RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps

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Abstract: Food waste poses a serious problem in the Philippines with far-reaching impacts on the economy, society, and environment. This affects households, restaurants, and other stakeholders. To deal with this matter, Senate Bill 240 also known as the Zero Food Waste Act of 2022 was put in place which gives importance to recycling and redistribution among others. This research presents "RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps" designed to manage food waste by promoting donations; tracking expiry dates of food stuff; and providing real-time information about available donated foods among other things. The objectives are system designing; developing mobile apps; and evaluating quality and usability according to ISO/IEC 25010:2011 standardization.

The methodology uses a descriptive developmental approach that employs rapid application development (RAD) for system design as well as observation, interviews, internet research, and survey questionnaires for data collection. This study was conducted in Bacolod City, Negros Occidental Province, Philippines among local communities, food establishments, and non-governmental organizations (NGOs). Findings reveal that the mobile app is highly efficient in managing food waste donation; sorting user profiles; showing available food waste on a map and generating lists of foods. The functionality and usability of this mobile application received positive feedback from users who tested it during their evaluation period. The RescuePlate system shows good performance across different ISO 25010 characteristics such as functional suitability, compatibility security, maintainability, and portability among others. Further, it is also recommended that a similar study may be conducted to improve the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps and the effectiveness of the presented solutions.

Keywords - Food waste, RescuePlate, mobile apps, RAD, efficiency

INTRODUCTION

The Philippines's food waste is a pressing issue that needs to be addressed urgently. The country records tremendous food losses on the supply chain, with one-seventh to one-fifth of edible rice, corn, and banana quantities being lost or wasted (Pastolero & Sassi, 2022*)*. Restaurant food services also contribute to this problem, mainly food waste and plastics (Acanto, 2016). In addition, household food waste has become a major concern, with meat, vegetables, and rice being the most wasted foods (Angeles-Agdeppa et al., 2023). According to a Social Weather Stations survey as of September 2023, 8.4

percent of respondents said they experienced moderate hunger, and 1.3 percent experienced severe hunger. An SWS survey shows that the number of Filipino families who experienced hunger at least once in the third quarter of the year was 9.8 percent. The third quarter figure was lower than the 10.4 percent registered in the second quarter and the same as the 9.8 percent in the first quarter. Wasting food is something that many of us do. Wasted food in the Philippines daily is 1,717 metric tons, according to DOST-FNRI research. This shows that waste must be recognized with urgency and addressed because it contributes to most global cases of food insecurity. To reduce the amount of food wasted in the Philippines, on July 11th,

Senate Bill 240, also known as the Zero Food Waste Act of 2022, was signed by Senator Loren B. Legarda. Recycling and redistribution are some of the ways this bill intends to curtail food waste. The bill seeks to require that businesses like supermarkets, hotels, restaurants, and bakeries, among others, give away their edible leftover foods to those who cannot afford them. Community service activities have played a vital role in promoting a zero-waste lifestyle, highlighting garbage procedures and how villages can develop zero-waste practices (Ko & Lu, 2023).

Currently, the world is facing a crucial stage in terms of food wastage that has severe economic, social and environmental repercussions. Various attempts are being made to deal with this issue. Artificial intelligence could be used to oversee production and supply chains of food while also streamlining such operations with the aim of fostering circular economy drives through redistributing excess provisions (Onyeaka et al., 2023). Clean technology adoption within food service management companies helps formulate specific targets for reducing food waste and engaging employees. However, there must be collaboration so that selfishness does not exist (Nayak et al., 2023). Solutions for food waste can now be found through modern technological development. Among these are creative ways of dealing with food waste such as information systems, artificial intelligence, mobile applications and the Internet of Things (IoT) among others. Legendre et al. (2023) states that big data technologies together with IoT have been progressively employed to manage food waste within supply chains so as to enhance resource utilization and fix inefficiencies at different points of the food cycle. However, removing this food waste requires adding these tech ideas to people's daily endeavors. Food waste in the Philippines can be addressed using web and mobile applications. These applications aim to increase recycling habits, improve waste segregation, and make recyclables accessible to recycling centers (Khan, 2023). Food technology advancements can convert food waste into usable animal feed products, which help to promote sustainable living and reduce waste at the same time (Ahmadzadeh et al., 2023). Food technology can convert food waste into usable animal feed products; thus, promoting sustainable living while minimizing garbage (Ahmadzadeh et al., 2023). Furthermore, digital applications like other technologies aid in reducing global malnutrition through collecting surplus foods and redistributing them so as to achieve sustainable management of all edible leftovers (Chaturvedi et al., 2020).

RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps is a system that will manage food waste donation, process and retrieve user information, foods availed, and household or business food inventory, and display maps of available food waste in the area. There may be technologies at present designed for decreasing food waste but what sets this system apart is it being for all in terms of waste disposal. This works together with a mobile app that enables users who have signed up to donate or pick up meals and get notifications as well as announcements plus hints on how to reduce wastage of food. Additionally, there are maps showing where food can be found within an area. People will now have a device through which they can involve themselves in getting rid of wastes by using this system.

OBJECTIVES OF THE STUDY

This study aims to develop the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps. Specifically, it aims to:

1. Design a system that will:
    1. Allow users to donate excess food to people or charities.
    2. Allow food shops to manage food expirations.
    3. Display a map with food excess donations.
    4. Generate food inventory for households or businesses.
    5. Allow users to request or donate food via SMS notification.
2. Develop a mobile application that will allow registered users to donate, avail, or request foods and receive notifications, announcements, and tips for reducing food waste.
3. Determine the quality of the developed system based on ISO/IEC 25010:2011 Systems and Software Quality Requirements Evaluation (SQuaRE) Quality Model.
4. To determine the usability of the proposed system in terms of usefulness, satisfaction, ease of use, and learning.

MATERIALS AND METHODS

The researcher used the descriptive developmental approach, which is the systematic study of the design, development, and careful evaluation of instructional programs, processes, and products that must meet the standard or criteria.

A. System Design
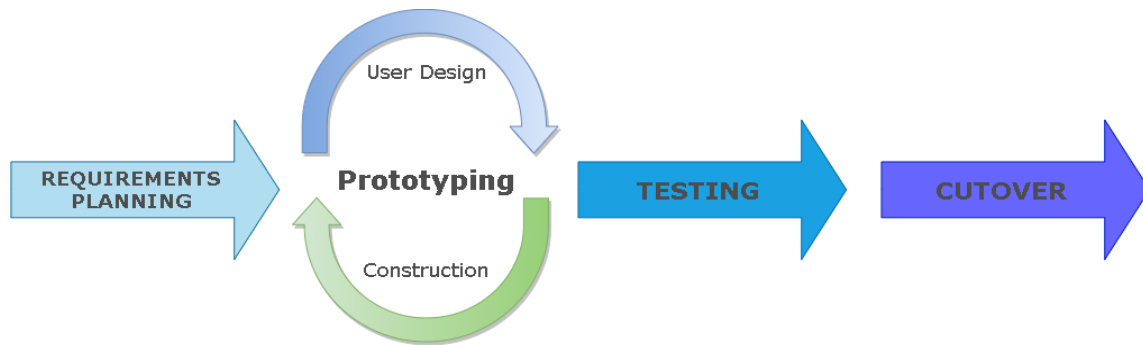
Figure 1. *Rapid Application Development*

Rapid Application Development (RAD) is a development model that prioritizes rapid prototyping and quick feedback over long-drawn-out development and testing cycles. With rapid application development, developers can make multiple iterations and updates to software rapidly without needing to start a development schedule from scratch each time. Throughout the entire course of the system development, the researcher will do the follow activities explained in the different phases:

Requirements Planning – is a phase in which users and analysts identify an application's or system's objectives. Information requirements from such objectives can also be identified through this phase. It is not about participants endorsing a proposal or document, it involves intense engagement between both groups.

Prototyping – This phase requires building, rebuilding, fixing, and refining the developed system using feedback from IT experts.

Testing - There are four phases of software testing: unit, integration, system, and acceptance. However, these four stages can be divided into verification stages (the first two) and validation stages (the last two).

Cutover – the SDLC implementation phase's final activities that involve data conversion, testing new systems, changeover to the new system, and training end-users. The entire process is condensed compared to traditional approaches, though. Therefore, the new system was constructed, delivered, and commissioned much earlier.

B. Research Design

Locale of the Study

This study will take place in Bacolod City, Negros Occidental, Philippines. Specifically, the main participants will be the local community, food establishments, and NGOs.

Sample Size

Table 1.0: Sample Size

Participant	Population
Local Community	23
Food Establishments	5
NGOs	2
Total Sample Size	**30**

Sampling Technique

The researcher will gather data for food establishments and NGOs using the purposive sampling technique while for the local community the researcher will use the convenient sampling technique.

Respondents of the Study

The main participants of this study are the local community, food establishments, and NGOs.
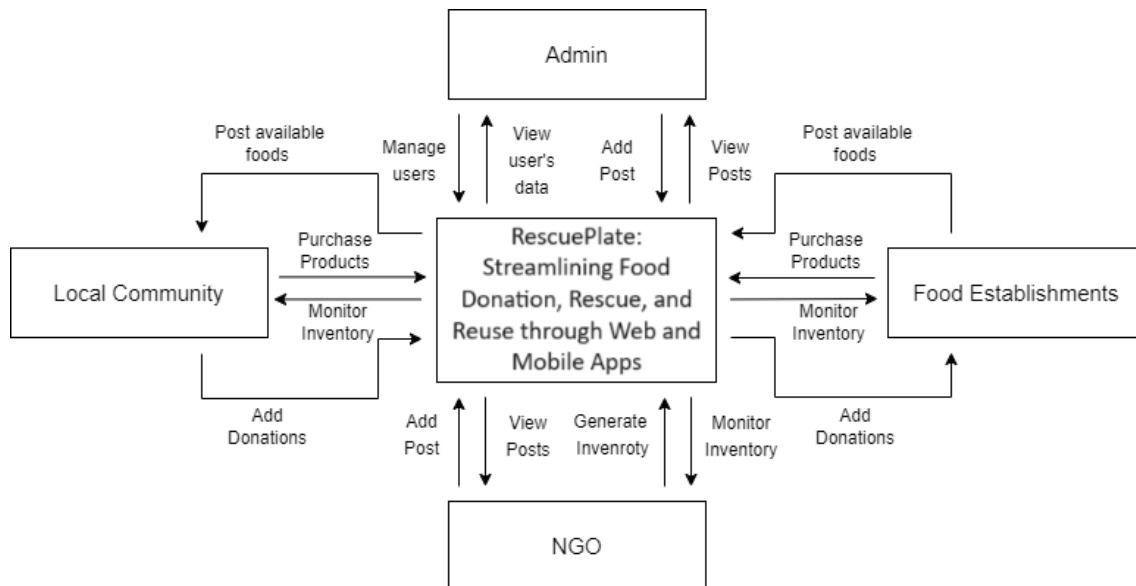
Research Instrument

The researcher will use both self-made and standard instruments to gather data and to evaluate the developed system.

Reliability and Validity of Research Instrument

The questionnaires will be duly reviewed and validated by three (3) experts using the Carter V. Good and Douglas F. Scates tool for validating and evaluating the questionnaires.

The self-made questionnaire will undergo a reliability test with a group of thirty (23) residents of Bacolod City, Negros Occidental.

Data Gathering Procedure

The proponent will use different data gathering tools that will help gather relevant information to achieve the goal of the proposed study. Here are the data gathering tools:

1. Observation. The researcher will conduct observations to review the processes of food waste management in the local community and food establishments.
2. Interview. The researcher will conduct interviews with the stakeholders, including the local community, food establishments, and NGOs.
3. Internet Research. The researcher will gather additional information through the internet related to the study.
4. Survey Questionnaire. The proponent will provide surveys to all the users of the system for them to comment on or write about the needs and not needs of the system that will be developed.

Data Analysis Procedure

The data that will be collected will be analyzed using the mean and grand mean with corresponding verbal interpretations.

Context Flow Diagram

Figure 2. Context Flow Diagram

Figure 2 shows how the researcher maps out how the entire system's features and components will work together according to its purpose

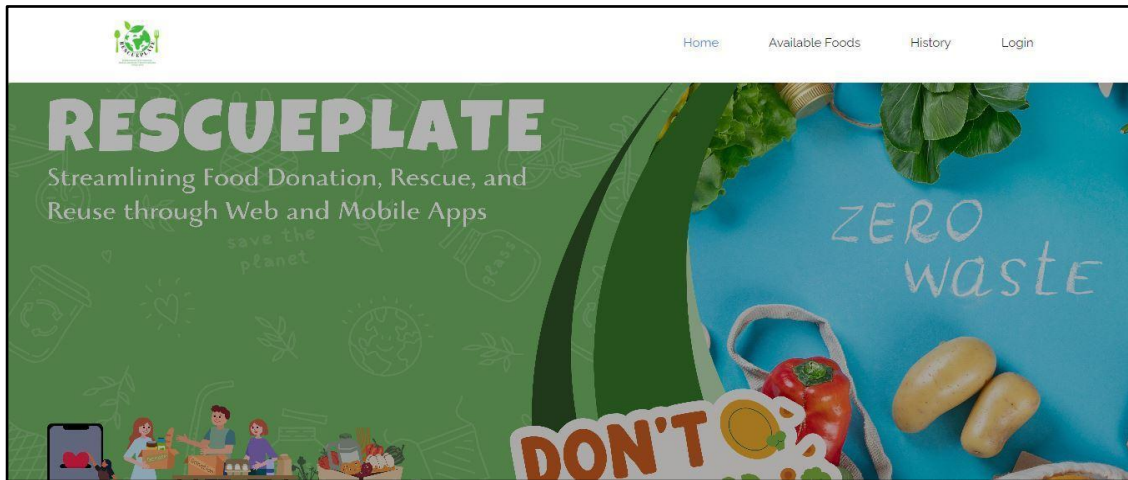**RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps Screenshots**

Figure 3. Webpage of RescuePlate

Figure 3 shows how the RescuePlate platform works through a user-friendly website, which aims at simplifying food donation, rescue and reuse via both web and mobile applications. The homepage is where users can navigate to different parts of the site including real-time food donations (which are listed under "Available Foods"), and track their past donation and rescuing activities in time ("History"). With this in mind, it is easier for users to find any relevant information about this organization.

For registered users there is an option of secure login in order to get involved into the system. In addition to these materials, there are also useful suggestions on how people may reduce food wastage and promote sustainable consumption habits contained in the "Tips to Reduce Waste" section. It offers an integrated way that makes it accessible for anyone who needs a tool to enhance his life with regard to food sustainability and waste minimization.
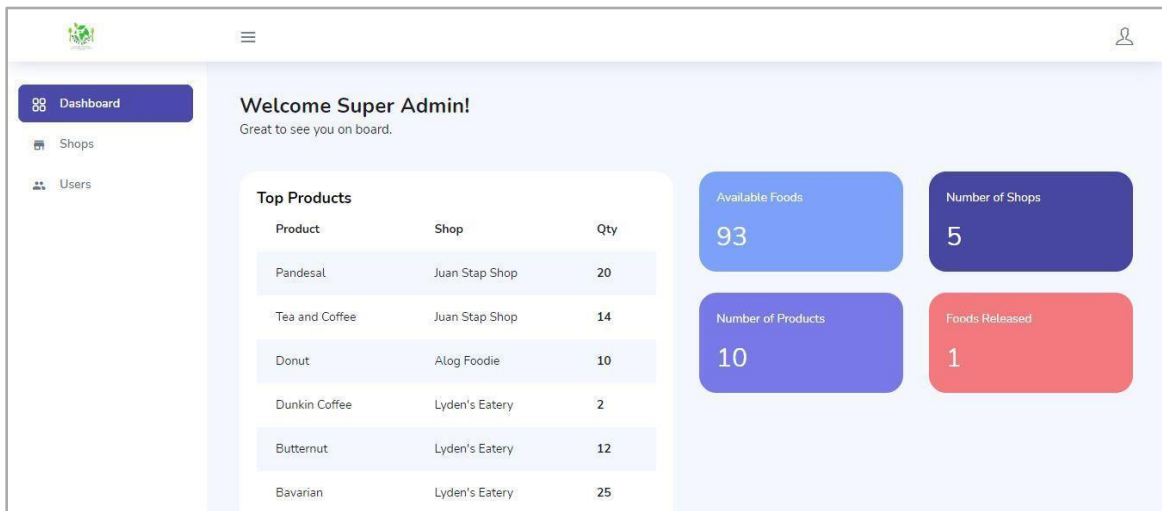

Figure 4. Super-admin Account Web App

Super-admin page on the web, as shown in figure 4, is a means to centrally control an environment aimed at enabling people to donate and get food. The sections here consist of top products given, available food in time; number of partnering shops; and tracking of product or release of food items. This Super-admin position enables managing shops and accounts for

efficient sharing of resources thus making donation processes easy and improving effectiveness in community engagement through better management of food rescue operations. To support decision-making information visibility and the platform's performance optimization, this interface gives priority to user-friendliness through data display.

Page 261
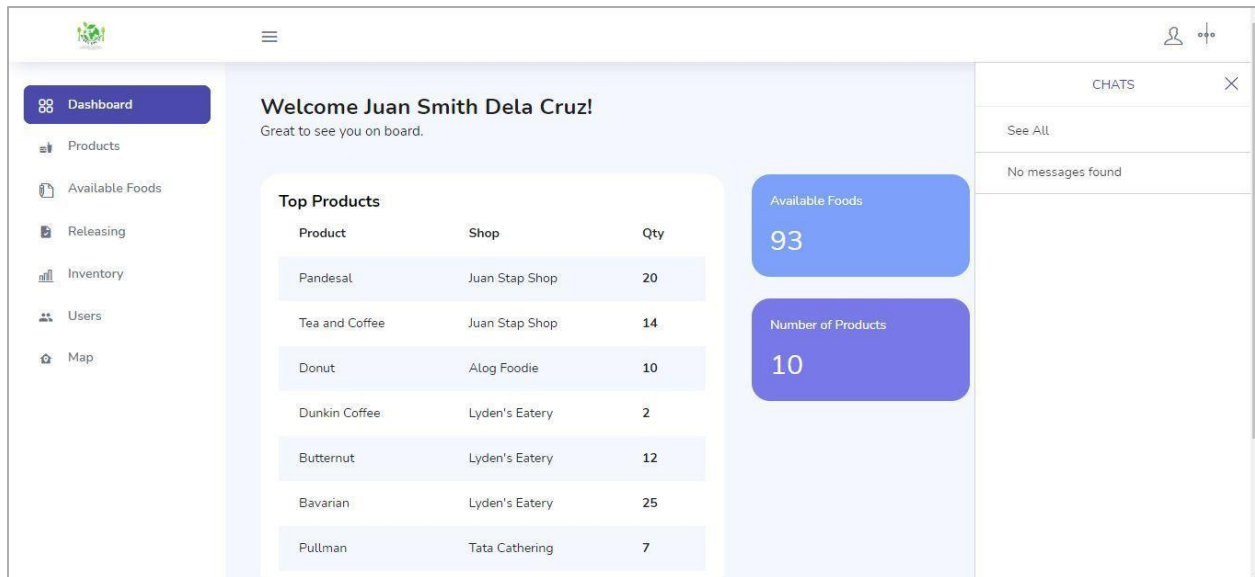
Figure 5. *Store Account Web App*

Figure 5 represents the store account interface in the RescuePlate web app that has tools for managing inventory and engaging users. Participating stores can chat with donation interested individuals, list top items on the front page, and manage their donation stocks. They are able to directly offer food donations to users as well as receive expiry alerts of approaching items that may result in waste. The stores part of this initiative also has capacity to manage users while a map display helps in planning how donations will be distributed. Summarily, it is through figure 5 that efficient operation and impactful engagement become possible for all stores involved in donating through the RescuePlate app.
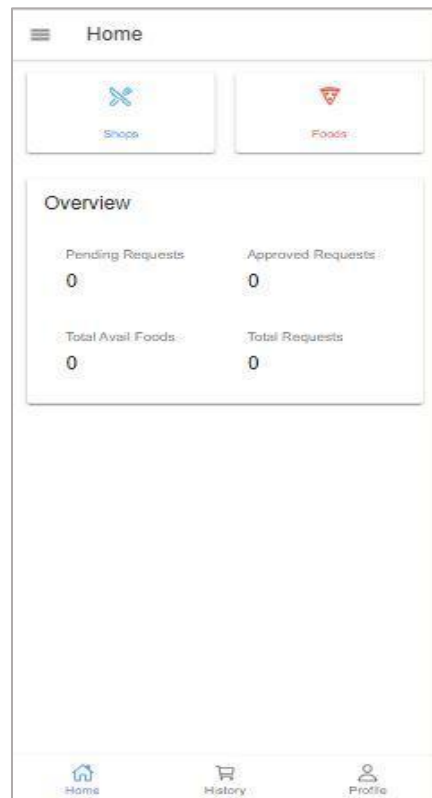
Figure 6. *RescuePlate Mobile App*

Figure 6 showcases the RescuePlate mobile app interface, allowing users to easily access donation opportunities, explore local shops, and request available food items. The application allows users to browse through and get donations straight from contributors, to contact stores near them giving out some and select the food items that one would like to ask or receive. The home page provides an overview of the pending and approved requests, total foods available and requests made thus helps users understand donation activities taking place. This sidebar navigation makes it easier for people going through all the pages by offering Home, History and Profile shortcuts, hence providing smooth interactions with the app's functionality. In short Figure 6 provides a means by which individuals can become involved in donation activities as well as have easy access to basic food sources via an intuitive mobile platform.

RESULT AND DISCUSSION

Table 2.0: In terms of managing food waste donation.

	Mean	**Verbal Interpretation**
The system can manage food products.	4.6	Very Good
The system can manage the donation of food waste.	4.5	Very Good
The system can manage the availing of food waste.	4.6	Very Good
The system can provide notifications for available food waste.	4.0	Good
Total	**4.44**	**Very Good**

Table 2.0 shows the result of user's feedback on RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps in terms of managing food waste donation that enables them to manage food products, manage donation of food waste, and manage the availing of food waste with a mean value rating of 4.44 which is interpreted as Very Good.

Table 3.0: In terms of filtering the user's profile as to donation, request, and foods availed.

	Mean	**Verbal Interpretation**
The system can filter donations per user.	4.86	Very Good
The system can filter requests per user.	4.66	Very Good
The system can filter availed foods per user.	4.76	Very Good
Total	**4.76**	**Very Good**

Table 3.0 shows the result of user's feedback on RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps in terms of filtering user's profile as to donation, request, and foods availed that enables them to filter donation per user, filter requests per user, and filter availed foods per user with a mean value rating of 4.76 which is interpreted as Very Good.

Table 4.0: In terms of displaying a map of available food waste.

	Mean	Verbal Interpretation
The system can display a map with available food wastes.	4.06	Good
The system can update the map if no food wastes are available.	4.06	Good
The system can allow users to set pickup locations on the map for food waste donations.	4.06	Good
Total	**4.06**	**Good**

Table 4.0 shows the result of user's feedback on RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps in terms of displaying map of available food waste which allows them to view the displaying of map with available food wastes, view the updated map if there is no available food waste, and set pickup locations on the map for food waste donation with a mean value rating of 4.06 which is interpreted as Good.

Table 5.0: In terms of generating food inventory for households or businesses.

	Mean	Verbal Interpretation
The system can display inventory of foods for households or businesses.	4.6	Very Good
The system can display expiring foods.	4.8	Very Good
Total	**4.7**	**Very Good**

Table 5.0 shows the result of user's feedback on RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps in terms of generating food inventory for households or businesses which allows them to display inventory of foods for households or businesses and can display expiring foods with a mean value rating of 4.7 which is interpreted as Very Good.

Table 6.0: In terms of developing a mobile application that will allow registered users to donate, avail, or request foods and receive notifications, announcements, and tips for reducing food waste.

	Mean	Verbal Interpretation
The mobile application allows users to avail foods.	5	Very Good
The mobile application allows users to request food.	4.83	Very Good

The mobile application allows users to receive notifications for available food waste.	4.53	Very Good
The mobile application allows users to receive and view announcements regarding food wastes.	4.43	Very Good
The mobile application allows users to receive and view tips regarding food wastes.	4.63	Very Good
Total	**4.68**	**Very Good**

Table 6.0 shows the result of user's feedback on RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps in terms of developing a mobile application that will allow registered users to donate, avail, or request foods and receive notifications, announcements, and tips for reducing food waste which allows them to donate, avail, or request food waste and receive notifications, announcements, and tips regarding food wastes with a mean value rating of 4.68 which is interpreted as Very Good.

In terms of Functional Usability, the web application is versatile primarily because it runs on any web browser and is easy to navigate through the use of the mouse. The minimum required android version for the mobile application to function perfectly is API level 20 Android version 5.0 (Lollipop) while the target version is API level 29 Android version 10 (Android Q).

In terms of Performance efficiency, the system runs and processes the data faster because it runs on its cloud-based web server and uses a MySQL database which can store a big amount of data in the system. The use of server-side scripting programming languages like PHP, AJAX, and JavaScript makes the system compatible with other operating systems like Mac OS and Linux operating systems which can run with little or no modification on its code.

In terms of Security, the system is very secure because it uses various validation checks to make sure the user will give only valid input information to the system. The system also has a login page which only allows authorized users to gain access to the system and restrict unauthorized users.

Furthermore, the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps is very portable and can be accessed through android phones. The system can also be accessed through any web browsers which most users are already familiar with. The other benefit is that the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps is a cloud-based server; users can access the system anywhere and anytime using any device including computers, laptops, or smartphones as long as they have internet access.

Table 7.0: In terms of the characteristics set in ISO 25010 Software Quality Model.

Criteria	Mean	Verbal Interpretation
Functional Suitability	4.7	Very Good
Performance Efficiency	4.7	Very Good
Compatibility	4.83	Very Good
Usability	4.3	Good
Reliability	4.43	Good

Security	4.53	Very Good
Maintainability	4.53	Very Good
Portability	4.43	Good
Total	**4.55**	**Very Good**

Table 7.0 shows the result of the IT Experts' feedback in determining the quality of the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps based on the characteristics set in the ISO 25010 Software Quality Model.

In terms of Compatibility, it was rated 4.83, which is interpreted as Very Good. With regards to Functionality

Suitability and Performance Efficiency it was rated 4.7, which is interpreted as Very Good. With regards to Maintainability and Security, it was rated 4.53, which is rated as Very Good. With regards to Portability, it was rated as 4.43, which is interpreted as Good. With regards to Usability, it was rated as 4.3, which is interpreted as Good.

Table 8.0: In terms of usefulness, satisfaction, and ease of use and learning.

Criteria	**Mean**	**Verbal Interpretation**
Usefulness	4.76	Very Good
Satisfaction	4.7	Very Good
Ease of Use	4.86	Good
Ease of Learning	4.63	Good
Total	**4.74**	**Very Good**

Table 8.0 shows the result of the users' feedback in determining the usability of the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps based on usefulness, satisfaction, and ease of use and learning.

In terms of Ease of Use it was rated as 4.86, which is interpreted as Very Good. In terms of Usefulness, it was rated as 4.76, which is interpreted as Very Good. In terms of Satisfaction, it was rated as 4.7, which is interpreted as Very Good. In terms of Ease of Learning, it was rated as 4.63, which is interpreted as Very Good.

CONCLUSION

In the light of the findings of the study, the researcher concludes that, based on the thorough evaluation of the experts and respondents, the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps has functional suitability, performance efficiency and with high compatibility, usability, reliability, security, maintainability, and portability. The system is very useful, provides satisfactory features, and is easy to use and learn.

The RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps enables users to efficiently manage food donations, filter user's profile as to donation, requests, and foods availed, display a map of

available food wastes, generate inventory for households or businesses, and comes with a mobile application to donate, avail, or request foods and receive notifications, announcements, and tips for reducing food wastes. With the system, food waste can be reduced and eliminated with the participation of local communities, NGOs, food establishments, and other entities.

RECOMMENDATION

Based on the findings and conclusions drawn, the following recommendations are put forward:

1. The RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps is recommended to improve the notifications for available food waste as it was only rated with 4.03 which is interpreted as Good.

2. Improve the displaying a map of available food waste as it was only rated with 4.06 which is interpreted as Good.

3. Further, it is also recommended that a similar study may be conducted to improve the RescuePlate: Streamlining Food Donation, Rescue, and Reuse through Web and Mobile Apps and the effectiveness of the presented solutions.

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