

3.6.1 Tools And Libraries

In the implementation of “Faydh”, we have successfully implemented all user stories in our product backlog. We designed the User-Interface using Figma[14] to have a general idea of how we want the application to look and the placement of buttons and page navigation. We set up our Android Emulator(Pixel 5 API 30) with 800MB internal storage and 1GB RAM to run tests more quickly and efficiently than to set up an actual hardware device while implementing. We used Visual Studio Code as our IDE since we needed multiple extensions that made the development process easier. For example, Awesome flutter snippets[53], which are collection snippets and shortcuts for commonly used Flutter functions and classes, and Android iOS Emulator[54] to run the Android emulator easily and directly from VScode. We also used Firebase [52], which has a set of hosting services. We used its NoSql Firestore as our main database with five collections which are for Users, Admin, Forum posts, Food posts, and Reported contents. We didn't make the forum posts embedded in the user document to allow users to post as many posts as they want rather than limiting them to avoid reaching the maximum document size(1MB per Document), which Firebase sets. We also used the Authentication service given by Firebase for login and password resetting. And Firebase Storage for storing images. We also used multiple flutter libraries and dependencies for the implementation in (Figure 29) below

```

dependencies:
  dropdown_button2: ^1.8.5
  flutter:
    | sdk: flutter      You, 2 weeks ago + faydh project creation -
    # The following adds the Cupertino Icons font to your application.
    # Use with the CupertinoIcons class for iOS style icons.
    cupertino_icons: ^1.0.2
    path: ^1.8.2
    image_picker: ^0.8.6
    image_cropper: ^3.0.0
    path_provider: ^2.0.11
    flutter_image_compress: ^1.1.3
    google_nav_bar: ^5.0.6
    line_icons: ^2.0.1
    firebase_auth: ^3.5.0
    firebase_storage: ^10.3.3
    cloud_firestore: ^3.4.0
    firebase_core: ^1.20.0
    uuid: ^3.0.6
    provider: ^6.0.3
    font_awesome_flutter: ^9.0.0
    firebase_core_platform_interface: 4.5.1
    firebase_messaging: ^13.0.4 # will satisfy your firebase core things that depend on ^4.5.1
  
```

Figure 29. Dependencies used in implementation

We used StackOverflow [55] to get help from professionals and enthusiasts regarding any error messages we got throughout the implementation. We also used the Flutter Documentation [56] for the dropdown menu code snippets in (Figure 30) below that allow users to choose their user type in the signup page.

```

384   //user type
385   Padding(
386     padding: const EdgeInsets.only(top: 8, bottom: 4),
387     child: Align(
388       alignment: Alignment.centerRight,
389       child: DropdownButtonFormField<String>(
390         alignment: Alignment.centerRight,
391         value: selectedValue,
392         icon: const Align(
393           alignment: Alignment.centerLeft,
394           child: Icon(Icons.arrow_drop_down)), // Align
395         elevation: 16,
396         borderRadius: BorderRadius.circular(40),
397         > | decoration: InputDecoration[] // InputDecoration
398         items: userTypes.map<DropdownMenuItem<String>>(
399           (String value) {
400             return DropdownMenuItem<String>(
401               value: value,
402               child: Text(value),
403             ); // DropdownMenuItem
404           }.toList(),
405           validator: (value) {
406             if (value == null) {
407               return "الرجاء اختيار نوع المستخدم";
408             }
409           },
410           onChanged: (String? value) {
411             //Do something when changing the item if you want.
412             setState(() {
413               selectedValue = value!;
414             });
415           },
416           onSaved: (value) {
417             selectedValue = value.toString();
418           }, // DropdownButtonFormField // Align // Padding
419         ),
        
```

Figure 30 DropDown Menu Code snippet

3.6.2 Major Features

- 'AddFoodPost' feature.

In Figure 31 and Figure 32 below, we have implemented the 'AddFoodPost' feature. When the user fills in all of the required fields, the food post information is sent to the `foodPostData` method to be stored in the database.

```
Database.addFoodpostData(
    context: context,
    docId: DateTime.now()
        .toString(),
    userId:
        user.uid.toString(),
    userPost:
        user
            .displayName
            .toString(),
    postTitle:
        postTitleTextEditingController
            .text
            .toString(),
    postText:
        descriptionTextEditingController
            .text
            .toString(),
    postAddress: selectedValue
        .toString() +
    ", " +
    neighborhoodEditingController
        .text
        .toString(),
    postImage:
        urlDownloadImage
            .toString(),
    postExp:
        _date.toString(),
    food_cont:
        foodCountEditingController
            .text
            .toString(),
    providerblocked: false,
    reserve: '0',
    notify: '0',
    notifyCancelP: '1',
    notifyCancelC: '1',
).whenComplete(() {
    Navigator.pop(context);
    setState(() {
        selectedValue = null;
    });
});
```

Figure 31 AddFoodPost Code

```
static Future<void> addFoodpostData({
    required BuildContext context,
    required String docId,
    required String userId,
    required String userPost,
    required String postTitle,
    required String postText,
    required String postAddress,
    required String postImage,
    required String postExp,
    required String food_cont,
    required bool providerblocked,
    String? reserve,
    String? notify,
    String? reservedby,
    String? notifyCancelP,
    String? notifyCancelC,
}) async {
    DocumentReference documentReference = _foodPostCollection.doc(docId);

    Map<String, dynamic> data = <String, dynamic>{
        'id': userId.toString().trim(),
        'docId': docId.toString().trim(),
        'userPost': userPost.toString().trim(),
        'postTitle': postTitle.toString().trim(),
        'postText': postText.toString().trim(),
        'postAddress': postAddress.toString().trim(),
        'postImage': postImage.toString().trim(),
        'pathImage': "pathImage".toString().trim(),
        'postExp': postExp.toString().trim(),
        'food_cont': food_cont.toString().trim(),
        'providerblocked': providerblocked,
        'postDate': DateTime.now().toString(),
        'reserve': reserve,
        'notify': notify,
        'reservedby': reservedby,
        'notifyCancelP': notifyCancelP,
        'notifyCancelC': notifyCancelC,
    };
    await documentReference.set(data).whenComplete(() {
        print('Note item saved to the database');
        Fluttertoast.showToast(msg: "تم نشر الاعلان بنجاح");
        Navigator.pop(context);
    });
}
```

Figure 32 foodPostData Code

- “block user” feature

In Figure 33and Figure 34 below, we have implemented the block user feature. When the admin blocks the user, the flag (Active) will be updated to prevent the blocked user from entering the app, and all blocked user awareness content posts and food posts will be deleted, also the consumer will be notified about the cancelled food post .

```

content: const Text(
  "هل أنت متأكد من حظر المستخدم ؟",
  textAlign: TextAlign.right,
), // Text
actions: <Widget>[
  TextButton(
    child: const Text("نعم"),
    onPressed: () {
      // callback function for on click event of Cancel button
      Navigator.of(context).pop();
    },
  ), // TextButton
  TextButton(
    child: const Text("غير اذى"),
    onPressed: () async {
      FirebaseFirestore.instance
        .collection('users')
        .doc(widget
            .postData.userId
            .toString())
        .update(
          {'Active': false});

      FirebaseFirestore.instance
        .collection('posts')
        .where('userId',
            isEqualTo: widget
                .postData.userId)
        .get()
        .then((QuerySnapshot
          querySnapshot) {
      querySnapshot.docs
        .forEach((doc) {
          FirebaseFirestore.instance
            .collection('posts')
            .doc(doc["cid"])
            .delete();
        });
    });
    FirebaseFirestore.instance
      .collection('foodPost')
      .doc(widget
          .postData.postId
          .toString())
      .update({
        'providerblocked': true
      });
    }
);

```

Figure 33 block user Code

```

var snapp =
  await FirebaseFirestore
    .instance
    .collection(
      'foodPost')
    .doc(widget
        .postData.postId)
    .get();

if (snapp.exists) {
  Map<String, dynamic>? data =
  snapp.data();

  var reservedby =
  data!["reservedby"];

  if (reservedby == null) {
    print('trueee');
    FirebaseFirestore.instance
      .collection(
        'foodPost')
      .doc(widget
          .postData.postId)
      .delete();
  } else {
    print('no');
  }
}

FirebaseFirestore.instance
  .collection(
    'reportedContent')
  .doc(widget.postData.Rid
    .toString())
  .delete();

```

Figure 34 block user Code

- “Expired food notification” feature

In Figure 35and Figure 36 below, we have implemented a feature that notifies users when food expires. The getToken method will take the device token and call the saveToken method. If the food is expired, it will then send a notification to the user using the device token. This ensures that users are aware of their food expiration dates.

```
void getToken({required id}) async {
    await FirebaseMessaging.instance.getToken().then((token) {
        setState(() {
            mtoken = token;
            print('my token is $mtoken');
        });
        var period = const Duration(hours: 6);
        Timer.periodic(period, (arg) {
            print('inside save token');
            saveToken(id: id, token: token!);
        });
        saveToken(id: id, token: token!);
    });
}
```

Figure 35 notification of expired food Code

```
void saveToken({required String id, required String token}) async {
    /* await FirebaseFirestore.instance
       .collection('users')
       .doc(id)
       .update({'token': token}); */

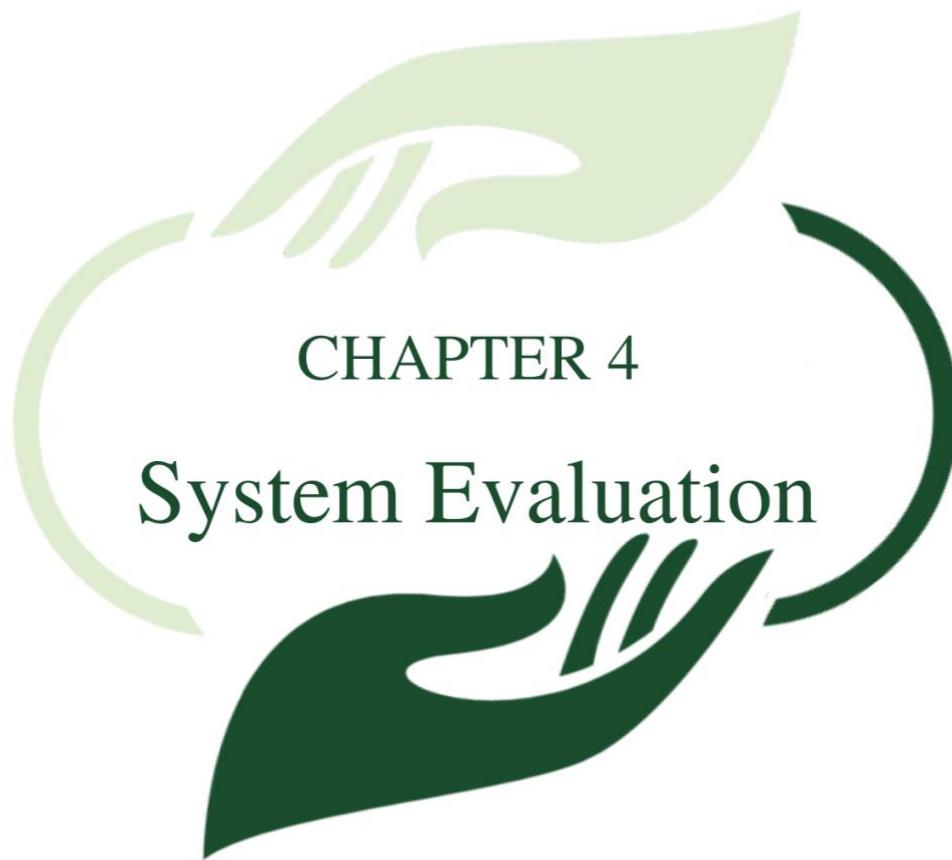
    DateTime now = DateTime.now();
    String formattedDate = DateFormat('yyyy-MM-dd').format(now);
    DateTime dt1Now = DateTime.parse(formattedDate);
    print("formattttt");
    print(formattedDate);
    FirebaseFirestore.instance
        .collection('foodPost')
        .where('Cid', isEqualTo: id)
        .get()
        .then((QuerySnapshot querySnapshot) {
    querySnapshot.docs.forEach((doc) {
        var raw_date = doc["postExp"].toString().split('-');
        DateTime dt2check = DateTime(int.parse('${raw_date[0]}'),
            int.parse('${raw_date[1]}'), int.parse('${raw_date[2]}'));
        String exp = doc["postExp"];
        print("expdateee");
        print(exp);
        if (dt1Now.isAfter(dt2check)) {
            Future.delayed(const Duration(seconds: 2), () {
                print("expired");
                initInfo();
                sendPushMessage(
                    token: token, title: "مدة انتهاء", text: doc["postTitle"]);
                FirebaseFirestore.instance
                    .collection('foodPost')
                    .doc(doc["docId"])
                    .delete();
            });
        }
    });
}
```

Figure 36 notification of expired food Code

3.6.3 Implementation challenges

During the development of the “Faydh” application, we faced many challenges. Since we developed the application using Flutter (Dart), an entirely new language and framework that we had never worked on before, we enrolled in a Udemy course. We watched different YouTube videos and tutorials, which helped us overcome this difficulty. The second challenge was the database. At first, we implemented our application using MongoDB, but we had to change it to Firebase since it has a lot of services (Firebase Authentication, Firebase storage) that we need instead of implementing the APIs ourselves. Although Flutter updates provide lots of useful new features, they have also changed a number of packages, resulting in conflicts with existing code. This can create difficulties for us to make changes and adjustments to our existing code to account for these changes. The main difficulty in Release #2 was the code being too big for our personal computers to handle and open the emulators at the same time, so we had to buy a phone to continue implementing and testing on it. We also had a lot of other commitments and projects which conflicted with our usual meeting time, so we had to keep rescheduling our meetings. Lastly, merging our code without any problems or conflicts and exchanging work among the team members via GitHub.

You can check the project on the GitHub repository: [HERE](#)



CHAPTER 4

System Evaluation

4 System Evaluation

4.1 User Acceptance Testing

In this section, we will describe the user acceptance testing conducted with 25 users: Five working in charities, five working in businesses, ten individuals, and we chose 5 random users that meets certain criteria that we have previously identified (refer to section 4.2.1: System users) to act as admins for our application in this test. We asked each type of users to test all functionalities provided for their type (check objectives in chapter 1.2.1).

User acceptance testing aims to validate the testing done at the end of the development cycle and identify potential problems not yet detected in previous tests. Before the testing we prepared a list of questions to determine whether it can be accepted or not, and then we gave the participants an overview about the application and the purpose it has and explained the purpose of the test and asked them to fill Participant Consent Form (you can find it in appendix D). During the testing we did the NFR testing to validate the quality attributes. After participants used the application, we collected information using a questionnaire about participants and their experience using it. The test only required knowing the Arabic language, as our application only supports Arabic. The test takes around 15 – 20 minutes.

4.1.1 Demographics of Participants

We asked the participants about their gender, age, educational level, knowledge of technologies, and their mother tongue. 52% of the users were males and 48% are females. the ages of 20% of the users were under 20 years-old, 12% were between 20–30 years-old, 40% were between 31-41 years-old and 32% of them were above 41 years-old. The educational level of 84% of the users were bachelor's degree, 8% were postgraduates and 8% high school graduates.as for their knowledge of technologies 8% intermediate and 92% advanced. For their mother tongue 100% were Arabic native speakers. The below figures (Fig.37, Fig.38) displays their responses.

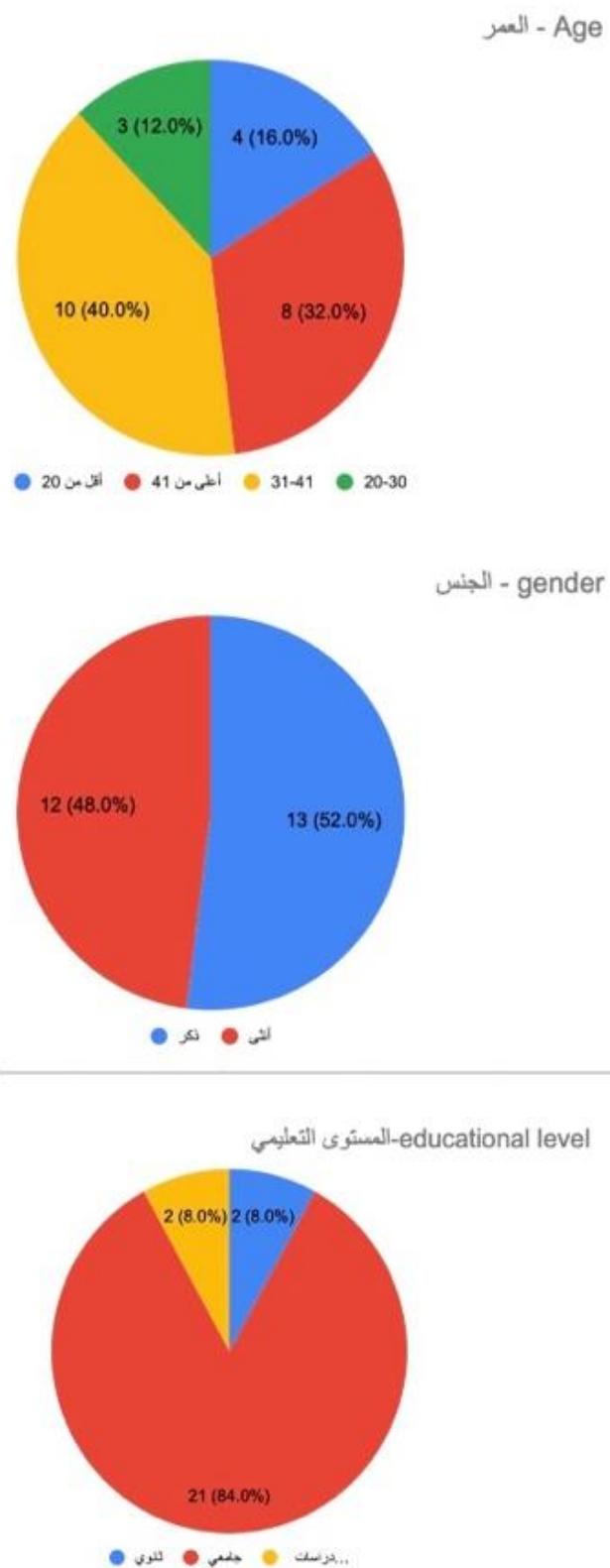
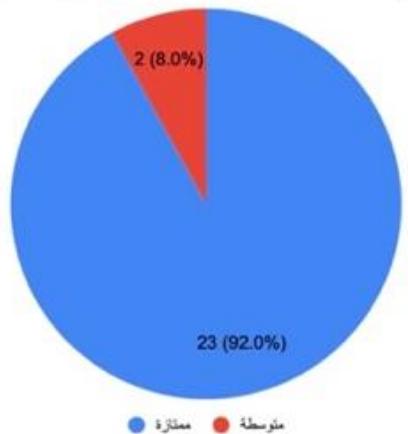


Figure 37 Demographics of testers 1

مدى خبرة مختبر التطبيق في استخدام تطبيقات الجوّال knowledge of technologies



اللغة الرسمية - mother tongue



Figure 38 Demographics of the testers 2

4.1.2 Background Demographics

We asked the participants some questions to know the background status of our potential users OF charities and businesses. The following table (Table4) display their responses

Table 4. Background Demographics table

users Questions \ users	User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	User 10
If you are working in charity or businesses what is your position?	Distribution Supervisor	Supervisor	Accountant	Program and activities coordinator	Sales Manager	public relations manager	Owner	public relations	public relations associate	Sales Officer
If you are working in charity or businesses what is your years of experience?	2	3	1	10	8	8	2	4	5	10

4.1.3 Questionnaire Results

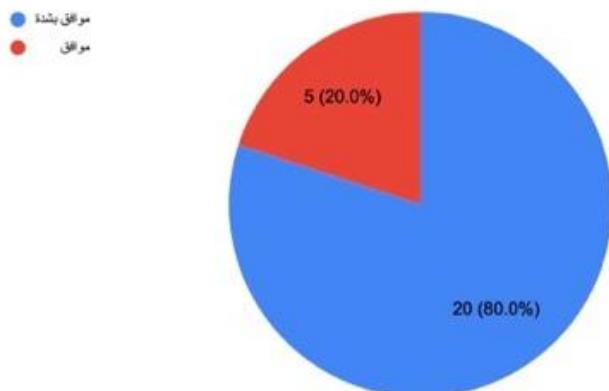
We asked the participants about their experience with our application. The questions we asked is a subset of SUS (Standard Usability Scale) [57], which is a reliable tool for measuring system usability. We used a 5-points Likert scale for responses [58]. The following figures (Fig.39 to Fig.45 numbered from 1 to 7 for the sake of the charts to be readable) and tables (Table5 to Table 8) display their responses. The complete questionnaire is provided in appendix C.

Table 5. Questionnaire Result table#1

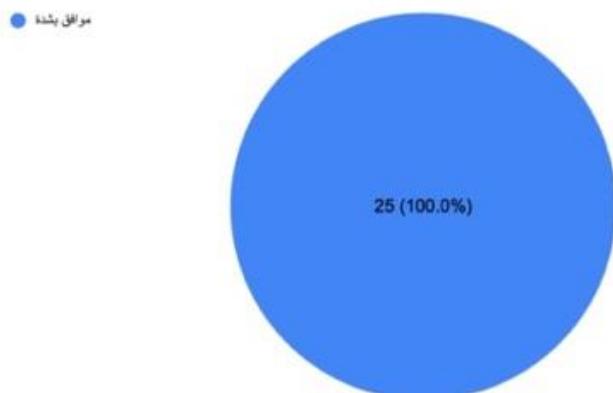
Questions \ Scale	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I found the navigation through the app was easy	20	5			
I found the design of the application interfaces easy to use	25				
I found that the response speed of the application was good	16	8	1		
I found that some icons weren't clear				4	21

I needed to learn a lot of things before I could get going with this system				3	22
I found that the app provides enough features to reduce food waste	14	9	2		
I found the alert messages while using the app clear and easy to understand	14	11			
I found the app difficult to use				1	24
I think that I would like to use this app frequently	16	4	5		
I found the various functions in this app were well integrated	23	1	1		
I found the app inconsistent				1	24
The prompts displayed for inputs were clear	12	12	1		
I found the mechanism of adding awareness content in the forum was easy (all user except the admin)	19	4			
Do you recommend using Faydh application?	25				
Do you have any other comments Do you find faydh app helpful?	The users gave us some comments, such as adding picture in post food ad process was not clear and reservation process need confirmation message. They also suggest to adding instant messaging feature and allow users to like and reply in others awareness contents.				

ووجدت أن التنقل بين الصفحات كان سهلاً



ووجدت أن واجهات التطبيق سهلة الاستخدام



ووجدت أن سرعة الاستجابة للتطبيق جيدة

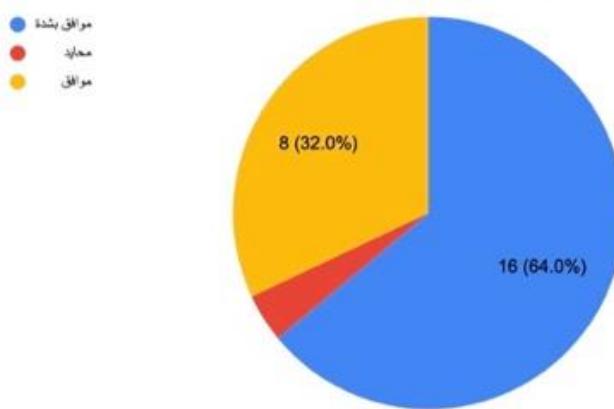
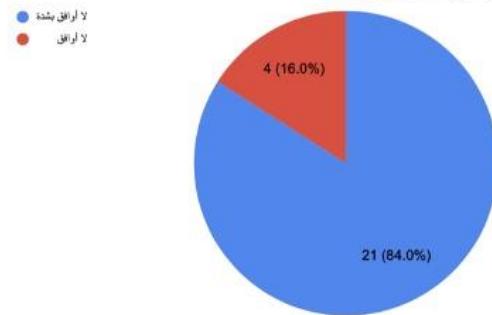
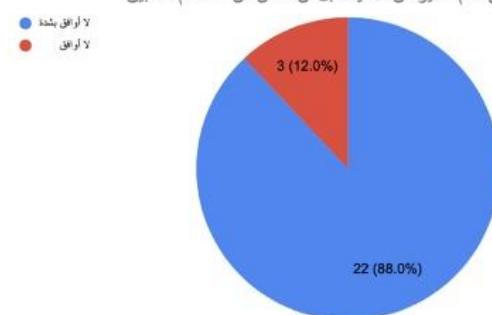


Figure 39 UAT questionnaire results 1

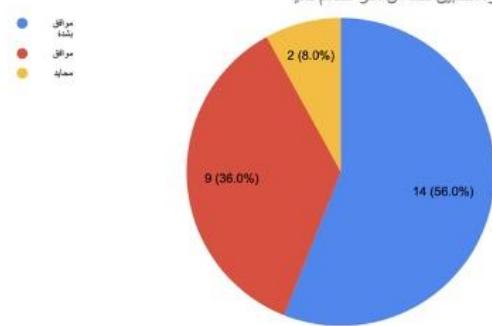
ووجدت أن بعض الأيقونات لم تكن واضحة



كنت بحاجة إلى تعلم الكثير من الأشياء قبل أنتمكن من استخدام التطبيق



ووجدت أن ما يوفره التطبيق للحد من هدر الطعام كافياً



ووجدت أن رسائل التنبية أثناء استخدام التطبيق سهلة الفهم وواضحة

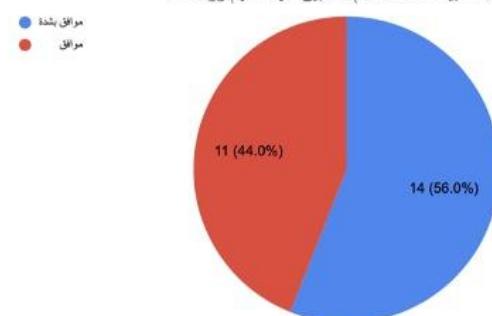


Figure 40 UAT questionnaire results 2

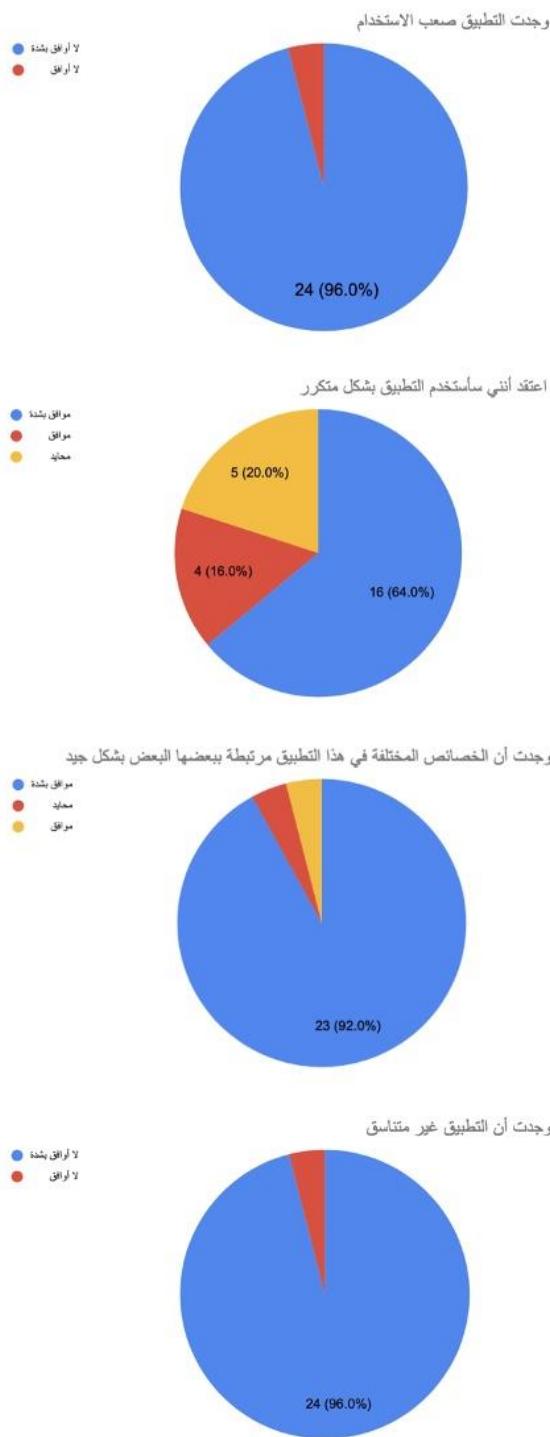


Figure 41 UAT questionnaire results 3

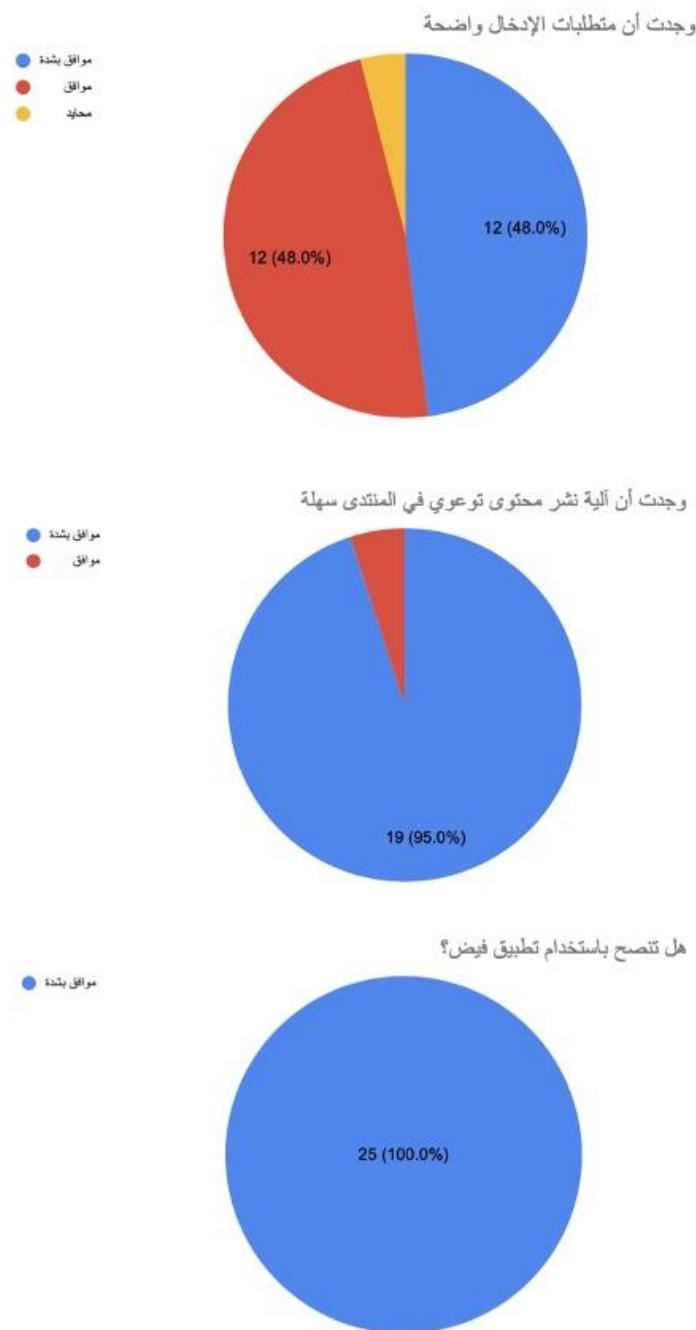


Figure 42 UAT questionnaire results 4

Table 6.Admin questionnaire Result table

Questions	Scale	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
As an admin, I can manage the app easily	5					
As an admin, I found that the mechanism for blocking users was simple	4	1				

كمشرف، وجدت أن إدارة التطبيق سهلة

موافق بشدة



كمشرف، وجدت أن آلية حظر المستخدمين المخالفين بسيطة وواضحة

موافق بشدة
موافق

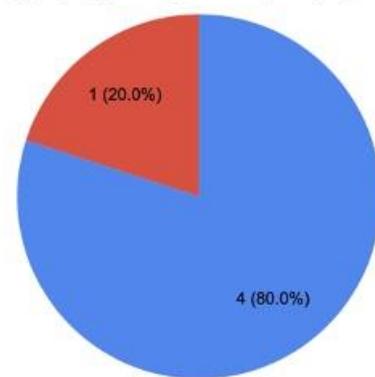


Figure 43 UAT questionnaire results 5

Table 7. Provider(Business & Individual) questionnaire Result table

Questions	Scale	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
As a provider, I found the mechanism of adding food post was easy.		10	4	1		
As provider, I found that I can manage my food ads easily		12	2	1		
as a provider, I believe that I will help in reduce food waste through the use of the Faydh app by donating surplus food		13	1	1		

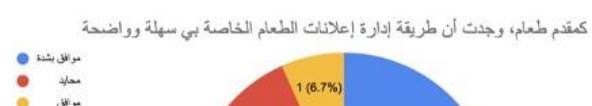


Figure 44 UAT questionnaire results 6

Table 8. Consumer(Charity&individual) questionnaire Result table

Questions	Scale	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
As a consumer, I found the mechanism of reserving food ad was easy		14	1			
As consumer, I found that I can manage my food reservations easily		13	2			

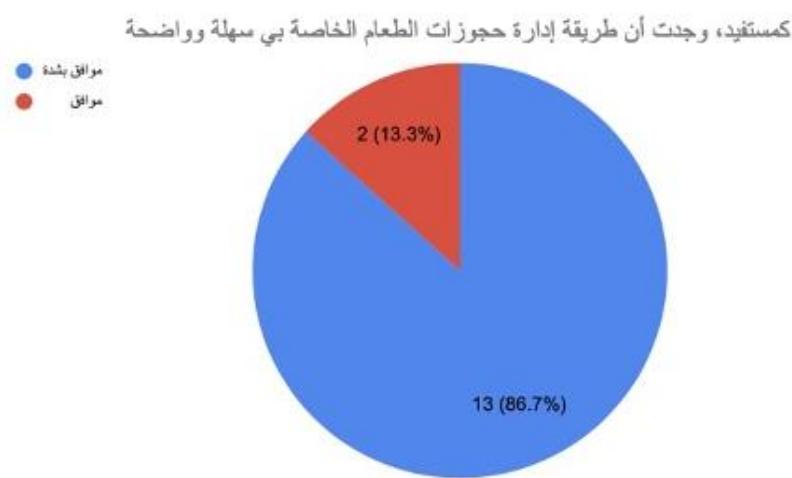
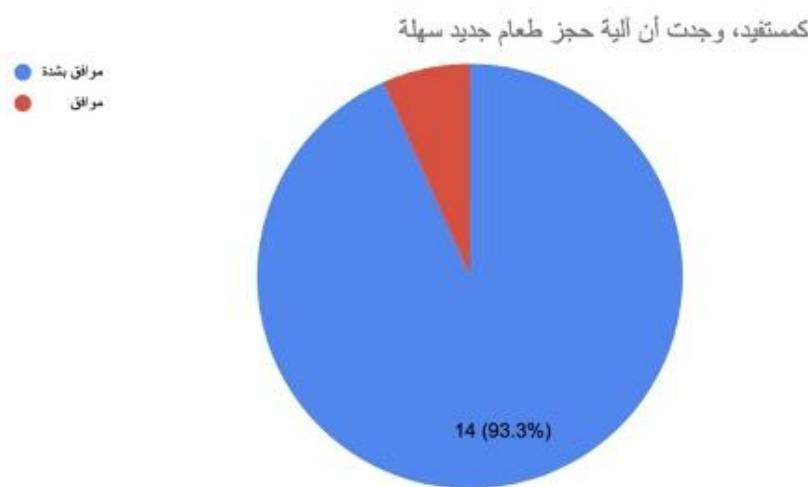


Figure 45 UAT questionnaire results 7

4.2 Quality Attributes (NFR testing)

We tested 3 non-functional requirements that we have previously added in our product backlog. And after deciding on the testing measures, we tested each functionality on a number of users

Table 9. NFR testing Table

User story	Quality Attribute	Measure	Results (time)
As a consumer, I want to see my search result within 5 seconds so that I can make quick decision based on my search.	Performance: measure of the response time of the application under different load conditions [61].	Measure the time that it takes to search for food ads and users list.	We tested the search feature with 20 users (10 individuals, 5 Charities and 5 admins). The average search results would appear in 4 seconds which is less than 5 and what we had expected.
As a user, I want to have a commonly used UI icons so that dealing with the interface will be easy for me.	Usability: measure of the degree to which an application can be easily used and operated [61].	<ul style="list-style-type: none"> - efficiency: Measure the time for users to complete different tasks - effectiveness: measure the completion rate and number of errors - satisfaction: measure the subjective experience of the user when completing their tasks <p>We will measure the test quality on these tasks:</p> <ol style="list-style-type: none"> 1- Adding food post 2- Adding forum content 3- Reserving food post 	<p>We measured the efficiency (avg time to finish) and effectiveness (completion rate and number of errors) and satisfaction (user experience)for each task:</p> <p>1- Adding food post task for 15 users (10 individuals and 5 businesses)</p> <p>And the average time came to around 1 minute and 14 second to complete a single food post.</p> <p>Which is less than the maximum time we expected (2 -3 minutes)</p> <p>And out of all of the 15 users only 6 users faced a problem with understanding the process of adding a picture to the food post. But all users</p>

		<p>4- Block reported user</p> <p>completed the task successfully at the end, so the completion rate is 100%</p> <p>And as for the satisfaction we asked for their experience in the questioner by asking (As a provider, I found the mechanism of adding food post was easy) and 66.67 % strongly agreed and 26.667% agreed and the remaining 6.67% answered with normal that were satisfied with the process of accomplishing the task.</p> <p>2- Adding forum content task for 20 users (10 individuals, 5 businesses and 5 charities)</p> <p>And the average time of completing the task was 32 second. Which was less than the time we expected (1 minute).</p> <p>The task was accomplished by all 20 testers with 0 errors and 100% completion rate.</p> <p>As for the satisfaction we asked for their experience in the questioner by asking (I found the mechanism of adding awareness content in the forum was easy) and 95 % strongly agreed and 5% agreed that they were satisfied with the process of accomplishing the task and found it easy.</p> <p>3-Reserving food post task for 15 users (10 individuals and 5 charities)</p>
--	--	---

			<p>And the average time came to around 7 second to find and reserve a food post.</p> <p>Which is less than the maximum time we expected (1 minute)</p> <p>The task was accomplished by all 15 testers with 0 errors and 100% completion rate.</p> <p>And as for the satisfaction we asked for their experience in the questioner by asking (As a consumer, I found the mechanism of reserving food ad was easy) and 93.33% strongly agreed and 6.67% agreed that they were satisfied with the process of accomplishing the task.</p> <p>4- Block reported user task for 5 Admins</p> <p>And the average time came to around 9 seconds to find all users page and block a user.</p> <p>Which is less than the maximum time we expected (30 seconds)</p> <p>The task was accomplished by all 5 testers with 0 errors and 100% completion rate.</p> <p>And as for the satisfaction we asked for their experience in the questioner by asking (As an admin, I found the</p>
--	--	--	--

			mechanism of blocking violating users was easy) and 80% strongly agreed and 20% agreed that they were satisfied with the process of accomplishing the task.
As a user, I want the app to be available 98% of the time I try to access it, so that I don't get frustrated and find another application to use.	Availability: describes how likely the system is accessible to a user at a given point in time[62].	Compute the availability of the application	Faydh depends on firebase for authentication and storing data as it is the only part that could affect the availability of our application and we found that Firebase availability is 99.95%. of the time [63] which is less than 98% which was our application expected availability.

4.3 Discussion

After completing the user acceptance testing and analyzing the questionnaire result, we figured that the system evaluation was satisfactory, and it showed us the good aspects of the application, 80% of the users strongly agreed and 20% agreed that navigation through the app was easy.

All the users found the design of the application interfaces easy to use. Also 64% strongly agreed, 32% agreed, and 4% neutral that the response speed of the application was good. In addition to that 84% of the users strongly disagreed and 16% disagreed that some icons weren't clear. Furthermore 88% of the users strongly disagreed and 12% disagreed that they needed to learn a lot of things before I could get going with this system.

As well 56% of the testers strongly agreed, 36% agreed, and 8% neutral that the app provides enough features to reduce food waste. In addition, 56% of the testers strongly agreed and 44% agreed that the alert messages while using the app clear and easy to understand. Also 96% of the testers strongly disagreed and 4% disagreed that the app difficult to use.

Among the testers 64% Strongly agreed ,16% agreed that they would use the app frequently and the rest 20% answered neutral about it. Also 92% Strongly agreed, 4% agreed and 4% neutral that the various functions in this system were well integrated. When asked about the

inconsistency of the app 96% of the testers strongly disagrees and the other 4% disagree that they found the app inconsistent.

Moreover, 48% of the testers were strongly agreed, 48% agreed and 4% neutral that The prompts displayed for inputs were clear. Also, 95% of the testers strongly agreed and 5% agreed that they found the mechanism of adding awareness content in the forum was easy. Furthermore, All the testers Strongly agreed about recommending using Faydh application to others.

For the admin, 100% of the testers strongly agreed that they can manage the app easily. Moreover 80% of the testers strongly agreed and 20% agreed that the mechanism for blocking users was simple .

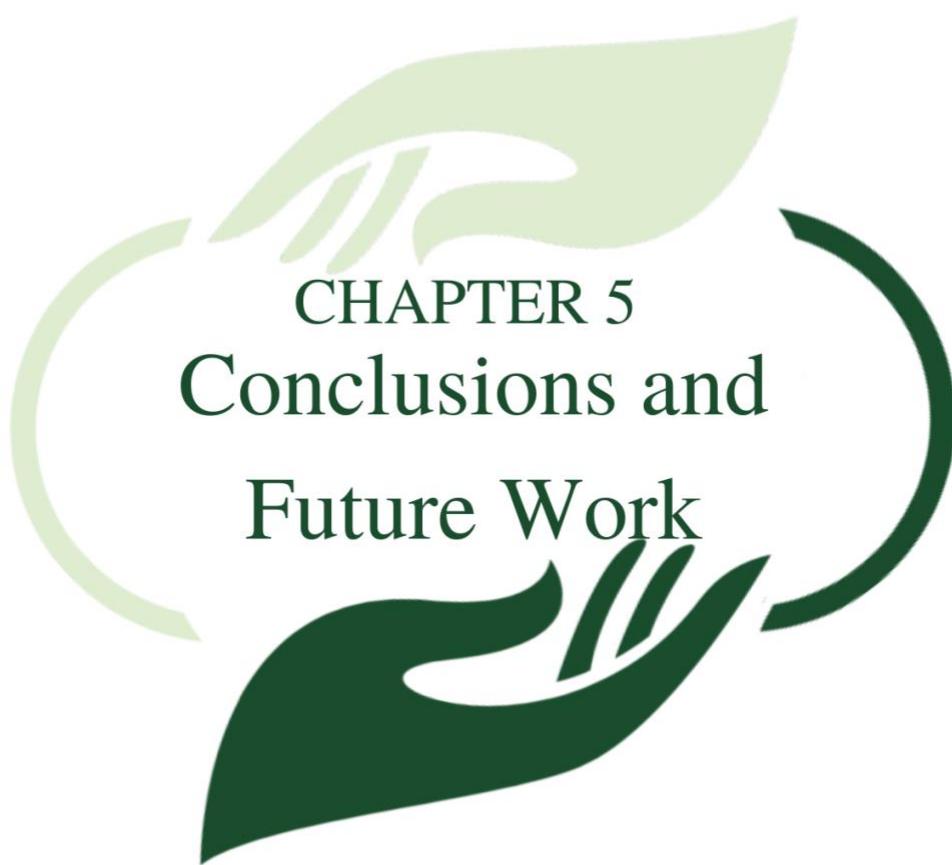
As for the questions that were given to the providers. When asked about the adding food post feature 66.7% strongly agreed , 26.7% agreed and 6.7% neutral that it was easy. Also 80% strongly agreed, 6.7% agreed and the remaining 13.3% neutral that the process of managing food is easy. And 86.7% strongly agreed , 6.7% Agreed and 6.7% neutral when believing that Faydh will help them reduce their food waste by donating their surplus food in the app.

For consumers, 93.3% of them strongly agreed and 6.7% agreed that they found the mechanism of reserving food ad was easy. Also, 86.7% of them strongly agreed and 13.3 agreed that they can manage their food reservations easily.

After analyzing the results, and doing the SUS score calculation [64] (check appendix E) we found that our application's score is **93.7%** which is higher than the average of the SUS Scores by cell phone interface **65.9%** [64] that means that our application got mostly positive feedback and has passed the usability testing successfully where the users found it easy to use and helpful and it is ready to launch. We also asked the users about what they think of the application and we got a lot of compliments (refer appendix F to see the feedbacks)

The users also gave us some comments to improve the application and we did fix it according to their comments such as adding picture in post food ad process was not clear because the picture frame is grey box and users thought that is the button when we have another button for it, we fixed it by getting rid of the grey box so the add picture button is more clear. and reservation process need confirmation message, so we fixed it accordingly.

They also suggested adding instant messaging feature and allow users to like and reply in others awareness contents which we have added to the feature work section since we think they would be a great addition to Faydh.



CHAPTER 5
Conclusions and
Future Work

5 Conclusions and Future Work

This document depicts our experience with Faydh from the idea's inception as a seed and nurturing it throughout all stages we underwent. The introduction chapter describes the concept and provides a broad overview of Faydh. An essential part of preparing the reader to understand Faydh details is the background chapter, which briefly explains what are the aspects of Faydh application, such as the impact of some environmental factors on food waste, the causes of food waste, and its adverse effects, particularly food waste in Saudi Arabia. Additionally, the literature review chapter defines the factors that cause excess food to make people aware of food waste. We researched and debated academic articles and mobile apps on the same subject of Faydh to create an application that fills the market application gap and describes Faydh characteristics. The system analysis and design chapter translate Faydh features into a form used to assist the development of the Faydh application and enhance the understanding of Faydh components and how they interact. It started after we had a clear envision of Faydh features. Following a system analysis, we began the implementation chapter which is building our application using Visual Studio code and flutter framework. Finally, we moved to system testing chapter which test using User Acceptance Testing our application to ensure that it work properly without errors.

5.1 Local and Global Impact

5.1.1 Local Impact

Most people don't realize how often they waste food and the negative impacts it can have on food security, the environment, and climate change. Reducing food loss and waste could benefit them, their families, and the world, now and in the future. Safe and wholesome food that is currently thrown away could help feed hungry people and reduce food insecurity today.

We live in the technological age, and we have been watching closely how this affects food rescue, which has historically been fairly low-tech, mainly consisting of storage and distribution facilities operated by volunteers. More recently, we've seen food rescue organizations in Saudi Arabia need technologies to improve their operations and facilitate a more streamlined experience for their food donors and raise awareness about food waste.

Since the Kingdom of Saudi Arabia's culture is based on honoring the guest and providing more food, it may be more than needed, and some or most of the food served may not be eaten. Donating wasted food can be a better alternative. Faydh will encourage Saudis to share their excess food for the benefit of people or charities without worrying about the best way to deal with excess food. Faydh will also assist Saudi Arabia in its digital transformation by combining IT and food industry.

5.1.2 Global Impact

Every year 2.5 billion tons of food ends up being wasted. It is a huge problem that affects the economy, environment, and society globally and in our country. It has been expressly recognized by the United Nations as part of their sustainable development goals to 'achieve a better and more sustainable future for all[60].

In our busy lives, many people need to be aware of the importance of reducing food waste and need more time to understand the food needs of each of them or will lead their behavior to an increase in food waste or its expired. Faydh solves this problem by looking at the automation

process and using it to develop the solution. As the world discusses increasing food productivity, they must consider its environmental effect. From another perspective, reducing food waste in societies increases human health and the environment. Faydh is currently available in Saudi Arabia, although it can be adapted to be used in other Arabic-speaking countries. It may be expanded to additional languages and platforms in the future, In order to make it available to a larger audience.

5.2 Difficulties

As expected, our journey as we developed the concept of Faydh was not smooth. To fulfill the project's objectives, we had some difficulties communicating with the charity that would suit our demands and meet their needs as a charity that accepts food. Furthermore, Due to the continuous upgrades and version changes, we also needed help setting up the work environment for implementation, such as installing the emulator into the computer. More difficulties are mentioned in implementation difficulties in the system implementation chapter.

5.3 Limitation and Future Work

"FAYDH" only supports the Arabic language at the moment. Moreover, since many of our potential users are immigrants and workers who speak other languages, we want to make our application support English, Filipino, Urdu, and Hindi. It is currently for the Android operating system, but we plan to extend it to IOS operating system.

Furthermore, since our application only deletes the posts with expired food, we want to work with compost manufacturers and waste management companies like Tadweer [59] to give people the option of getting rid of any expired food through Tadweer to reduce waste. Additionally, we want to allow livestock owners to get any food that is not allowed to be donated to humans (touched food) by registering in a separate form to get their contact details. Finally, a chat feature in our application for Donors and Consumers would be a great addition to allow users to communicate within our app.

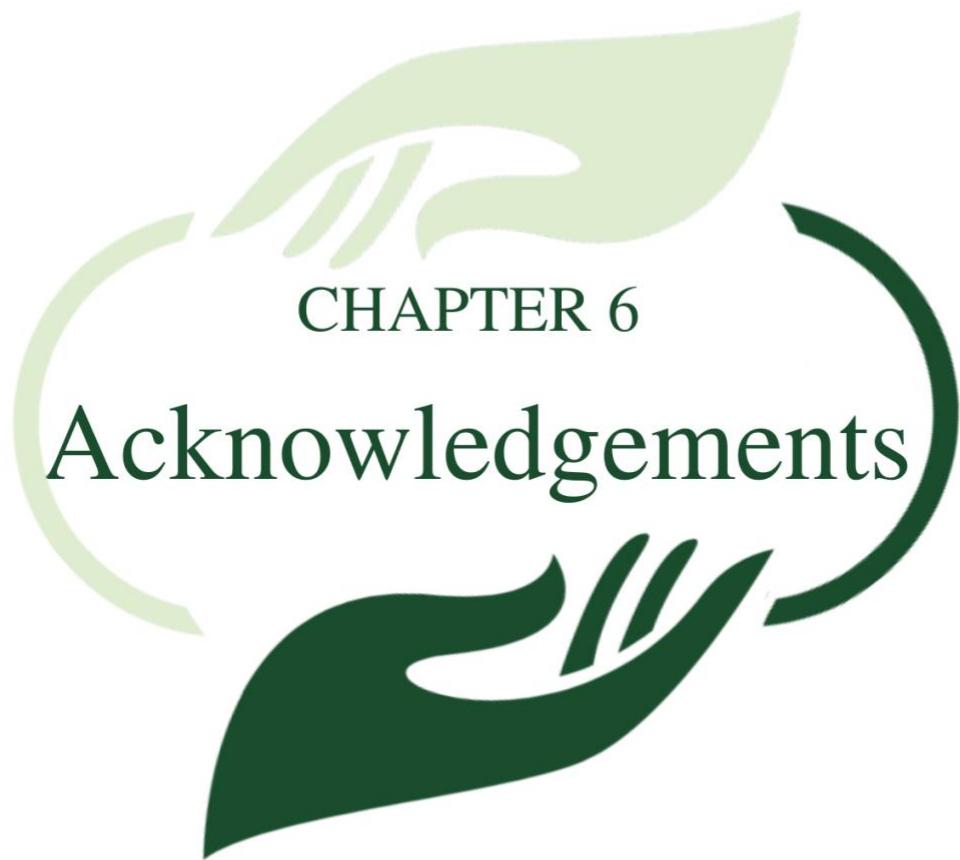
We considered adding a dataset for charities to authenticate a particular charity. However, there is no dataset available for charities here in Saudi Arabia. Furthermore, since even mosques in Saudi Arabia accept food donations, it would be hard to limit the authentication to only government-supported charities since our primary goal in "FAYDH" is to give food to everyone in need.

Lastly, while doing the User acceptance testing the users gave us some ideas to improve Faydh which would be a great addition like allowing users to like/dislike and reply to others forum content.

5.4 main contribution

It is our responsibility as students and members of society to contribute to the discovery and development of new knowledge in order to improve the quality of life. To this end, utilizing all stages of food life, from food preparation to converting expired and inedible food, is a step towards environmental conservation automation that can lead to a massive boost in this field.

Faydh Application is keen to support the Arabic language within the Kingdom of Saudi Arabia, as most food waste reduction applications residing in Saudi Arabia are very basic and limited compared to those in other countries. This is why "Faydh" was developed, to give individuals and businesses the opportunity to donate their surplus food by posting food ads, and to provide statistics about the food they post. The app also allows food consumers to search through the food ads, and all users can edit their profiles and posts. Furthermore, Faydh provides a space to post content that raises awareness of food waste.



CHAPTER 6

Acknowledgements

6 Acknowledgements

First, we would like to thank Allah for giving us the power and patience to complete our graduation project. We are also incredibly grateful to our supervisor, Dr. Rabia Jafri Ali, for her hard work and guidance. Her recommendations have taught us so much and have been invaluable in our journey. We would also like to extend our thanks to our families and friends for their unwavering support and encouragement. They put up with our late nights, fatigue, and absences, and met us with support and encouragement to help us reach the finish line. Finally, we cannot forget each developer and innovator – Shaden, Jomanah, Shaikha, and Alanoud – without whom our project would not have been possible. Thank you all for your dedication and hard work.

CHAPTER 7

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7 References

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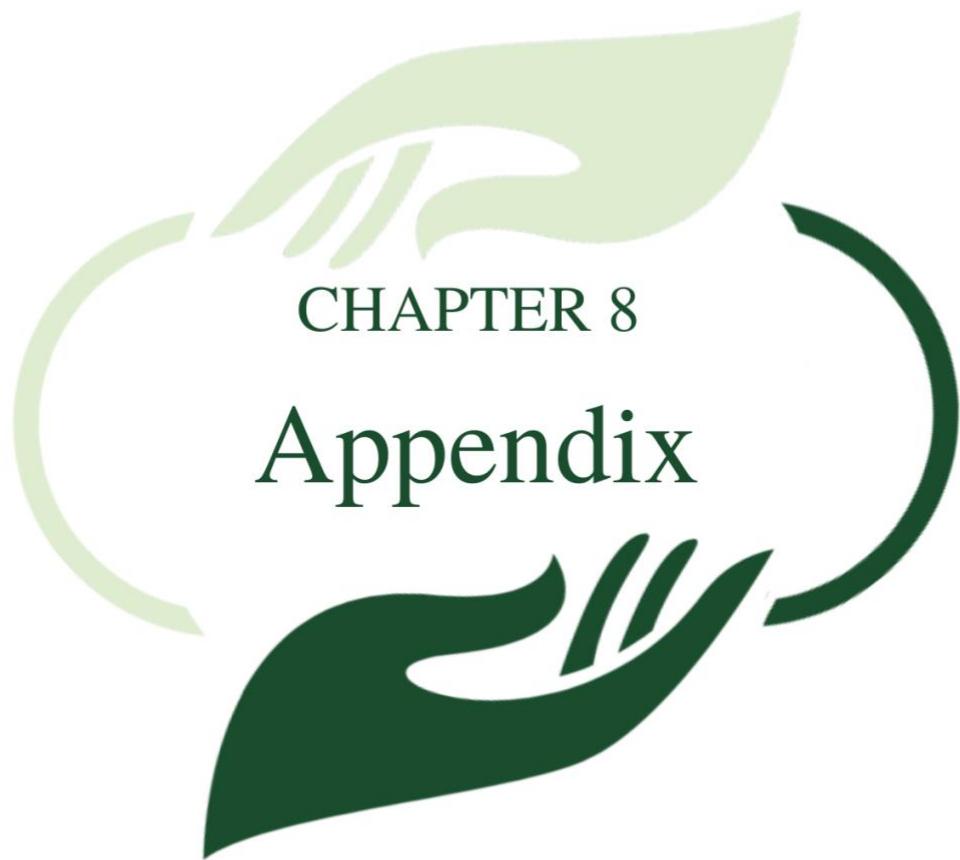
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8 Appendix

8.1 Appendix A: Questionnaire questions and answers



Faydh | فَيْض

السلام عليكم ورحمة الله وبركاته

نحن طالبات جامعة الملك سعود- قسم تقنية المعلومات

نقدم لكم استبياناً مشروع "فَيْض" لإكمال متطلبات مشروع التخرج

"فَيْض" تطبيق عربي يقدم للأفراد والشركات (المطاعم ، المخابز ، المقاهي ، الأسواق المركزية ، إلخ) في المملكة العربية السعودية طريقة سهلة وسليمة لمشاركة فائض الطعام على المنظمات (الجمعيات الخيرية ، بنوك الطعام ، إلخ) والأفراد لمنعه من الهدر.

كما يتبع التطبيق للمستخدمين مساحة لرفع مستوى الوعي حول إهار الطعام من خلال نشر روابط المقالات والصور والمنشورات وما إلى ذلك.

مدة الاستبيان لا تتجاوز ٣ دقائق ، شاكرين لكم تعاونكم في تعينة هذا الاستبيان.

Figure 46 questionnaire form description

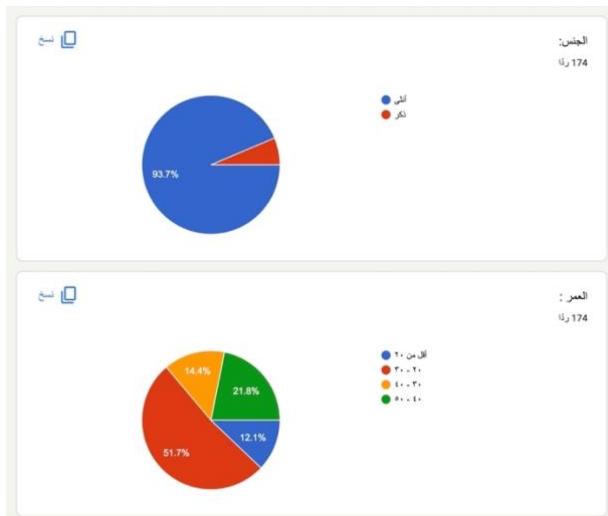


Figure 47 Questionnaire questions & answers 1

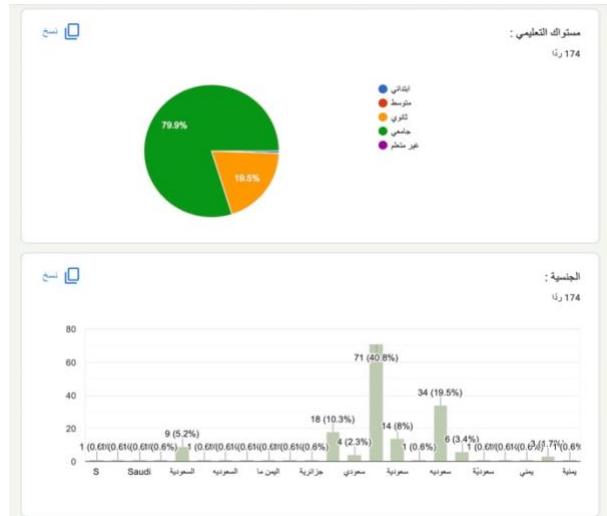


Figure 48 Questionnaire questions & answers 2

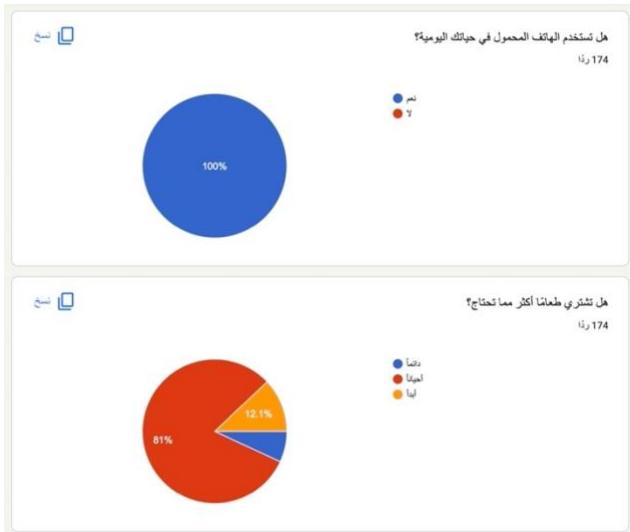


Figure 49 Questionnaire questions & answers 3

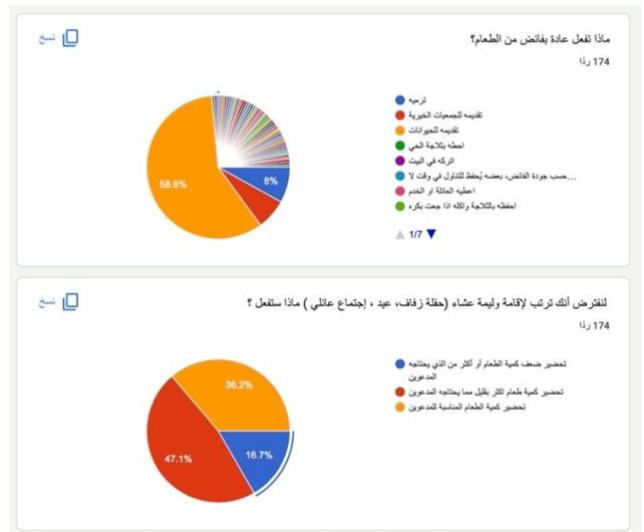


Figure 50 Questionnaire questions & answers 5

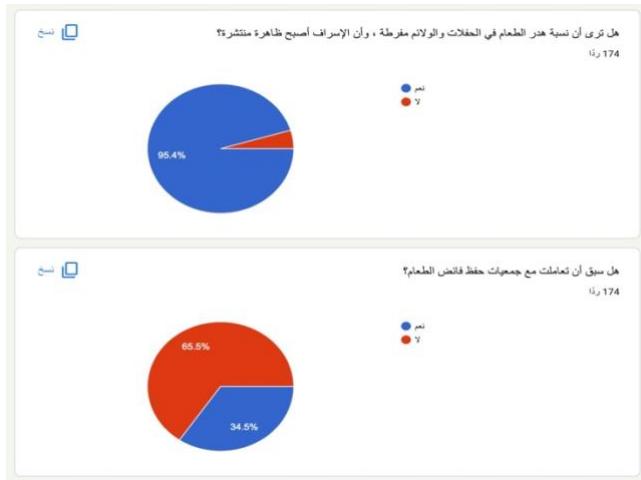


Figure 51 Questionnaire questions & answers 5



Figure 52 Questionnaire questions & answers 6



Figure 53 Questionnaire questions & answers 8

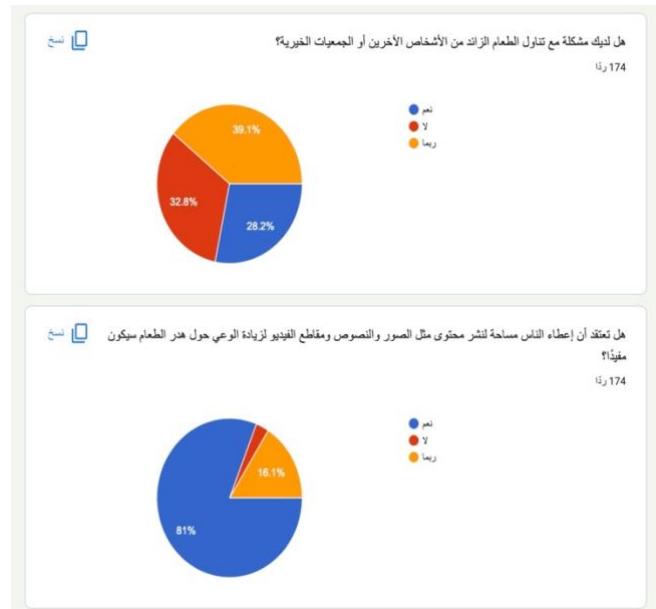


Figure 54 Questionnaire questions & answers 7



Figure 55 Questionnaire questions & answers 9

8.2 Appendix B: interview questions

Mr. Salman Alzumia's interview questions (Business).

Background Information:

- o The name
- o Career Title
- o educational background
- o Years of experience in the field

- ☒ Tell us about your business and how many branches you have in Saudi Arabia.
- ☒ How much food is wasted in your business branches in Saudi Arabia?
- ☒ What causes your business to have surplus food?
- ☒ How do you deal with excess food at the end of the shift?
- ☒ Do you use any technologies to deal with surplus food in your branches
- ☒ What are the most prominent challenges facing your business branches concerning surplus food?
- ☒ Do you have any plans for dealing with excess food?
- ☒ Feedback and suggestions for the proposed application:

- o We are developing an application that would allow organizations/businesses and individuals to post surplus food and enable organizations and individuals to pick up the posted food. It will also allow all users to post content to raise awareness about food waste reduction. Would it be helpful to you?

- o Finally, what do you like best about the app concept, and are there things that need to be changed/ improved and added to the system?

☒ Consent regarding research publications

- o We would be honored if you would allow us to mention your and your organization's names in our research publications. Can you please let us know if that is ok with you? If not, any feedback you provide will be reported in the publications anonymously. Will this be ok with you?

Mr. Faisal Al-Wahhabi's interview questions (Charity).

☒ Background Information:

- o The name
- o Career Title
- o educational background
- o Years of experience in the field
- o What are the main goals of your charity?

☒ What techniques do you use in communicating with food donators?

- ☒ Who do you primarily receive surplus food from (businesses or households)?**
- ☒ What methods do you use for giving away surplus food?**
- ☒ Which group of people do you usually donate to?**

- ☒ How many beneficiaries are Saudi families and residents of this charitable association?
- ☒ What are the main challenges the charity faces regarding acquiring and distributing food?
- ☒ Do you use any technology for acquiring and distributing surplus food? In case technology is used, what specific devices/applications are being used, and what are your limitations (problems/challenges that you face in using them)?
- ☒ What about the charity's plan and future projects to improve food waste reduction?
- ☒ Feedback and suggestions for the proposed application:

- We are developing an application that would allow organizations/businesses and individuals to post surplus food and enable organizations and individuals to pick up the posted food. It will also allow all users to post content to raise awareness about food waste reduction. Would it be helpful to you?
- Finally, what do you like best about the app concept, and are there things that need to be changed/ improved and added to the system?

☒ Consent regarding research publications

- We would be honored if you would allow us to mention your and your organization's names in our research publications. Can you please let us know if that is ok with you? If not, any feedback you provide will be reported in the publications anonymously. Will this be ok with you?

Ms. Hend Alshaya's interview questions (Individual).

Background Information:

- The name
- The age

- education level
- nationality
- Do you use a mobile phone
- What languages are you fluent in?

- ☒ **Where will you get your food if you need food and you do not have enough money to buy from?**
- ☒ **Have you ever contacted charity organizations, and how was your experience with them?**
- ☒ **Do you use any technology for acquiring and distributing surplus food? In case technology is being used, what specific devices/applications are being used, and what are your limitations (problems/challenges that you face in using them)**
- ☒ **Feedback and suggestions for the proposed application:**
- We are developing an application that would allow organizations/businesses and individuals to post surplus food and enable organizations and individuals to pick up the posted food. It will also allow all users to post content to raise awareness about food waste reduction. Would it be helpful to you?
- Finally, what do you like best about the app concept, and are there things that need to be changed/ improved and added to the system?
- ☒ **Consent regarding research publications**
- We would be honored if you would allow us to mention your and your organization's names in our research publications. Can you please let us know if that is ok with you? If not, any feedback you provide will be reported in the publications anonymously. Will this be ok with you?

8.3 Appendix C: UAT questions

*نوع مختبر التطبيق:	<input type="radio"/> مشرف
	<input type="radio"/> فرد
	<input type="radio"/> منظمة خيرية
	<input type="radio"/> منظمة تجارية
*اسم المختبر	<input type="text" value="إجابتك"/>
*عمر مختبر التطبيق	<input type="radio"/> أقل من 20
	<input type="radio"/> 20-25
	<input type="radio"/> 25-30
	<input type="radio"/> أعلى من 35
*جنس مختبر التطبيق	<input type="radio"/> ذكر
	<input type="radio"/> أنثى
*المستوى التعليمي لمختبر التطبيق	<input type="radio"/> ابتدائي
	<input type="radio"/> متوسط
	<input type="radio"/> ثانوي
	<input type="radio"/> جامعي
	<input type="radio"/> دراسات عليا
*مدى خبرة مختبر التطبيق في استخدام تطبيقات الجوال	<input type="radio"/> ممتازة
	<input type="radio"/> متوسطة
	<input type="radio"/> لا توجد خبرة
*لغة المختبر الرسمية	<input type="radio"/> العربية
	<input type="radio"/> الانجليزية
	<input type="radio"/> غير ذلك

Figure 56 Demographic questions for testers

<p>* وجدت أن التنقل بين الصفحات كان سهلاً</p> <p>موافق بسندة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محايد <input type="radio"/></p> <p>لا أوفق <input type="radio"/></p> <p>لا أوفق بسندة <input type="radio"/></p>
<p>* وجدت أن واجهات التطبيق سهلة الاستخدام *</p> <p>موافق بسندة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محايد <input type="radio"/></p> <p>لا أوفق <input type="radio"/></p> <p>لا أوفق بسندة <input type="radio"/></p>
<p>* وجدت أن سمعة الاستجابة للتطبيق جيدة *</p> <p>موافق بسندة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محايد <input type="radio"/></p> <p>لا أوفق <input type="radio"/></p> <p>لا أوفق بسندة <input type="radio"/></p>
<p>* وجدت أن بعض الزيارات لم تكن واضحة *</p> <p>موافق بسندة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محايد <input type="radio"/></p> <p>لا أوفق <input type="radio"/></p> <p>لا أوفق بسندة <input type="radio"/></p>
<p>* كنت بحاجة إلى تعلم الكثير من الأشياء قبل أن أتمكن من استخدام التطبيق</p> <p>موافق بسندة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محايد <input type="radio"/></p> <p>لا أوفق <input type="radio"/></p> <p>لا أوفق بسندة <input type="radio"/></p>

Figure 57 UAT questions 1

<p>* وجدت أن ما يوفره التطبيق للحد من صدر الطعام كافي</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>
<p>* وجدت أن رسائل التنبية أثناء استخدام التطبيق سهلة الفهم وواضحة *</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>
<p>* وجدت التطبيق صعب الاستخدام</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>
<p>* اعتقاد أنني سأستخدم التطبيق بشكل متكرر</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>
<p>* وجدت أن الشخصيات المختلفة في هذا التطبيق مرتبطة بعضها البعض بشكل جيد *</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>
<p>* وجدت أن التطبيق غير متناسق *</p> <p><input type="radio"/> موافق بسندة</p> <p><input type="radio"/> موافق.</p> <p><input type="radio"/> محايد</p> <p><input type="radio"/> لا أوفق</p> <p><input type="radio"/> لا أوفق بسندة</p>

Figure 58 UAT questions 2

<p>* وجدت أن آلية نشر محتوى توعوي في المنتدى سهلة</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>
<p>* كمقدم طعام، وجدت أن طريقة إدارة إعلانات الطعام الخاصة بي سهلة وواضحة *</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>
<p>* كمستفيد، وجدت أن طريقة إدارة حجوزات الطعام الخاصة بي سهلة وواضحة *</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>
<p>* وجدت أن متطلبات الإدخال واضحة *</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>
<p>* كمقدم طعام، وجدت أن آلية نشر طعام جديد سهلة *</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>
<p>* كمستفيد، وجدت أن آلية حجز طعام جديد سهلة *</p> <p>موافق ببنيدة <input type="radio"/></p> <p>موافق <input type="radio"/></p> <p>محابد <input type="radio"/></p> <p>لا أافق <input type="radio"/></p> <p>لا أافق ببنيدة <input type="radio"/></p>

Figure 59 UAT questions 3

*** وجدت أن ما يوفره التطبيق للحد من مدر الطعام كافياً**

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

*** وجدت أن رسائل التنبيه أثناء استخدام التطبيق سهلة الفهم وواضحة ***

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

*** وجدت التطبيق صعب الاستخدام ***

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

*** اعتقد أنني سأستخدم التطبيق بشكل متكرر ***

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

*** وجدت أن الخصائص المختلفة في هذا التطبيق مرتبطة بعضها البعض بشكل جيد ***

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

*** وجدت أن التطبيق غير متناسب ***

موافق بشدة
 موافق
 محايد
 لا أافق
 لا أافق بشدة

Figure 60 UAT questions 4

كمقدم طعام، أعتقد أنني سأتمكن من الحد من هدر الطعام من خلال استخدام تطبيق * فيض عن طريق التبرع بالطعام الفائض

موافق بشدة

موافق

محايد

لا أافق

لا أافق بشدة

هل تتصح باستخدام تطبيق فيض؟ *

موافق بشدة

موافق

محايد

لا أافق

لا أافق بشدة

هل وجدت تطبيق فيض مفيداً؛ وما أكثر شيء أعجبك في التطبيق؟ *

إجابتك

هل لديك أي اقتراحات لتحسين التطبيق؟ *

إجابتك

Figure 61 UAT questions 5

8.4 Appendix D: Participant Consent Form

نموذج موافقة المشاركة

الغرض من دراسة قابلية الاستخدام هذه هو تقييم تصميم تطبيق فيض. نحن مهتمون بتحديد ما إذا كان بإمكان الأشخاص إنجاز المهام المترابطة عليها والعنوان على المعلومات بسهولة في التطبيق. لن تقوم الجلسة "باختبارك أنت أو قدرتك، بل ستختبر الجلسة التطبيق لتقديم معلومات حول المجالات التي يمكن تحسينها. يرجى العلم أنه لا توجد مخاطر مرتبطة بالمشاركة في هذه الجلسة.

خلال هذه الجلسة، سيطلب منك إكمال بعض المهام باستخدام التطبيق وملء استبيان رضا المستخدم. عند إكمال المهام، سيقوم أعضاء فريق المشروع بالمراقبة وتتوين الملاحظات. بالإضافة إلى ذلك، سيتم تسجيل الجلسة للمراجعة المستقبلية. لن تستغرق الجلسة أكثر من 20 دقيقة.

إذا كنت غير مرتاح لأي سبب من الأسباب أثناء الجلسة ولا ترغب في إكمال مهمة ما، يمكنك قول ذلك وستنتقل إلى المهمة التالية. بالإضافة إلى ذلك، إذا كنت لا ترغب في المتابعة، فيمكنك إنهاء الجلسة والغاء المشاركة في أي وقت.

سيشارك ما يقارب 25 شخصاً في هذه الدراسة. سيتم تضمين نتائج جميع الجلسات في تقرير قابلية الاستخدام لعرضه على لجنة مشروع التخرج 2 بجامعة الملك سعود. لن يتم تضمين اسمك في التقرير ولن يتم ربط اسمك بأي بيانات تم جمعها خلال الجلسة.

إذا كنت ترغب في التحدث مع شخص ما حول مشاركتك في هذه الدراسة، أو إذا كنت تشعر أنك لم تتم معاملتك كما هو موضح أعلاه، فيرجى الاتصال بقائد الفريق على 0548543758.

أنا أنا
قرأت وفهمت تماماً مدى الدراسة وأي مخاطر
متعلقة بها. وتمت الإجابة على جميع أسئلتي، إن وجدت، بشكل مرضي. يقر توقيعي أدناه بفهمي للمعلومات المقدمة في هذا النموذج ويشير إلى رغبتي في المشاركة في جلسة اختبار المستخدم هذه. لقد تم إعطائي نسخة فارغة من نموذج الموافقة هذا لتسجيلاتي.

التاريخ : _____

التوقيع: _____

Figure 62 Participant Consent Form

8.5 Appendix E: SUS calculations

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	Participant	q1 +	q2 -	q3 +	q4 -	q5 +	q6 -	q7 +	q8 -	q9+	q10+	q11+	q12 +	q13 +	q14 +	q15 +	q16+	q17+	q18+	q19 +		SUS Score	
2	p1	5	1	5	1	5	1	5	1	5		5	5	5				5	5	5		100.0	Business
3	p2	5	1	5	1	5	1	5	1	4	1	5		4	5	5		5	5	5		96.6	Business
4	p3	5	1	5	1	5	1	5	1	3	1	5		4	4	5		4	5	5		91.6	Business
5	p4	5	1	5	1	5	1	5	1	5	1	5		3	5	5		5	5	5		96.6	Business
6	p5	5	2	5	2	5	1	4	1	5		5		3	5	5		4	3	4		85.0	Business
7	p6	5	1	5	1	5	1	5	1	5	1	5	5	4	5	5		4	5	5	5	97.0	individual
8	p7	5	2	5	2	3	2	3	2	4	4	4	5	4	4		5	5	5	4		80.9	individual
9	p8	5	1	5	1	4	1	4	1	5	1	5	5	5	5		5	5	5	5		97.0	individual
10	p9	5	1	5	1	5	1	5	1	4	1	5	5	3	5	5		5	5	5	5	95.6	individual
11	p10	5	1	5	1	4	1	5	1	5	1	5	5	4	5	5		5	5	5	5	97.0	individual
12	p11	5	1	5	1	4	1	5	1	5	1	5	5	5	5	5		5	5	5	5	98.5	individual
13	p12	5	1	5	1	5	1	5	1	5	1	5	5	5	3	5		3	3	3	5	88.2	individual
14	p13	4	1	5	1	5	1	5	1	4	1	4	5	5	4	5		4	4	5	5	92.6	individual
15	p14	5	1	5	1	5	1	5	1	4	1	4	5	3	4	5		5	5	5	5	92.6	individual
16	p15	4	1	5	1	4	1	5	1	5	1	5	5	5	4	5		5	5	5	5	95.6	individual
17	p16	5	2	5	1	4	1	4	1	4	1	4	5	5	4	5						91.0	charity
18	p17	5	1	5	1	5	1	5	1	4	1	4	5	5	4	5						94.6	charity
19	p18	5	1	5	2	5	1	5	1	4	1	4	4	5	4	5						92.8	charity
20	p19	5	1	5	1	5	1	5	1	5	1	4	5	3	5	5						94.6	charity
21	p20	5	1	5	1	5	1	5	1	4	1	5	5	5	4	5						96.4	charity
22	p21	4	1	5	1	4	1	5	1	4		5	4			5	5					92.3	Admin
23	p22	4	1	5	1	4	1	4	1	4		5	5			5	4					90.4	Admin
24	p23	5	2	5	1	5	1	5	1	5	1	4	5	5	4	5	5					94.2	Admin
25	p24	5	1	5	1	5	1	5	1	5	1	5	5	5	5	5						100.0	Admin
26	p25	4	1	5	1	4	1	5	1	4		5	4			5	5					92.3	Admin
27																					avg	93.7	

8.6 Appendix F: testers feedback

هل وجدت تطبيق فيض مفيداً؟ وما أكثر شيء أعجبك في التطبيق؟

مفيد جدا ، عدم وجود تطبيقات مشابهة بالرياض	جدا!، أهم ميزة هي الجمع بين كافة المستخدمين المحتملين في ادارة الطعام الفائض	نعم، امكانية حظر جميع المستخدمين	رائع ومفيد جدا	نعم
نعم، الابلاغ عندما لايأتي المستفيد لأخذ الطعام	مفيد جدا ، اعجبني انه يسهل عملية التبرع بفائض الطعام ويسهل العثور على الراغبين بالطعم	مفيد جداً واتمنى استخدامه في الكافيه الخاص بي لأن نهاية اليوم يبقى كثير من الحل الذي ما انتاع ولا استطع بيعه اليوم اللي بعده ففكرة اني اتبرع بالأكل جداً جيدة وباستفادة منها شخصياً	أكيد، طريقة وسهولة اضافة الطعام الفائض	جدا مفيد للجهة التجارية للتقليل من هدرها للطعام
تطبيق واضح	نعم، سهولة التبرع والجز	نعم، المنتدى مكان جيد للتوعية بين الناس	اول تطبيق للطعام اعرفه ورائع جدا والفكير جديده	نعم، اعجبني تحديد تاريخ انتهاء الصلاحية
تطبيق جداً مفيد و يسهل لكافة المجتمع بالتزبرع بالطعام الزائد احسنت!	تطبيق جميل جداً وفكيره ممتازة، تشكر جهودكم بحق	جدا مفيد! جميع مميزات التطبيق تقريبا كلنا بحاجة اليها	نعم تطبيق ممتاز جداً ، بالتوفيق	

Figure 63 testers feedback

