

Mini-Project Report On

Feed Forward (A Food Donation Application)

*Submitted in partial fulfillment of the requirements for the
award of the degree of*

Bachelor of Technology
in
Computer Science & Engineering

By
Nekha S Thomas (U2003149)
Pooja Menon (U2003160)
Sayujya Salim (U2003189)

Under the guidance of
Ms. Jomina John



**Department of Computer Science & Engineering
Rajagiri School of Engineering and Technology (Autonomous)
Rajagiri Valley, Kakkanad, Kochi, 682039**

July 2023

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
RAJAGIRI SCHOOL OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
RAJAGIRI VALLEY, KAKKANAD, KOCHI, 682039**



RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

CERTIFICATE

*This is to certify that the mini-project report entitled "**Feed Forward (A Food Donation Application)**" is a bonafide work done by **Ms. Nekha S Thomas (U2003149)**, **Ms. Pooja Menon (U2003160)** and **Ms. Sayujya Salim (U2003189)**, submitted to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Computer Science and Engineering during the academic year 2022-2023.*

Dr. Preetha K. G.
Head of Department
Dept. of CSE
RSET

Ms. Anita John
Mini-Project Coordinator
Asst. Professor
Dept. of CSE
RSET

Ms. Jomina John
Mini-Project Guide
Asst. Professor
Dept. of CSE
RSET

ACKNOWLEDGEMENTS

We wish to express our sincere gratitude towards **Dr. P. S. Sreejith**, Principal of RSET, and **Dr. Preetha K. G.**, Head of Department of Computer Science and Engineering for providing us with the opportunity to undertake our mini-project, "Feed Forward App".

We are highly indebted to our mini-project coordinators, **Ms. Anita John**, Assistant Professor, Department of Computer Science and Engineering and **Mr. Sajanraj T D**, Assistant Professor, Department of Computer Science and Engineering for their valuable support.

It is indeed our pleasure and a moment of satisfaction for us to express our sincere gratitude to our mini-project guide **Ms. Jomina John**, for her patience and all the priceless advice and wisdom she has shared with us.

Last but not the least, we would like to express our sincere gratitude towards all other teachers and friends for their continuous support and constructive ideas.

Nekha S Thomas

Pooja Menon

Sayujya Salim

ABSTRACT

Feed Forward is an innovative food donation app dedicated to addressing food insecurity and promoting sustainable food practices. Through seamless connections among donors, volunteers, and recipients, the app facilitates efficient distribution of surplus food to those in need. Donors can effortlessly create donation sessions, specifying food items, quantities, and pickup locations. Volunteers can view nearby sessions and accept or decline based on availability. Real-time tracking allows donors to monitor delivery progress until food reaches recipients. With its user-friendly interface and food safety focus, Feed Forward aims to create a positive impact, encouraging a giving culture while minimizing food wastage. Employing advanced technologies like Flutter for front-end and PHP with MySQL for back-end, the app ensures a secure and user-friendly experience.

Contents

Acknowledgements	ii
Abstract	iii
List of Figures	vi
1 Introduction	1
1.1 Background	1
1.1.1 Food Donation	1
1.2 Existing System	2
1.3 Problem Statement	2
1.4 Objectives	2
1.5 Scope	3
2 Literature Review	4
2.1 Online food delivery: A systematic synthesis of literature and a framework development	4
2.2 AAHAR App	7
2.3 Construction of a service quality scale for the online food delivery industry	8
3 System Analysis	13
3.1 Expected System Requirements	13
3.2 Feasibility Analysis	13
3.2.1 Technical Feasibility	13
3.2.2 Operational Feasibility	13
3.2.3 Economic Feasibility	13
3.3 Hardware Requirements	14
3.4 Software Requirements	14
3.4.1 Android Studio	14

3.4.2	Flutter	14
3.4.3	Figma	15
3.4.4	Visual Studio Code (VSCode)	15
3.4.5	MySQL	15
4	Methodology	16
4.1	Proposed Method	16
4.1.1	Donation sessions	17
5	System Design	21
5.1	Architecture Diagram	21
5.2	Sequence diagram	22
6	System Implementation	23
6.1	User Module	23
6.2	User Interface (UI) Module	24
6.3	Backend Module	24
6.4	Volunteer Module	24
6.5	Admin Module	24
7	Results	26
8	Risks and Challenges	32
9	Conclusion	33
References		34
Appendix A: Base Paper		34
Appendix B: Sample Code		41
Appendix C: CO-PO and CO-PSO Mapping		60

List of Figures

2.1	Aahar App	7
4.1	Program Flow	18
5.1	Architecture diagram	21
5.2	Sequence Diagram	22
6.1	Module Division	23
7.1	Tracking Donation	26
7.2	Home Page	26
7.3	Sign In Page	27
7.4	Profile	27
7.5	Sign Up Modes	28
7.6	Forgot Password	28
7.7	Donor Sign up	29
7.8	Volunteer Activation	29
7.9	Admin View	30
7.10	Sign In Success	30
7.11	Database Tables	31

Chapter 1

Introduction

1.1 Background

1.1.1 Food Donation

Food donation is an invaluable act of kindness that not only addresses the pressing issue of hunger but also plays a crucial role in reducing food waste and promoting sustainability. Millions of people around the world suffer from food insecurity, while vast amounts of edible food are discarded daily. Through food donation initiatives, surplus food is redirected from businesses, households, and farms to those in need, ensuring that nutritious meals reach those facing hunger and hardship. Food donation initiatives have a profound impact on the lives of vulnerable individuals and communities. By providing nutritious meals, food donations alleviate hunger, improve health, and enhance overall well-being. Families experiencing financial constraints, homeless individuals, and disaster-affected communities all benefit from the generosity of food donors.

Beyond alleviating hunger, food donation efforts have a positive effect on the environment. When edible food is discarded, it not only wastes valuable resources such as water, land, and energy used in production but also contributes to greenhouse gas emissions when it decomposes in landfills. By diverting food from landfills, food donation helps reduce the environmental burden and aligns with the principles of sustainable consumption.

Despite the positive impact of food donation initiatives, there are challenges to overcome. Logistics, transportation, and food safety regulations are crucial factors that require careful consideration to ensure efficient and safe food distribution.

Opportunities for collaboration between governments, businesses, and non-governmental organizations can lead to more effective food donation systems. Investing in technology and data analytics can optimize food rescue efforts, minimize food waste, and improve

resource allocation.

Food donation is not merely an act of charity; it is a pathway towards a more equitable and sustainable world. Through food donation initiatives, we can address both the immediate needs of the hungry and the broader issue of food waste. Every plate of rescued food not only nourishes bodies but also nurtures hope and compassion. Together, let us continue to support and expand food donation efforts, bridging the gap between abundance and need, while striving for a future where no one goes to bed hungry.

1.2 Existing System

The Robin Hood Army is a volunteer-based organization that operates across various cities in India. They have a mobile app that allows volunteers to register and participate in food rescue and distribution activities. Feeding India is a non-profit organization that runs a food donation app, connecting donors like restaurants, caterers, and individuals with NGOs and charitable organizations. The app enables users to donate surplus food, and their team ensures the efficient redistribution to those in need.

1.3 Problem Statement

To create a food donation application that serves as an interface between donors searching for a channel to donate to the needy without wasting the surplus food.

1.4 Objectives

- **Reduce Food Wastage:** One of the primary objectives of the app is to significantly reduce food wastage. By connecting surplus food donors with those in need, the application ensures that edible food that would otherwise go to waste finds its way to individuals facing hunger or food insecurity. Through efficient logistics and real-time tracking, the app optimizes food rescue efforts, diverting surplus food from landfills and redirecting it to charitable organizations or food banks. By minimizing food wastage, the app plays a vital role in promoting sustainable consumption practices and environmental preservation.
- **Counter Poverty and Hunger:** Another key objective of the app is to address

poverty and hunger in communities. By providing nutritious meals to individuals and families in need, the application directly contributes to alleviating hunger and improving food security. It acts as a lifeline for vulnerable populations, including low-income families, homeless individuals, and disaster-affected communities. The app's focus on redistributing surplus food ensures that nutritious meals reach those who might otherwise struggle to access sufficient food resources, thus making a significant impact in the fight against poverty and hunger.

- **Nurture a Sense of Togetherness:** Beyond its functional goals, the app aims to foster a sense of togetherness and community engagement. By bringing together donors, volunteers, and recipients, the application promotes a culture of giving and compassion. It creates a shared purpose where individuals and businesses collaborate to tackle food insecurity, irrespective of socioeconomic backgrounds. The sense of togetherness nurtured by the app encourages people to actively participate in the fight against hunger, thereby strengthening community bonds and generating a collective impact in creating a more inclusive and caring society.

1.5 Scope

The food donation application holds a significant scope as it expands outreach to connect surplus food donors, volunteers, and recipients across diverse communities, thus effectively addressing food insecurity and wastage on a larger scale. By fostering partnerships with businesses and non-profit organizations, implementing innovative technologies, and promoting responsible food practices, the app can drive social change and create a more sustainable future. Scaling its impact through careful planning and continuous improvement, the application has the potential to become a powerful tool in the fight against hunger, supporting policy initiatives and inspiring a culture of giving and compassion, where surplus food is maximized to alleviate hunger and minimize food waste.

Chapter 2

Literature Review

2.1 Online food delivery: A systematic synthesis of literature and a framework development

The thin margin is one of the predominant characteristics affecting the restaurant industry, and hence, restaurant operators tend to seek opportunities to increase their profit and market share (Rivera, 2019). One such opportunity is development of food delivery system (Kimes, 2011). Food delivery space has witnessed several technological advancements and triggered consumer demand which attracted both restaurants and third parties to deliver foods (Muller, 2018). Restaurants may deliver food items using their own website/application (e.g. Domino's, Pizza Hut and KFC) or via third party aggregators (e.g. Foodpanda, Swiggy, Zomato and Uber Eats). Development of e-commerce has largely contributed to changing food consumption patterns, and more and more consumers prefer to use online platforms to order foods (Hwang et al., 2019a). Online food delivery has emerged as a popular trend in e-commerce space, and serves as a tool to reach a larger number of consumers in a cost effective manner (Ray et al., 2019).

Online food delivery (OFD) refers to online channel that consumers use to order food from restaurants and fast-food retailers (Elvandari et al., 2018). In OFD system, consumers have a better choice in terms of restaurants and food items (Pigatto et al., 2017). By adopting OFD, restaurants and fast-food retailers can increase their reach among consumers in a cost-effective manner while consumers can order the meal of their choice without spending much time and efforts (Ray et al., 2019). In the recent past, OFD has witnessed several technological advancements. For instance, restaurants have transitioned from offline into online platforms by developing their own websites and allowing customers to order food using restaurants' own website (Yeo et al., 2017). Further, due to the increasing use of smartphone applications, restaurants have launched their apps which also

serve as online food ordering platforms for consumers (Ray et al., 2019). However, due to operations and/or financial reasons, not all restaurants use their own delivery channels for food delivery (Hwang et al., 2020). Hence, restaurants opt for third-party platforms and food aggregators to facilitate online food delivery, helping them to reach out to a wider market in a cost-effective manner (Williams et al., 2020). Foodpanda, Swiggy, Zomato and Uber Eats are a few examples of third-party food delivery platforms (Lo et al., 2020). However, such platforms, i.e., third-party food delivery services, are normally limited to metro cities. Thus, to geographically expand the availability of OFD services, restaurants opted for AI and drone-based channels for food delivery, another form of OFD (Hwang et al., 2021). Accordingly, all the above indicated platforms, such as OFD, online to offline delivery, mobile application-based food delivery, and drone-based food delivery are classified as OFD services.

In the recent years, OFD has recorded an exponential growth. According to “Online Food Delivery Services Global Market Report 2020–30”, the global OFD market is expected to grow from 107.44 billion dollars in 2019 to 154.34 billion dollars in 2023, at an annual growth rate of 11.51percent. The above statistics indicate an enormous potential for the growth of OFD system, a factor triggering the research on the OFD from multifarious perspectives, using various conceptualisations and methods. Although several studies exist on OFD, the literature on this domain is fragmented (Ray et al., 2019). That is, the literature reports various psychological, sociological, and contextual factors driving consumers’ intention to adopt OFD. However, the findings of the previous studies are inconsistent and fragmented which limit a comprehensive understanding of factors affecting customer responses to OFD. Moreover, in the extant literature, several theories were used to underpin OFD research, thus presenting a fragmented outlook on underpinning theories used in the OFD context. Hence, the extant literature needs to be reconciled to propose a synthesised perspective on theoretical development in the OFD phenomenon. Lastly, OFD industry evidenced several technological advancements ranging from website to, mobile application, drone, and AI. In the extant literature, studies attempted to investigate the role of technology in delivering food items and how consumers respond to different OFD platforms. However, studies carried out on different technological platforms and facets of OFD were not synthesised to show the future technological trajectory of OFD.

Considering the extent and diversity of prior research on OFD, researchers are likely to be benefitted from a focused discussion of current dynamics of OFD research. The above discussion indicates that OFD literature needs to be synthesised to show various factors driving intention to adopt OFD, various theoretical underpinnings of OFD research and different technological platforms and facets of OFD. Such a synthesis is a need of the hour to map current growth of OFD research and to provide avenues for future research in this domain (Khanra et al., 2020, Dhir et al., 2020). Systematic literature reviews can provide a valuable summarization of current knowledge in a domain (Aznoli and Navimipour, 2017, Talwar et al., 2020) and allow for the identification of gaps to provide avenues for future research in the domain (Gopalakrishnan and Ganeshkumar, 2013, Dhir et al., 2020). Hence, this research adopts the structured literature review (SLR) method to undertake a systematic assessment and a comprehensive analysis of extant literature on OFD to identify some insightful gaps that advance the research on OFD.

Accordingly, we propose the following research objectives. The first objective is to analyse the development of the OFD literature over the years. The second objective is to propose a conceptual framework of OFD based on the synthesised literature on this domain. The third and the final objective is to provide avenues for future research by pointing out the gaps in the extant OFD literature. To achieve the abovementioned objectives, the current study adopted Paul and Criado's (2020) process of conducting systematic literature review. Paul and Criado's (2020) process of conducting SLR is considered a more comprehensive approach to doing SLR because it enables researchers to synthesise literature in four key areas, i.e., theories, characteristics, contexts, and methods (TCCM). Given that OFD literature is fragmented in terms of theories used and characteristics (i.e. factors affecting customer responses to OFD and technological platforms used in OFD), Paul and Criado's (2020) process of conducting systematic literature review seems more appropriate than other SLR approaches. Further, due to the rigour and comprehensiveness, many scholars have recommended following Paul and Criado's (2020) approach to provide an insightful synthesis of the literature (e.g., Jebarajakirthy et al., 2021; Mishra et al., 2021). Hence, this SLR follows Paul and Criado's (2020) approach to provide a deeper understanding of the OFD phenomenon and a comprehensive review of the literature on OFD.

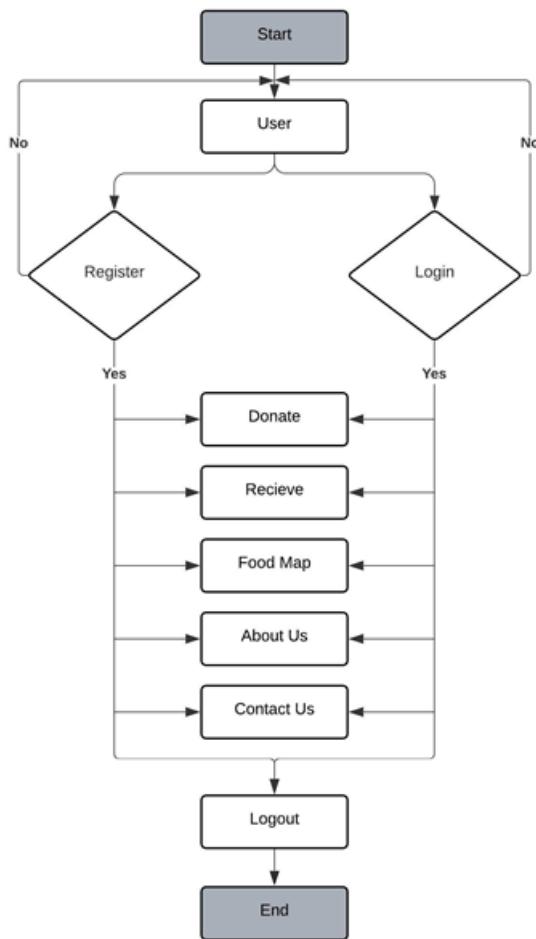


Figure 2.1: Aahar App

2.2 AAHAR App

'Aahar' a social platform that brings together volunteers and donors interested in donating food. Aimed at eliminating food wastage, 'Aahar' is a unique concept started in Indore.

Basic objective of 'Aahar' involves –

Using excess cooked food to feed the hungry and needy Connecting individuals interested in procuring as well as donating food at different establishments. With a network of individuals and community organizations, 'Aahar' is helping distribute food to those who really need it. Sign in to the app is just by using an otp verification and is not that secure to use just by a phone number. The volunteers are also not verified using a valid identity card of vehicle and user details which might cause a problem in the future .

2.3 Construction of a service quality scale for the online food delivery industry

With the development of Internet technology, the popularity of smart phones, the busyness of people, and changes of lifestyles, the online food delivery (OFD) market is flourishing (Yeo et al., 2017, Cho et al., 2019). The output value of the global OFD market was USD 82 billion in 2018 and is anticipated to be USD 200 billion by 2025 (Frost and Sullivan, 2019). However, in 2020, the global hospitality industry was hard hit by the COVID-19 pandemic and experienced a significant decline in performance. In contrast, the OFD industry has grown rapidly due to the COVID-19 pandemic and the turnover of the global OFD industry has increased by about 140 percent (Popper, 2020). According to the estimation of Statista (2020), the revenue of the OFD industry in 2020 is about USD 51.51 billion in China and about USD 26.53 billion in the United States. Taiwan's OFD industry is also growing rapidly. The output value of Taiwan's OFD market reached USD 1 billion in 2019 and will increase to USD 1.7 billion in 2021 (Lee and Chen, 2019).

Service quality is an important factor to gain competitive advantages in the food and beverage (FB) industry (Kim et al., 2009, Cheng et al., 2012, Cheng et al., 2019a). The PZB model proposed by Parasuraman et al. (1985) is an important theory of service quality research and according to this model, the company's operator must determine the deficiency in service quality. OFD is an industry dedicated to assisting customers in providing food delivery services (Banerjee et al., 2019, Chandrasekhar et al., 2019) and in recent years, with the continuing vigorous development of the industry, its service quality has also attracted the attention of many consumers (Banerjee et al., 2019, Suhartanto et al., 2019, Annaraud and Berezina, 2020). OFD service quality has often been ignored by operators in the past, resulting in a decrease in customer satisfaction and consumer intention (Chen, 2016). OFD service quality positively influences customer satisfaction and loyalty (Annaraud and Berezina, 2020, Saad, 2020, Yusra and Agus, 2020), hence, in the fiercely competitive OFD market, all food delivery service factors are important connotations of OFD service quality, and must be effectively measured and continually improved by operators (Banerjee et al., 2019, Cho et al., 2019, Annaraud and Berezina, 2020). According to the resource-based theory (RBT), corporate resources shall be effectively allocated to create competitive advantages (Grant, 1991). In order to improve

OFD service quality and shape service quality advantages, it is necessary to identify the deficiencies in service quality and allocate the most appropriate resources based on the PZB model and RBT. Thus, how to effectively measure OFD service quality will be the top priority.

According to the relevant literature in the past, in order to effectively evaluate the service quality of different types of FB industries or identify their service deficiencies that need to be improved, the use of an accurate and appropriate “service quality scale” is the first and necessary prerequisite (Kim et al., 2009, Markovic’ et al., 2010, Cheng et al., 2012, Chen, 2014, Tsai and Lin, 2014, Cheng et al., 2019a). Therefore, many types of restaurant service quality scales (such as DINESERV, GRSERV and LRSERV etc.) have been constructed by scholars (Stevens et al., 1995, Kim et al., 2009, Markovic’ et al., 2010, Chen et al., 2015, Cheng et al., 2019a). However, OFD involves multiple service factors, including meal quality and hygiene, service convenience, the functional attributes of ordering systems, tangible service, professional deliverymen and service efficiency (Fancelllo et al., 2017, Cho et al., 2019, Roh and Park, 2019). This shows that the importance of OFD service quality is self-evident and these service factors are also related to the FB industry, home delivery industry and web services. Hence, OFD service quality cannot be solely evaluated by the service quality scale of dinner service (DINESERV), home delivery service (HD-SERV), web service (E-S-QUAL and E-RecS-QUAL) or mobile service (M-S-QUAL). Through the review of studies on OFD service quality, some scholars (Banerjee et al., 2019, Cho et al., 2019, Annaraud and Berezina, 2020, Yusra and Agus, 2020) have explored OFD service quality, but their OFD service quality questionnaires have mostly focused on the service quality of the OFD ordering system or App, such as the efficiency, privacy, fulfillment, responsiveness, contact, system availability, service convenience and customer service of the OFD ordering system or App, and they rarely adopted rigorous and in-depth research procedures to develop questionnaire items. In practice, in addition to the ordering system, many service disputes and customer complaints often occur in the process of food delivery services, including interaction between deliveryman and customer (Chen, 2016, i-Buzz research, 2020, Yang and Xie, 2020) and maintenance of meal quality (Ghosh, 2020; Wu, 2019). However, the above-mentioned service quality attributes have not been effectively and completely evaluated by previous scholars in the OFD service quality questionnaire surveys (Banerjee et al., 2019, Annaraud and Berezina,

2020, Yusra and Agus, 2020). Based on the above-mentioned literature, the questionnaire items on OFD service quality proposed by previous scholars cannot completely meet the multi-service characteristics of the current OFD industry. In the past, few scholars have discussed how to effectively evaluate OFD service quality, and there are few service quality scales suitable for evaluating OFD service quality in the academic field, which is a major gap in the studies on OFD. This shows that it is necessary to construct a useful evaluation scale based on the service characteristics of OFD to accurately evaluate OFD service quality, and serve as a reference for the OFD industry to improve service quality. If this study can construct an effective OFD service quality scale and extract the important and meaningful service quality attributes of OFD, it will enable OFD operators to accurately understand the advantages and disadvantages of service quality, grasp the direction of service quality improvement, and properly allocate service resources. In addition, if an effective OFD service quality scale can be constructed, then future researchers will have a suitable evaluation tool to conduct in-depth research on OFD service quality, so that the research results have better research validity. This is the first research motivation.

Traditionally, the service quality scales in the hospitality industry are mostly developed through qualitative and quantitative methods (Kim et al., 2009, Hahn et al., 2017, Cheng et al., 2019a). With the popularity of online communities and media as well as the rapid spread of information, customer attitudes towards OFD service are widely discussed and exposed in online communities, blogs or media (Daily View, 2019). The information may imply key factors of OFD service that consumers consider important or even the important basis for improving OFD service quality, but may not be able to be extracted from the previous literature (Cheng et al., 2019b). With the popularity of e-commerce and online communities, the data of online communities or system platforms can be rearranged by Internet Big Data Analytics (IBDA) to extract valuable information, and enterprises can make the best decisions by referring to the information (Wu and Ma, 2017). In addition, IBDA can extract the current important service quality attributes of various service industries from online communities and media, and even some of those service quality attributes that are ignored in past literature. It can be seen that in addition to the traditional qualitative and quantitative research procedures, the results of IBDA are also suitable as a reference for constructing a service quality scales (Cheng et al., 2019b). However, as the OFD market has developed rapidly along with online communities and

media, previous scholars have rarely used IBDA for OFD research or development of OFD service quality questionnaires, which is a research gap in OFD. If the “key service factors for OFD” which are extracted from online communities and media by IBDA can be used to develop OFD service quality items in the process of qualitative and quantitative research for constructing the OFD-SERV scale, this will be more in line with OFD consumer needs and industry trends. This is the second research motivation.

Many scholars have discussed the relationship between service quality, customer satisfaction and loyalty in the FB industry (Kim et al., 2009, Wu and Cheng, 2018). In recent years, some scholars have discussed the influence of OFD service quality on customer satisfaction and loyalty (Annaraud and Berezina, 2020, Saad, 2020, Yusra and Agus, 2020). However, these OFD service quality items in the above-mentioned related literature are not designed through rigorous research procedures, nor can they fully reflect the multi-service attributes of OFD. Therefore, the relationship between OFD service quality, customer satisfaction and loyalty may not be verified, which is also a research gap in OFD. Once the OFD-SERV scale to be constructed in this study is completed, it is necessary to re-verify the influence of OFD service quality on customer satisfaction and loyalty. This is the third research motivation.

In order to fill the above research gaps, based on the PZB model and RBT, this study aims to construct a complete OFD-SERV scale through qualitative research procedures, quantitative research procedures and IBDA, so as to effectively evaluate OFD service quality and identify the deficiencies in service quality. In addition, this study identifies the service quality factors of the OFD-SERV scale influencing the customer satisfaction and loyalty of OFD, so as to provide a reference for OFD operators to develop marketing strategies in the verification stage. The academic contribution of this study is to develop a useful OFD-SERV scale to provide a reference for future studies on OFD service quality, and IBDA applications will make the future service quality scale more innovative and better able to meet customer needs and expectations. The OFD-SERV scale constructed in this study will be able to more clearly verify the various service gaps based on the PZB model in the OFD industry and narrow the gap between OFD customer service expectations and perceived services, thereby improving OFD service quality and customer satisfaction. According to the concept of RBT, the OFD-SERV scale will enable OFD operators to better grasp the deficiencies in service quality, properly allo-

cate resources to improve service quality, emphasize effective use of service resources, and create competitive advantages for OFD companies. Moreover, the results of this study can also reconfirm the relationship between OFD service quality, customer satisfaction and loyalty, and establish new knowledge for the related theories of OFD service quality and customer satisfaction. In practice, due to the continually growing OFD market, the construction of the OFD-SERV scale will enable OFD operators to understand their own service quality performance more effectively, thereby improving OFD service quality, customer satisfaction and loyalty, and enhancing corporate competitiveness.

Comparison

”Feed Forward” differentiates itself by offering a comprehensive solution that not only facilitates food donation but also emphasizes volunteer engagement, live tracking for donors, and tailored support for charity organizations. Its commitment to food safety, sustainability, and user experience positions ”Feed Forward” as an innovative and impactful app in the realm of food donation, contributing to a more equitable and compassionate society.

Chapter 3

System Analysis

3.1 Expected System Requirements

The system of user which is a smart phone is expected to have the following features:

- Android platform with a version above 4.
- Requirement of Internet connection for face recognition.
- A storage space of approximate 100 MB for the app.
- A minimum Ram size of 2GB is required in the device.

3.2 Feasibility Analysis

3.2.1 Technical Feasibility

The project is technically feasible since majority of the population are in possession of smartphones. The app only requires minimum requirements to run on a smartphone .

3.2.2 Operational Feasibility

The operations are built in a simple and easy to use manner for donors of all age, volunteers and recipients. Installation of the app is the only prerequisite operation to be done.

3.2.3 Economic Feasibility

By adopting cost reduction strategies and ensuring user adoption, the app can establish a sustainable economic model to support its mission of reducing food waste and combating food insecurity effectively. The development of the app is also zero budget as it was built using free resources.

3.3 Hardware Requirements

The following are the system requirements to develop the Feed Forward App.

- Processor: Intel Core i5
- Hard Disk: Minimum 100GB
- RAM: Minimum 8GB

3.4 Software Requirements

The following are the software used in the development of the app.

Operating System: Windows or Mac OS

3.4.1 Android Studio

Android Studio, the official IDE for Android app development, is built on IntelliJ IDEA, providing a unified environment for creating applications across various Android devices. Its structured code modules enable developers to divide projects into manageable units, facilitating independent building, testing, and debugging. As an open-source platform, Android Studio fosters collaboration and innovation in the developer community. With its comprehensive tools, user-friendly interface, and frequent updates, the IDE ensures access to the latest Android features, making mobile app development efficient and accessible for all levels of expertise. Android Studio empowers developers to create high-quality, feature-rich Android apps with ease and effectiveness.

3.4.2 Flutter

Flutter is a powerful open-source framework utilized for Android app development. Developed by Google, it allows developers to create high-performance, visually appealing, and cross-platform applications using a single codebase. Flutter's reactive programming style facilitates rapid development, enabling hot reload for instant updates during the coding process. With a wide range of customizable widgets and extensive libraries, developers can design interactive user interfaces and implement complex functionalities efficiently. Flutter's native performance, along with its support for various devices and platforms,

makes it an ideal choice for developers seeking to build feature-rich and visually stunning Android apps with ease.

3.4.3 Figma

Figma is a collaborative browser-based interface design tool, with additional offline features enabled by desktop applications for macOS and Windows. The Figma mobile app for Android and iOS allows viewing and interacting with Figma prototypes in real-time on mobile and tablet devices. The feature set of Figma focuses on user interface and user experience design, with an emphasis on real-time collaboration, utilising a variety of vector graphics editor and prototyping tools.

3.4.4 Visual Studio Code (VSCode)

Visual Studio Code (VSCode) is a versatile and widely-used code editor for Android app development, especially for backend languages. Its extensive ecosystem of extensions and plugins allows developers to work seamlessly with various backend technologies like PHP. VSCode's intelligent code completion, debugging capabilities, and integrated terminal streamline the development process, enhancing productivity. Additionally, the built-in Git integration facilitates version control and collaborative coding. With its lightweight yet powerful features, VSCode serves as an excellent choice for backend development in Android app projects, providing a smooth and efficient coding experience for developers.

3.4.5 MySQL

MySQL is a popular and widely-used relational database management system used in Android app development. It provides a robust and efficient way to store and manage data in Android applications. Developers can use MySQL to design and create databases, define tables, and execute SQL queries to perform various operations like inserting, updating, deleting, and retrieving data. The ability to connect Android apps to MySQL databases allows seamless synchronization of data between the app and server, enabling features like user accounts, real-time data updates, and more.

Chapter 4

Methodology

4.1 Proposed Method

Develop a mobile application that has the following functionality.

- User Registration: Users register and create profiles as donors, volunteers, recipients, or charity organizations.
- Donation Sessions: Donors create sessions with surplus food details and pickup locations.
- Volunteer Engagement: Active volunteers accept nearby donation sessions based on availability.
- Real-Time Tracking: Donors track volunteer's live location during delivery.
- Recipient Support: Charity organizations register recipients' locations for efficient distribution.
- Security and Privacy: Implement secure measures for user data protection.

Volunteer Engagement

Volunteer engagement is a crucial aspect of the "Feed Forward" food donation app, empowering individuals to actively participate in food rescue efforts. The app provides a seamless and user-friendly interface for volunteers to view available donation sessions in their nearby locations.

Once a donor creates a donation session with surplus food details and pickup location, the app displays these sessions to active volunteers. Volunteers can access a list of available donation opportunities and view essential information about each session, such as the type and quantity of food, the pickup location, and the distance from their current location.

Using this information, volunteers can decide to accept or reject a donation session based on their availability and proximity. If a volunteer accepts a session, the app notifies the donor, confirming the volunteer's engagement in the food rescue process.

By empowering volunteers to choose donation sessions that align with their schedules and locations, the "Feed Forward" app ensures a flexible and efficient engagement process. This approach encourages more volunteers to participate and contribute to the app's mission of reducing food waste and combating food insecurity in their communities. Through volunteer engagement, "Feed Forward" fosters a culture of giving and compassion, inspiring individuals to make a positive impact and build stronger, more resilient communities.

4.1.1 Donation sessions

Donation Sessions in the food donation app are at the core of its mission to combat food insecurity and reduce food waste. Donors initiate these sessions by providing essential details about surplus food items they wish to donate. During the creation process, donors specify the quantity, type, and expiration date of the food items, ensuring transparency and food safety.

Additionally, donors include the pickup location where the volunteer will collect the donated food for distribution. This location can be the donor's address or a designated drop-off point for convenience. The app then displays these donation sessions to nearby volunteers and charity organizations, allowing them to view available opportunities for rescue and distribution.

Once a donation session is created, it is made accessible to active volunteers who can view the details and decide to accept or reject the session based on their availability and proximity. The app provides real-time notifications to donors, keeping them informed about the progress of their donation session until the food reaches the recipient.

By facilitating efficient and transparent donation sessions, the app maximizes the impact of food rescue efforts and fosters a culture of giving and compassion within the community.

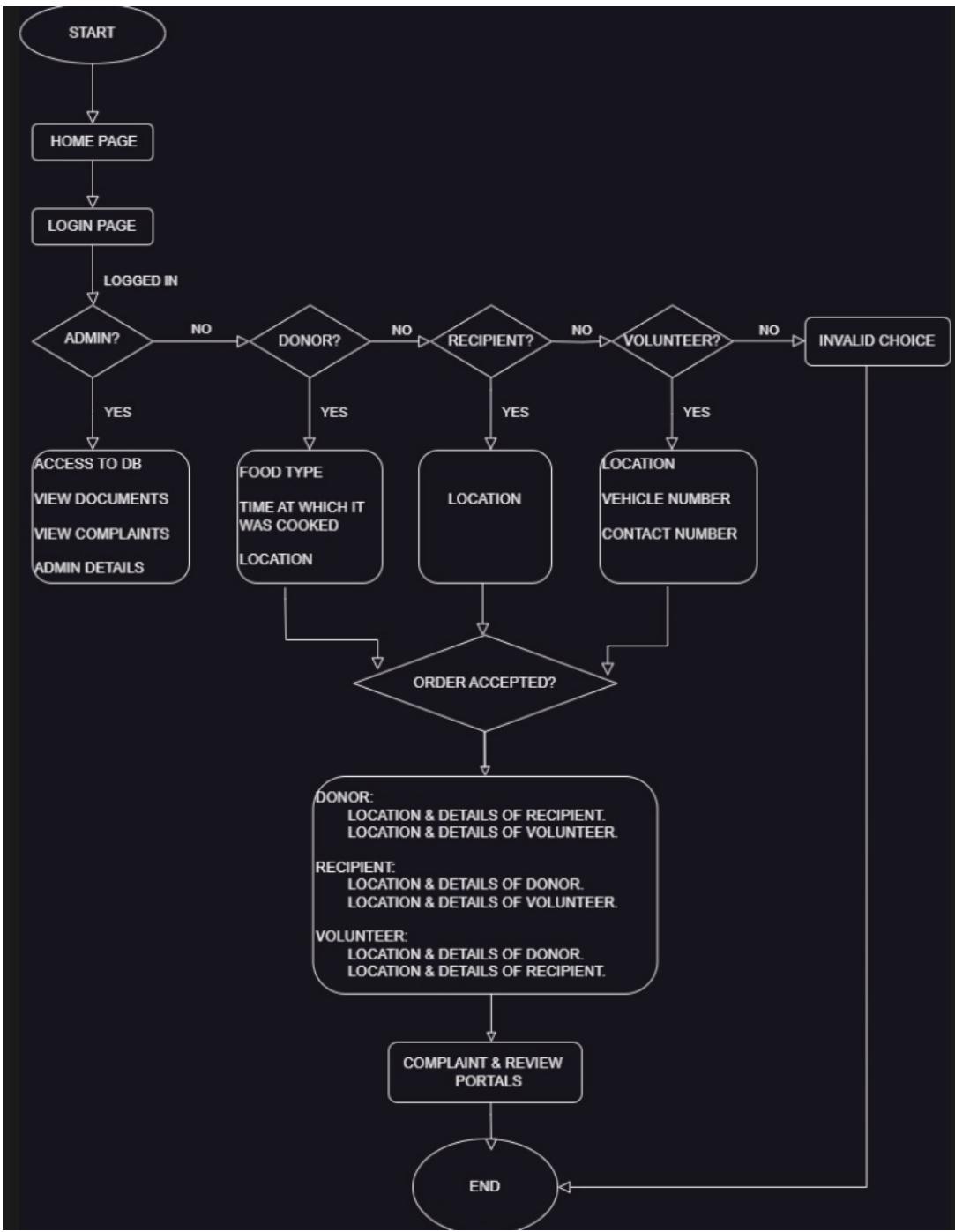


Figure 4.1: Program Flow

Real Time Tracking

Real-time tracking in the "Feed Forward" food donation app is achieved using the Google Maps API, a powerful tool that enables accurate and seamless location tracking during the food delivery process. The app leverages the Google Maps API to provide donors with live updates on the volunteer's location as they deliver the donated food items to recipients.

When a volunteer accepts a donation session, their device's GPS coordinates are continuously sent to the app's backend using the Google Maps API. The app then uses this data to display the volunteer's real-time location on the map in the donor's app interface. As the volunteer moves towards the recipient's location, the map updates dynamically, reflecting the current position of the volunteer.

This real-time tracking feature not only provides donors with transparency and reassurance but also enables them to estimate the delivery time accurately. It also helps optimize the delivery route, ensuring timely and efficient distribution of surplus food to those in need.

The Google Maps API offers robust location-based services, such as geolocation, directions, and distance calculations, making it an essential component in enhancing the "Feed Forward" app's overall user experience and effectiveness in combating food insecurity and reducing food waste.

Recipient Support

Recipients play a vital role in the "Feed Forward" food donation app as they are the beneficiaries of the surplus food distributed through the platform. The app provides a user-friendly interface for charity organizations to register recipients and their locations.

Charity organizations can easily sign up on the app and provide essential details about the number of needy people they serve and their respective locations. Once registered, charity organizations can receive donated food on behalf of recipients in their care.

When a donor creates a donation session, the app directs the assigned volunteer to the specified charity organization, ensuring efficient and direct food distribution. Recipients can then collect the donated food from the charity organization's designated location, ensuring a smooth and coordinated process.

By facilitating direct communication and coordination between donors, volunteers, and charity organizations, the "Feed Forward" app ensures that surplus food reaches recipients in need, making a meaningful difference in their lives. Through the recipient feature, the app reinforces its commitment to combating food insecurity, promoting inclusivity, and fostering a sense of community care and support.

Chapter 5

System Design

5.1 Architecture Diagram

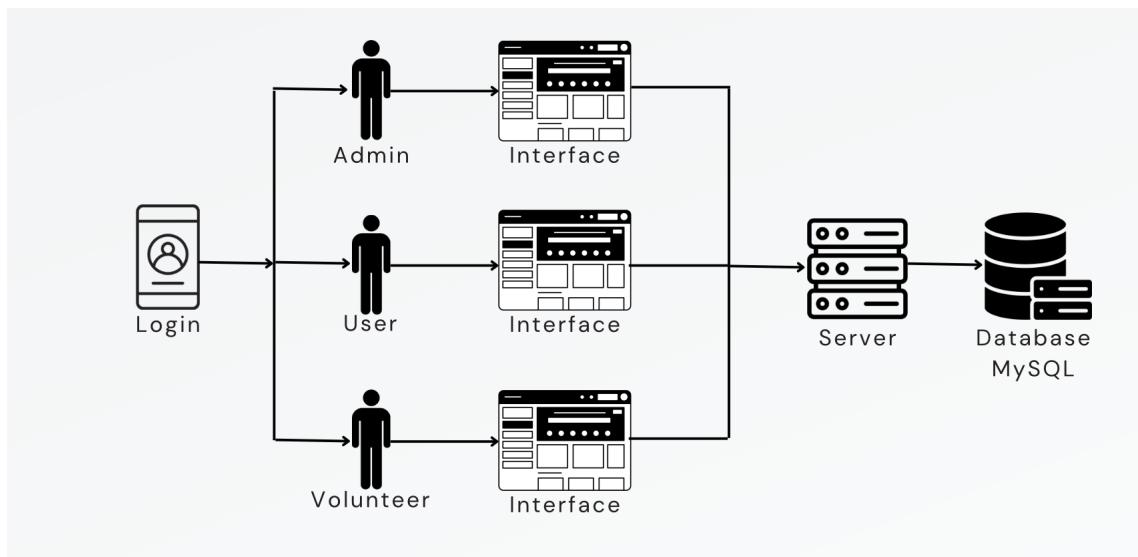


Figure 5.1: Architecture diagram

5.2 Sequence diagram

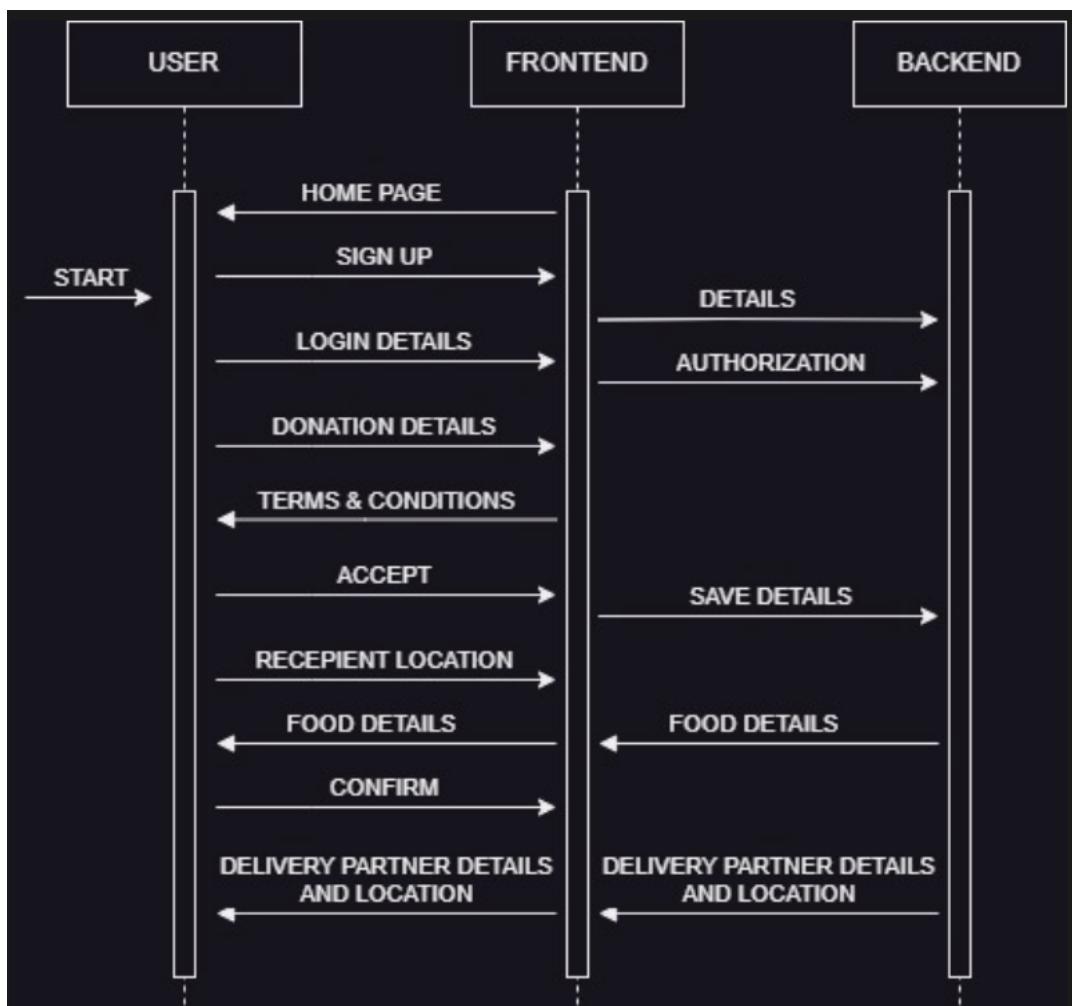


Figure 5.2: Sequence Diagram

Chapter 6

System Implementation

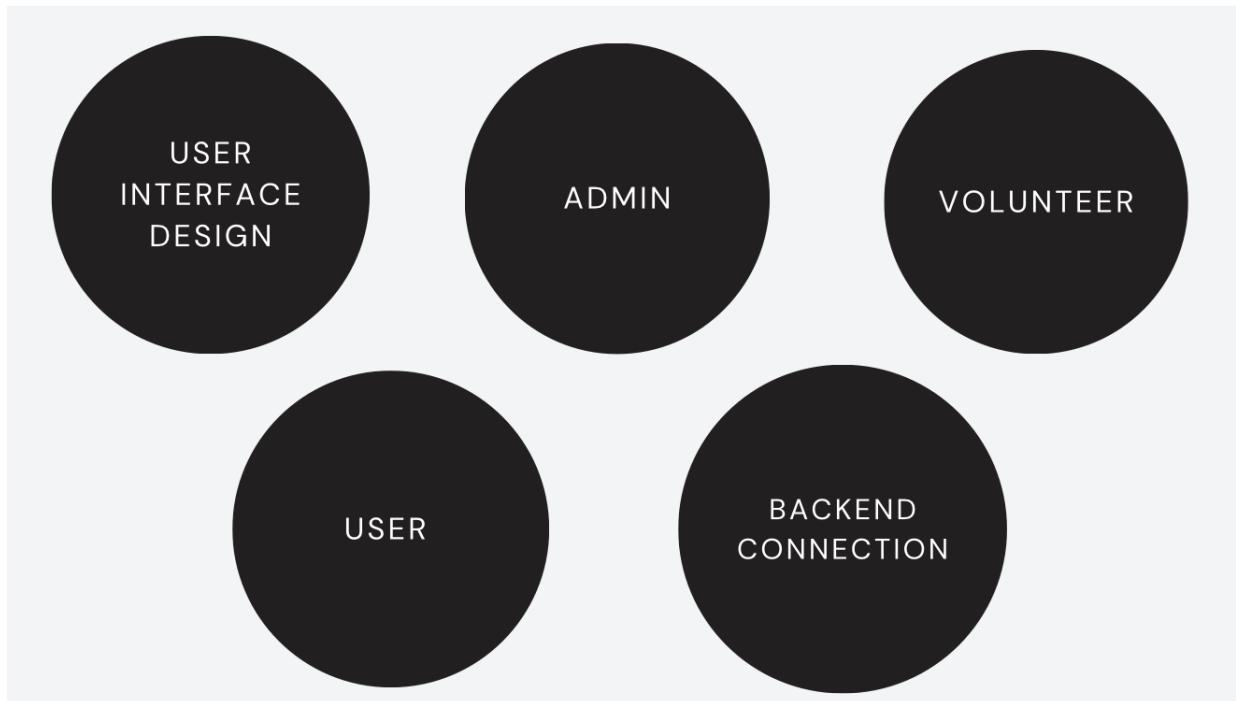


Figure 6.1: Module Division

6.1 User Module

The User Module handles all user-related functionalities in the app. It includes user registration, login, and profile management. When a user registers, their information is securely stored in the database, including details like name, contact information, and role (donor, volunteer, recipient, or admin). The module ensures secure user authentication, allowing users to access the app's features based on their roles and permissions.

6.2 User Interface (UI) Module

The UI Module is responsible for the front-end development and design of the app. It encompasses various screens and components that users interact with. For donors, it provides a user-friendly interface to create donation sessions, specifying surplus food items, quantity, and pickup location. For volunteers, the UI Module displays nearby donation sessions with details, allowing them to accept or reject based on their availability and location. Recipients can access their assigned donation sessions and receive notifications about food deliveries. The UI Module also facilitates real-time tracking for donors, displaying the live location of volunteers during the delivery process.

6.3 Backend Module

The Backend Module handles the server-side logic of the app and facilitates interactions with the database. It processes requests from the UI Module and performs necessary data validations and manipulations. For instance, when a donor creates a donation session, the Backend Module stores the session details in the database. It also handles real-time tracking by updating the volunteer's location as they progress during the delivery. Additionally, the Backend Module manages the communication between different modules through APIs.

6.4 Volunteer Module

The Volunteer Module focuses on functionalities related to volunteers. It allows volunteers to view nearby available donation sessions based on their location. When a volunteer accepts a session, the module updates the session status and assigns the volunteer to the donation task. The Volunteer Module also manages volunteer availability, enabling them to set their status as available or unavailable for donation sessions.

6.5 Admin Module

The Admin Module provides administrative access to monitor and manage the app's activities. Administrators can view and manage user profiles, donation sessions, volunteer engagements, and recipient details. This module allows administrators to intervene in the

donation process when necessary. For example, if a volunteer fails to deliver a donation, the admin can reassign the session to another volunteer.

Chapter 7

Results

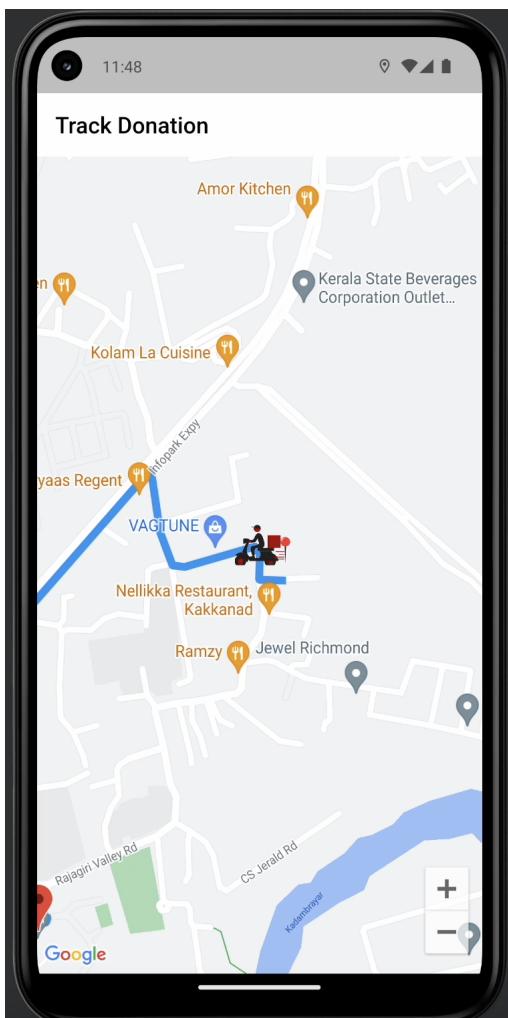


Figure 7.1: Tracking Donation



Figure 7.2: Home Page



Figure 7.3: Sign In Page

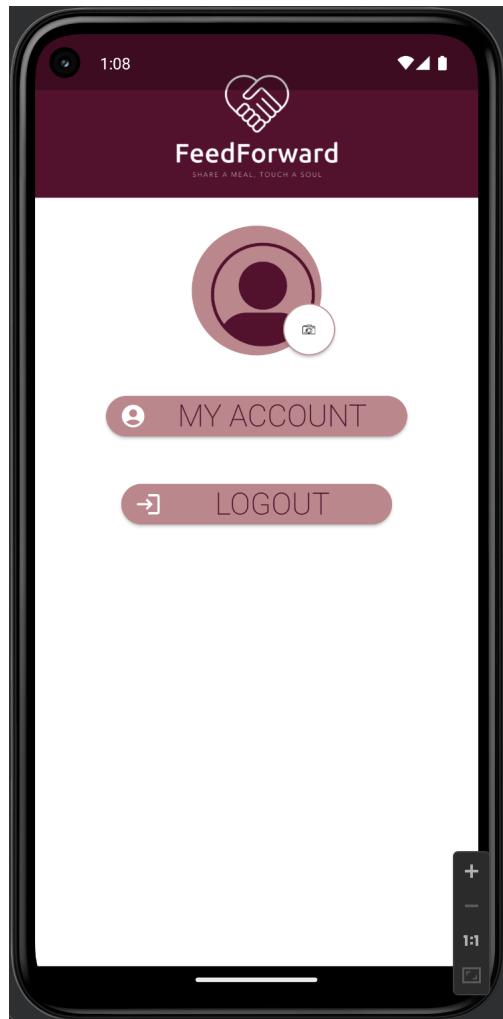


Figure 7.4: Profile



Figure 7.5: Sign Up Modes

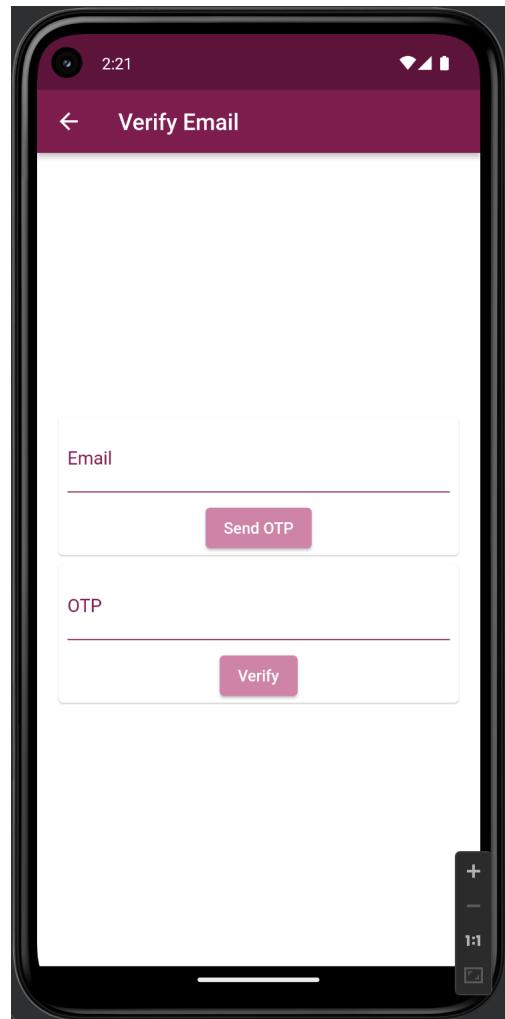


Figure 7.6: Forgot Password

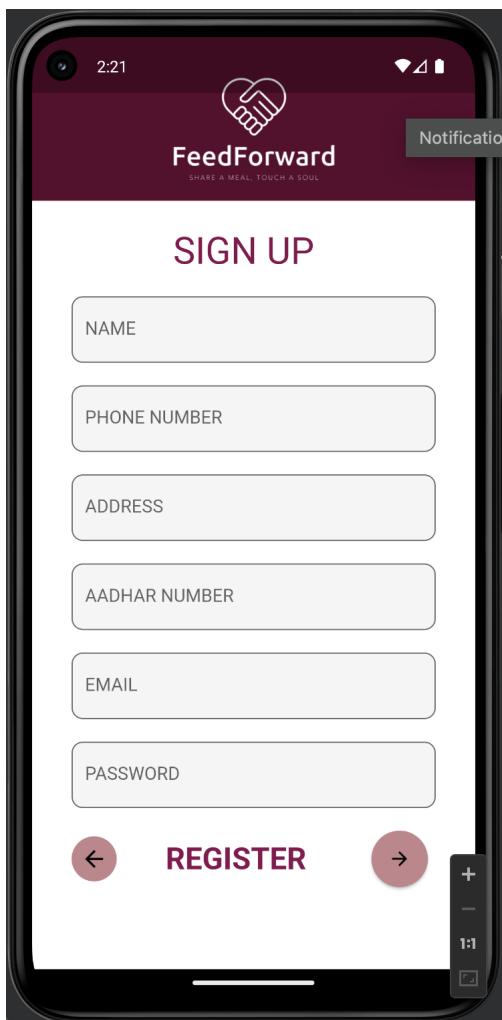


Figure 7.7: Donor Sign up

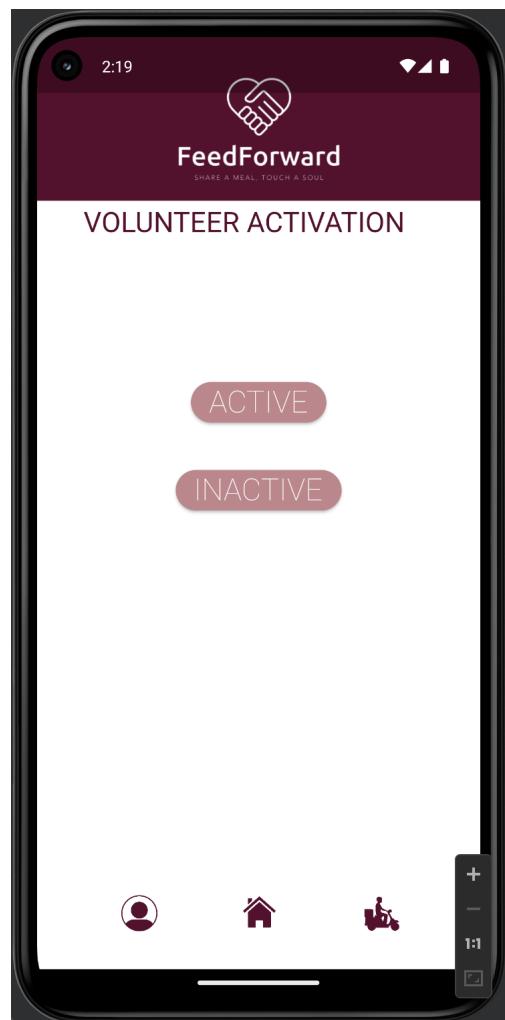


Figure 7.8: Volunteer Activation



Figure 7.9: Admin View



Figure 7.10: Sign In Success

The screenshot shows the phpMyAdmin interface for the database `feedforward_db`. The left sidebar lists various databases, and the main area displays the structure of the `feedforward_db` database. The table list shows the following details:

Table	Action	Rows	Type	Collation	Size	Overhead
<code>admin</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	1	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<code>donation</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	3	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<code>donor</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	3	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<code>receive</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	0	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<code>recipient</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	2	InnoDB	utf8mb4_general_ci	16.0 KiB	-
<code>volunteer</code>	<input type="checkbox"/> Browse <input type="checkbox"/> Structure <input type="checkbox"/> Search <input type="checkbox"/> Insert <input type="checkbox"/> Empty <input type="checkbox"/> Drop	2	InnoDB	utf8mb4_general_ci	16.0 KiB	-
6 tables Sum		11	InnoDB	utf8mb4_general_ci	96.0 KiB	0 B

Below the table list, there are buttons for Check all and With selected: followed by a dropdown menu. At the bottom, there are links for Print and Data dictionary, and a "Create new table" section with fields for Table name (empty) and Number of columns (4), and a Create button.

Figure 7.11: Database Tables

Chapter 8

Risks and Challenges

In the context of developing a food donation application, several risks and challenges need to be addressed to ensure the successful and efficient delivery of food to recipients. One significant concern is the contamination of food during the donation and delivery process, as improper handling or storage could lead to health hazards. Moreover, the perishable nature of food increases the chances of it getting stale, making timely delivery crucial. To ensure food safety and quality, a strict time limit must be adhered to, preventing any potential health risks to recipients.

Additionally, traffic blocks and delays during delivery routes pose logistical challenges, potentially affecting the freshness and edibility of the donated food. To tackle these issues, real-time monitoring of delivery drivers is essential, enabling efficient route optimization and timely updates to recipients. Furthermore, to maintain food quality, a reliable system for tracking the food's journey from donor to recipient must be in place, including quality checks and verification at each stage.

Addressing these risks and challenges requires a robust technological solution, seamless communication among stakeholders, and strict adherence to food safety standards. By implementing a well-designed and comprehensive food donation application, these concerns can be mitigated, enabling a smooth and safe process of collecting and delivering food to those in need.

Chapter 9

Conclusion

In conclusion, the food donation application shows great potential in addressing food insecurity by connecting donors, volunteers, and recipients. However, it faces challenges such as volunteer availability, food freshness during delivery, and maintaining food quality. Addressing these limitations requires continuous user education, community engagement, and ongoing improvements to the application's features. With careful monitoring and adherence to food safety standards, this app can make a positive impact in helping those in need receive timely and nutritious food donations. The future scope of this food donation application is promising. Enhancements can be made to improve user engagement and volunteer participation through gamification and reward systems. Implementing AI-driven route optimization algorithms can tackle traffic-related delays and ensure efficient food delivery. Integrating advanced food quality monitoring technologies and implementing blockchain for transparent food tracking can further enhance food safety measures. Expanding the app's reach to include more regions and collaborating with local charities can increase its impact. Additionally, incorporating user feedback to continuously improve the app's usability and adding support for multiple languages can make it more accessible to a diverse user base.

References

- [1] A. Sarkar, A. Goyal, D. Hicks, D. Sarkar and S. Hazra, "Android Application Development: A Brief Overview of Android Platforms and Evolution of Security Systems," 2019 Third International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC), Palladam, India, 2019, pp. 73-79, doi: 10.1109/I-SMAC47947.2019.9032440.
- [2] TY - JOUR AU - Esmaeel, Hana AU - Esmaeel, Hana PY - 2015/05/01 SP - T1 - Apply Android Studio (SDK) Tools VL - Vol.7 JO - Baghdad Science Journal ER -
- [3] TY - JOUR AU - Letkowski, Jerzy PY - 2015/01/01 SP - T1 - Doing database design with MySQL VL - Volume 6 JO - Journal of Technology Research ER -
- [4] Amit Shankar, Charles Jebarajakirthy, Preeti Nayal, Haroon Iqbal Maseeh, Aman Kumar, Achchuthan Sivapalan, Online food delivery: A systematic synthesis of literature and a framework development, International Journal of Hospitality Management, Volume 104, 2022, 103240, ISSN 0278-4319
- [5] Ching-Chan Cheng, Ya-Yuan Chang, Cheng-Ta Chen, Construction of a service quality scale for the online food delivery industry, International Journal of Hospitality Management, Volume 95, 2021, 102938, ISSN 0278-4319

Appendix A: Base Paper



ScienceDirect®

International Journal of Hospitality Management

Volume 104, July 2022, 103240

Online food delivery: A systematic synthesis of literature and a framework development

Amit Shankar^a✉, Charles Jebarajakirthy^b✉, Preeti Nayal^c✉, Haroon Iqbal Maseeh^b✉, Aman Kumar^d✉, Achchuthan Sivapalan^e✉

Show more ▾

Share Cite

<https://doi.org/10.1016/j.ijhm.2022.103240> ↗

[Get rights and content ↗](#)

Abstract

This study aims to systematically review the extant literature on online food delivery. The literature on online food delivery is synthesised in terms of theories, contexts, methods adopted and analytical techniques used. The literature review suggests that online food delivery research has transitioned from website-based food delivery to online to offline, mobile application-based food delivery, and drone-based food delivery. Further, based on the synthesis, we have developed a conceptual framework that shows the frequently reported antecedents, mediators, moderators, and consequences in online food delivery literature. Moreover, by identifying overlooked areas of online food delivery research, some insightful future research directions have been proposed to further advance this research domain. This review contributes to the hospitality literature, specifically to the food delivery literature.

Introduction

The thin margin is one of the predominant characteristics affecting the restaurant industry, and hence, restaurant operators tend to seek opportunities to increase their profit and market share (Rivera, 2019). One such opportunity is development of food delivery system (Kimes, 2011). Food delivery space has witnessed several technological advancements and triggered consumer demand which attracted both restaurants and third parties to deliver foods (Muller, 2018). Restaurants may deliver food items using their own website/application (e.g. Domino's, Pizza Hut and KFC) or via third party aggregators (e.g. Foodpanda,

Swiggy, Zomato and Uber Eats). Development of e-commerce has largely contributed to changing food consumption patterns, and more and more consumers prefer to use online platforms to order foods (Hwang et al., 2019a). Online food delivery has emerged as a popular trend in e-commerce space, and serves as a tool to reach a larger number of consumers in a cost effective manner (Ray et al., 2019).

Online food delivery (OFD) refers to online channel that consumers use to order food from restaurants and fast-food retailers (Elvandari et al., 2018). In OFD system, consumers have a better choice in terms of restaurants and food items (Pigatto et al., 2017). By adopting OFD, restaurants and fast-food retailers can increase their reach among consumers in a cost-effective manner while consumers can order the meal of their choice without spending much time and efforts (Ray et al., 2019). In the recent past, OFD has witnessed several technological advancements. For instance, restaurants have transitioned from offline into online platforms by developing their own websites and allowing customers to order food using restaurants' own website (Yeo et al., 2017). Further, due to the increasing use of smartphone applications, restaurants have launched their apps which also serve as online food ordering platforms for consumers (Ray et al., 2019). However, due to operations and/or financial reasons, not all restaurants use their own delivery channels for food delivery (Hwang et al., 2020). Hence, restaurants opt for third-party platforms and food aggregators to facilitate online food delivery, helping them to reach out to a wider market in a cost-effective manner (Williams et al., 2020). Foodpanda, Swiggy, Zomato and Uber Eats are a few examples of third-party food delivery platforms (Lo et al., 2020). However, such platforms, i.e., third-party food delivery services, are normally limited to metro cities. Thus, to geographically expand the availability of OFD services, restaurants opted for AI and drone-based channels for food delivery, another form of OFD (Hwang et al., 2021). Accordingly, all the above indicated platforms, such as OFD, online to offline delivery, mobile application-based food delivery, and drone-based food delivery are classified as OFD services.

In the recent years, OFD has recorded an exponential growth. According to "Online Food Delivery Services Global Market Report 2020–30", the global OFD market is expected to grow from \$107.44 billion in 2019 to \$154.34 billion in 2023, at an annual growth rate of 11.51%. The above statistics indicate an enormous potential for the growth of OFD system, a factor triggering the research on the OFD from multifarious perspectives, using various conceptualisations and methods. Although several studies exist on OFD, the literature on this domain is fragmented (Ray et al., 2019). That is, the literature reports various psychological, sociological, and contextual factors driving consumers' intention to adopt OFD. However, the findings of the previous studies are inconsistent and fragmented which limit a comprehensive understanding of factors affecting customer responses to OFD. Moreover, in the extant literature, several theories were used to underpin OFD research, thus presenting a fragmented outlook on underpinning theories used in the OFD context. Hence, the extant literature needs to be reconciled to propose a synthesised perspective on theoretical development in the OFD phenomenon. Lastly, OFD industry evidenced several technological advancements ranging from website to, mobile application, drone, and AI. In the extant literature, studies attempted to investigate the role of technology in delivering food items and how consumers respond to different OFD platforms. However, studies carried out on different technological platforms and facets of OFD were not synthesised to show the future technological trajectory of OFD.

Considering the extent and diversity of prior research on OFD, researchers are likely to be benefitted from a

focused discussion of current dynamics of OFD research. The above discussion indicates that OFD literature needs to be synthesised to show various factors driving intention to adopt OFD, various theoretical underpinnings of OFD research and different technological platforms and facets of OFD. Such a synthesis is a need of the hour to map current growth of OFD research and to provide avenues for future research in this domain (Khanra et al., 2020, Dhir et al., 2020). Systematic literature reviews can provide a valuable summarization of current knowledge in a domain (Aznoli and Navimipour, 2017, Talwar et al., 2020) and allow for the identification of gaps to provide avenues for future research in the domain (Gopalakrishnan and Ganeshkumar, 2013, Dhir et al., 2020). Hence, this research adopts the structured literature review (SLR) method to undertake a systematic assessment and a comprehensive analysis of extant literature on OFD to identify some insightful gaps that advance the research on OFD.

Accordingly, we propose the following research objectives. The first objective is to analyse the development of the OFD literature over the years. The second objective is to propose a conceptual framework of OFD based on the synthesised literature on this domain. The third and the final objective is to provide avenues for future research by pointing out the gaps in the extant OFD literature. To achieve the abovementioned objectives, the current study adopted Paul and Criado's (2020) process of conducting systematic literature review. Paul and Criado's (2020) process of conducting SLR is considered a more comprehensive approach to doing SLR because it enables researchers to synthesise literature in four key areas, i.e., theories, characteristics, contexts, and methods (TCCM). Given that OFD literature is fragmented in terms of theories used and characteristics (i.e. factors affecting customer responses to OFD and technological platforms used in OFD), Paul and Criado's (2020) process of conducting systematic literature review seems more appropriate than other SLR approaches. Further, due to the rigour and comprehensiveness, many scholars have recommended following Paul and Criado's (2020) approach to provide an insightful synthesis of the literature (e.g., Jebarajakirthy et al., 2021; Mishra et al., 2021). Hence, this SLR follows Paul and Criado's (2020) approach to provide a deeper understanding of the OFD phenomenon and a comprehensive review of the literature on OFD.

Section snippets

Review structure

A systematic literature review (SLR) can be either a theory-based review, method-based review, or domain-based review (Paul and Criado, 2020). In theory-based systematic reviews, researchers synthesize the literature on a specific theory (Paul and Rosado-Serrano, 2019). For example, Kozlenkova et al.'s (2014) study provides a review of the literature on 'Resource-Based Theory in Marketing'. In theory-based systematic reviews, researchers also propose new theories or suggest improvements to an...

Findings and discussions

The detailed information of selected 56 articles are presented in Appendix 1. The title of the manuscript,

authors details with publication year, and journal of publications are presented in Appendix 1. These papers were carefully reviewed to better understand the development of the OFD research (first objective of the study) and to architect a comprehensive conceptual framework (second objective of the study). A synthesis of these papers is presented in the following sections....

Future research agenda

We utilized a structured systematic literature review technique suggested by Paul and Criado (2020) to synthesize the literature on OFD. Based on this synthesis, we propose the future research directions, leveraging the TCCM framework used by Jebarajakirthy et al. (2021). This framework assists in identifying the underlying gaps in a research domain across four dimensions: theory development, context, characteristics, and method (Srivastava et al., 2020). The following section discusses the...

Academic and practical implications

This study provides several contributions to the OFD literature. Firstly, this study systematically reviewed the OFD literature to investigate the state-of-the-art of the research on this domain over time. This study discussed the evolution of the OFD concept and investigated its current dynamics. This review demonstrates the development of OFD literature over time in terms of theories, countries, methods adopted, analytical techniques used, domains, and journals where OFD literature was...

Limitations

Although this study contributes to the OFD literature, it suffers from a few limitations. First, we have used specific inclusion and exclusion criteria to select the academic literature for the review. Accordingly, the findings of the study are limited to the articles that have fulfilled our inclusion and exclusion criteria. Thus, the study's findings cannot be generalised to entire OFD literature. Further, we have reviewed the articles which were written only in English language. Thus, not...

Dr Amit Shankar is an Assistant Professor in Marketing at Indian Institute of Management Visakhapatnam, India. His research interests are in the areas of retaining, services marketing, and mobile banking. Amit's research has been published in the *Journal of Business Research*, *Journal of Retailing and Consumer Services*, *Marketing Intelligence & Planning*, *Journal of Bank marketing*, *Journal of Strategic Marketing*, *Journal of Enterprise Information Management*, *Australasian Marketing Journal*, ...

References (136)

I. Ajzen

The theory of planned behavior

Organ. Behav. Hum. Decis. Process. (1991)

U. Akram *et al.*

Feeling hungry? let's order through mobile! examining the fast food mobile commerce in China
J. Retail. Consum. Serv. (2020)

A.A. Alalwan

Mobile food ordering apps: An empirical study of the factors affecting customer e-satisfaction and continued intention to reuse

Int. J. Inf. Manag. (2020)

S. Bahoo

Corruption in banks: a bibliometric review and agenda

Financ. Res. Lett. (2020)

A. Behl *et al.*

Gamification and gigification: a multidimensional theoretical approach

J. Bus. Res. (2022)

A. Belarmino *et al.*

Exploring the motivations to use online meal delivery platforms: Before and during quarantine

Int. J. Hosp. Manag. (2021)

S.P. Borgatti *et al.*

Models of core/periphery structures

Soc. Netw. (2000)

R. Cai *et al.*

Mindset matters in purchasing online food deliveries during the pandemic: The application of construal level and regulatory focus theories

Int. J. Hosp. Manag. (2020)

C.C. Cheng *et al.*

Construction of a service quality scale for the online food delivery industry

Int. J. Hosp. Manag. (2021)

M. Cho *et al.*

Differences in perceptions about food delivery apps between single-person and multi-person households

Appendix B: Sample Code

CODE

- Main

```
//import 'dart:js';

import 'package:feedforward/recepsignup.dart';
import 'package:feedforward/signin.dart';
import 'package:feedforward/logo.dart';
import 'package:feedforward/mode.dart';
import 'package:feedforward/donorsignup.dart';
import 'package:feedforward/signupsuccessful.dart';
//import 'package:feedforward/';
import 'package:flutter/material.dart';
//import 'package:feedforward/forgotpassemal.dart';
import 'package:feedforward/dProfile.dart';
import 'package:feedforward/donationentry.dart';
import 'package:feedforward/userdetails.dart';
import 'package:feedforward/vsignup.dart';
import 'package:feedforward/otp.dart';
import 'package:feedforward/resetpass.dart';
import 'package:feedforward/donorrecp.dart';
import 'package:feedforward/admin.dart';
import 'package:feedforward/ddisplay.dart';
import 'package:feedforward/rdisplay.dart';
import 'package:feedforward/vdisplay.dart';
import 'package:feedforward/donorfrag.dart';
import 'package:feedforward/recepientfrag.dart';
import 'package:feedforward/volunteerfrag.dart';
import 'package:feedforward/donor_acnt.dart';
import 'package:feedforward/recep_acnt.dart';
import 'package:feedforward/vol_acnt.dart';
import 'package:feedforward/about.dart';
import 'package:feedforward/dProfile.dart';
import 'package:feedforward/rProfile.dart';
import 'package:feedforward/vProfile.dart';
//import 'package:feedforward/volactive.dart';
//import 'package:feedforward/dProfile.dart';
//import 'package:feedforward/details_prof.dart';

//import 'package:flutter/services.dart';

void main() {
runApp(MaterialApp(
debugShowCheckedModeBanner: false,
initialRoute: 'logo',
routes:{
'logo':(context)=>Logo(),
'signin':(context)=>USignin(),
```

```

'dup':(context)=>Dsignup(),
'rup':(context)=>Rsignup(),
'mode':(context)=>Mode(),
'verify':(context)=>Vsignup(),
'forgot':(context)=>ForgotPassword(),
'repass':(context)=>Resetpassword(),
'donorrecp':(context)=>MyOptions(),
'udetails':(context)=>Userdetails(),
'prof':(context)=>doProfile(),
'donor':(context)=>Donation(),
'admn':(context)=>Admin_page(),
'disp':(context)=>Ddisplay(),
'rdisp':(context)=>Rdisplay(),
'vdisp':(context)=>Vdisplay(),
'signupsucessful':(context)=>Successful(),
'dfrag':(context)=>SigninSuccess(),
'rfrag':(context)=>RecipientFrag(),
'vfrag':(context)=>VolunteerFrag(),
'daccnt':(context)=>DAccount(),
'raccnt':(context)=>RAccount(),
'vaccnt':(context)=>VAccount(),
'abt':(context)=>About(),
'rprof':(context)=>recProfile(),
'vprof':(context)=>volProfile(),
// 'vactive':(context)=>VolunteerActive(),
// 'detprof':(context)=>Profiledet(),
},
));
}

```

- Connections

```

<?php
$serverHost="localhost";
$user="root";
$password="";
$database="feedforward_db";

$conn=new mysqli($serverHost,$user,$password,$database);

```

- Donor module

```

//import 'package:flutter/cupertino.dart';

import 'dart:convert';

```

```
import 'package:flutter/material.dart';
import 'package:feedforward/users/model/donor_display.dart';
//import 'package:feedforward/users/model/ddelete_admin.dart';
import 'package:feedforward/api_connection/api_connection.dart';
import 'package:fluttertoast/fluttertoast.dart';
import 'package:http/http.dart' as http;

class Ddisplay extends StatefulWidget {
const Ddisplay({super.key});

@Override
State<Ddisplay> createState() => _DdisplayState();
}

class _DdisplayState extends State<Ddisplay>{
List<Donordisp> ddetails = [];
//Ddisplay _selectedDonor;
//bool _isUpdating;

Future<void> fetchDonor() async {
try{
final response = await http.get(Uri.parse(API.donor_details));
if (response.statusCode == 200) {

final List<dynamic> jsonData = json.decode(response.body);
//print(jsonData);
setState(() {
    // Modified section starts here
    ddetails = jsonData.map((item) =>
        Donordisp.fromJson(item)).toList();
    // Modified section ends here
});
} else {
    Fluttertoast.showToast(msg:"Failed to fetch donors:
${response.statusCode}");
}
} catch(e){
print(e.toString());
Fluttertoast.showToast(msg:e.toString());
}

@Override
void initState() {
// Fluttertoast.showToast(msg: "inside init");
super.initState();
}
```

```

fetchDonor();

}

Future<void> deleteRec(int id) async {
try {
final response = await http.post(
    Uri.parse(API.del_donor), // Replace with your API endpoint URL
    body: {'did': id.toString()}, // Send the ID of the record to delete
);
if (response.statusCode == 200) {
    var resBody=jsonDecode(response.body);
    if(resBody["success"]){
        setState(() {
            ddetails.removeWhere((element) => element.did == id);
        });
        Fluttertoast.showToast(msg: "Record deleted successfully.");
    }
} else {
    Fluttertoast.showToast(
        msg: "Failed to delete record: ${response.statusCode}");
}}}}catch (e) {
print(e.toString());
Fluttertoast.showToast(msg: "Error deleting record: $e");
}
}

@Override
Widget build(BuildContext context) {
return Container(
    decoration:BoxDecoration(
        image:DecorationImage(
            image: AssetImage('assets/registerpage.png'),fit: BoxFit.cover)),
    child:Scaffold(
        backgroundColor: Colors.transparent,
        body:Stack(
            children: [
SingleChildScrollView(
    //padding:EdgeInsets.only(top :150),
    scrollDirection: Axis.vertical,
    child: SingleChildScrollView(
//padding:EdgeInsets.only(top :150),
    scrollDirection: Axis.horizontal,
    child:Padding(
        padding: const EdgeInsets.fromLTRB(0, 150, 0, 0),
        child:DataTable(
            columns: [
DataColumn(label: Text('ID')),,

```

- Volunteer module

```
//import 'package:flutter/cupertino.dart';

import 'dart:convert';
```

```
import 'package:flutter/material.dart';
import 'package:feedforward/users/model/vol_display.dart';
import 'package:feedforward/api_connection/api_connection.dart';
import 'package:fluttertoast/fluttertoast.dart';
import 'package:http/http.dart' as http;

class Vdisplay extends StatefulWidget {
const Vdisplay({super.key});

@Override
State<Vdisplay> createState() => _VdisplayState();
}

class _VdisplayState extends State<Vdisplay>{
List<Voldisp> vdetails = [];
//Ddisplay _selectedDonor;
//bool _isUpdating;

Future<void> fetchVol() async {
try{
final response = await http.get(Uri.parse(API.vol_details));
if (response.statusCode == 200) {

    final List<dynamic> jsonData = json.decode(response.body);
    //print(jsonData);
    setState(() { //Fluttertoast.showToast(msg: "inside ");
        // Modified section starts here
        vdetails = jsonData.map((item) =>
        Voldisp.fromJson(item)).toList();
        // Modified section ends here
    });
} else {
    Fluttertoast.showToast(msg:"Failed to fetch donors:
    ${response.statusCode}");
}
} catch(e){
print(e.toString());
Fluttertoast.showToast(msg:e.toString());
}

@Override
void initState() {
//Fluttertoast.showToast(msg: "inside init");
super.initState();
fetchVol();
}
```

```
}

Future<void> deleteRec(int id) async {
try {
final response = await http.post(
    Uri.parse(API.del_vol), // Replace with your API endpoint URL
    body: {'vol_id': id.toString()}, // Send the ID of the record to
    delete
);
if (response.statusCode == 200) {
    var resBody=jsonDecode(response.body);
    if(resBody["success"]){
        setState(() {
            vdetails.removeWhere((element) => element.vol_id == id);
        });
        Fluttertoast.showToast(msg: "Record deleted successfully.");
    }
    else {
        Fluttertoast.showToast(
            msg: "Failed to delete record: ${response.statusCode}");
    }}}catch (e) {
print(e.toString());
Fluttertoast.showToast(msg: "Error deleting record: $e");
}
}

@Override
Widget build(BuildContext context) {
return Container(
decoration:BoxDecoration(
    image:DecorationImage(
        image: AssetImage('assets/registerpage.png'),fit:
        BoxFit.cover)),
child:Scaffold(
    backgroundColor: Colors.transparent,
    body:Stack(
        children: [
        SingleChildScrollView(
            //padding:EdgeInsets.only(top :150),
            scrollDirection: Axis.vertical,
            child: SingleChildScrollView(
                //padding:EdgeInsets.only(top :150),
                scrollDirection: Axis.horizontal,
                child:Padding(
                    padding: const EdgeInsets.fromLTRB(0, 150, 0, 0),
                    child:DataTable(
                        columns: [
```


- Admin module

```
import 'package:flutter/material.dart';
class Admin_page extends StatefulWidget {
const Admin_page({super.key});

@Override
State<Admin_page> createState() => _Admin_pageState();
}

class _Admin_pageState extends State<Admin_page> {

@Override
Widget build(BuildContext context) {
return Container(
decoration:BoxDecoration(
image:DecorationImage(
image: AssetImage('assets/Homepage.png'),fit: BoxFit.cover)),
child:Scaffold(
backgroundColor: Colors.transparent,
body:Stack(
children: [
Container(
padding: EdgeInsets.only(top: 350,left: 35,right: 35),
child:Column(
children: [
ElevatedButton(
style: ElevatedButton.styleFrom(backgroundColor:Color(0xFFC2858C),shape:
StadiumBorder()),
onPressed: () {
//donorinfo();
Navigator.pushNamed(context, 'ddisp');
},
child:Text(' DONOR ',style: TextStyle(
color: Colors.white,
fontSize: 27,fontWeight: FontWeight.w100
)
),
),
),
SizedBox(
height: 20,
),
ElevatedButton(
style: ElevatedButton.styleFrom(backgroundColor:Color(0xFFC2858C),shape:
StadiumBorder()),
onPressed: () {
}
)
]
)
)
)
);
```

```
        Navigator.pushNamed(context, 'rdisp');
    },
    child:Text('RECEPIENT',style: TextStyle(
color: Colors.white,
fontSize: 27,fontWeight: FontWeight.w100
)
),
),

),
SizedBox(
height: 20,
),
ElevatedButton(
style: ElevatedButton.styleFrom(backgroundColor:Color(0XFFC2858C),shape:
StadiumBorder()),
onPressed: () {
Navigator.pushNamed(context, 'vdisp');
},
child:Text('VOLUNTEER',style: TextStyle(
color: Colors.white,
fontSize: 27,fontWeight: FontWeight.w100
)
),
),

),
SizedBox(
height: 80,
),
Center(
child: ElevatedButton(
style: ElevatedButton.styleFrom(backgroundColor:Color(0XFFC2858C),shape:
StadiumBorder()),
onPressed: () {
Navigator.pushNamed(context, 'signin');
},
child:Text('BACK',style: TextStyle(
color: Colors.white,
fontSize: 27,fontWeight: FontWeight.w100
)
),
),

),
),
],
),
)

],
```

```
)  
,  
);  
}  
}
```

- Live Tracking

```
import 'dart:async';  
  
import 'package:flutter/material.dart';  
import 'package:flutter_polyline_points/flutter_polyline_points.dart';  
import 'package:google_mao/constants.dart';  
import 'package:google_maps_flutter/google_maps_flutter.dart';  
import 'package:location/location.dart';  
  
class OrderTrackingPage extends StatefulWidget {  
const OrderTrackingPage({Key? key}) : super(key: key);  
  
@override  
State<OrderTrackingPage> createState() => OrderTrackingPageState();  
}  
  
class OrderTrackingPageState extends State<OrderTrackingPage> {  
final Completer<GoogleMapController> _controller = Completer();  
  
static const LatLng sourceLocation =  
LatLng(9.998419751360114, 76.36142404035189);  
static const LatLng destination =  
LatLng(9.993581909590258, 76.35810162880433);  
  
List<LatLng> polylineCoordinates = [];  
LocationData? currentLocation;  
  
BitmapDescriptor sourceIcon = BitmapDescriptor.defaultMarker;  
BitmapDescriptor destinationIcon = BitmapDescriptor.defaultMarker;  
BitmapDescriptor currentLocationIcon = BitmapDescriptor.defaultMarker;  
  
void getCurrentLocation() async{  
Location location = Location();  
location.getLocation().then(  
    (location) {  
        return currentLocation = location;  
    },  
);  
GoogleMapController googleMapController = await _controller.future;
```

```
location.onLocationChanged.listen(
    (newLoc) {
        currentLocation=newLoc;
        googleMapController.animateCamera(
            CameraUpdate.newCameraPosition(
                CameraPosition(
                    zoom: 16.5,
                    target: LatLng(
                        newLoc.latitude!,
                        newLoc.longitude!,
                    ),
                ),
            ),
        );
        setState(() {});
    });
}

void getPolyPoints() async{
PolylinePoints polylinePoints = PolylinePoints();

PolylineResult result = await polylinePoints.getRouteBetweenCoordinates(
google_api_key,
PointLatLng (sourceLocation.latitude,sourceLocation.longitude),
PointLatLng (destination.latitude,destination.longitude),
);

if(result.points.isNotEmpty){
for (var point in result.points) {
    polylineCoordinates.add(
        LatLng(point.latitude, point.longitude),
    );
}
setState(() {});
}
}

void setCustomMarkerIcon(){
BitmapDescriptor.fromAssetImage(
    ImageConfiguration.empty,"assets/Pin_destination.png")
.then(
    (icon) {
    sourceIcon=icon;
},
);
BitmapDescriptor.fromAssetImage(
    ImageConfiguration.empty,"assets/Pin_source.png")
}
```

```

        .then(
            (icon) {
                destinationIcon=icon;
            },
        );
    BitmapDescriptor.fromAssetImage(
        ImageConfiguration.empty, "assets/volunteer.png")
    .then(
        (icon) {
            currentLocationIcon=icon;
        },
    );
}

@Override
void initState() {
getCurrentLocation();
setCustomMarkerIcon();
getPolyPoints();
super.initState();
}
@Override
Widget build(BuildContext context) {
return Scaffold(
appBar: AppBar(
    title: const Text(
        "Track Donation",
        style: TextStyle(color: Colors.black, fontSize: 20),
    ),
),
body: currentLocation == null
    ? const Center(
        child: Text("Loading...",
        style: TextStyle(color: Colors.black, fontSize: 18),
    )
)
: GoogleMap(
    initialCameraPosition:CameraPosition(
        target:
        LatLng(currentLocation!.latitude!,currentLocation!.longitude!)
        ,
        zoom: 11.5,
    ),
    polylines: {
        Polyline(
            polylineId: const PolylineId("route"),
            points: polylineCoordinates,
            color: Colors.orangeAccent,
    }
)
}

```

```

        width: 6,
    )

    },
    markers: {
    Marker(
    markerId: const MarkerId("currentLocation"),
    icon: currentLocationIcon,
    position:
    LatLng(currentLocation!.latitude!,currentLocation!.longitude!)
    ,
    ),
    Marker(
    markerId: MarkerId("source"),
    icon: sourceIcon,
    position: sourceLocation,
    ),
    const Marker(
    markerId: MarkerId("destination"),
    //icon: destinationIcon,
    position: destination,
    ),
    },
    onMapCreated: (mapController){
    _controller.complete(mapController);
    },
),
);

}
}
}

```

- OTP Generation

```

import 'dart:convert';

import 'package:flutter/material.dart';
import 'package:email_otp/email_otp.dart';
import 'package:feedforward/users/model/otp.dart';
import 'package:feedforward/api_connection/api_connection.dart';
import 'package:http/http.dart' as http;
import 'package:fluttertoast/fluttertoast.dart';
import 'package:feedforward/signin.dart';

class ForgotPassword extends StatefulWidget {
@Override
_ForgotPasswordState createState() => _ForgotPasswordState();
}

```

```
class _ForgotPasswordState extends State<ForgotPassword> {

USignin usigninWidget = USignin();

void updateCurrentId(int newId) {
usigninWidget.updateCurrentId(newId);
}

TextEditingController email = TextEditingController();
TextEditingController _otp = TextEditingController();
EmailOTP myauth = EmailOTP();
bool status_mail=false;

validateEmail() async {
OTPBACK otp_model = OTPBACK(
email.text.trim(),
email.text.trim(),
email.text.trim(),
email.text.trim(),
email.text.trim(),
);
try {
var res = await http.post(
Uri.parse(API.forgot),
body: otp_model.toJson(),
);
if (res.statusCode == 200) {
var resBody = jsonDecode(res.body);
if (resBody['success']) {
status_mail=true;
if(resBody['id']!=0){
updateCurrentId(resBody['id']);
Fluttertoast.showToast(msg:usigninWidget.getCurrentId().toString());
Fluttertoast.showToast(msg: "EMAIL VALIDATED");
otp();}
} else {
Fluttertoast.showToast(msg: "INVALID EMAIL ID");
}
}
} catch (e) {
print(e.toString());
Fluttertoast.showToast(msg: e.toString());
}
}

otp() async {
myauth.setConfig(
appEmail: "feedforward.mail@gmail.com",

```

```
        appName: "Email OTP",
        userEmail: email.text,
        otpLength: 6,
        otpType: OTPType.digitsOnly,
    );
    if (await myauth.sendOTP() == true) {
        ScaffoldMessenger.of(context).showSnackBar(
            const SnackBar(
                content: Text("OTP has been sent"),
            ),
        );
    } else {
        ScaffoldMessenger.of(context).showSnackBar(
            const SnackBar(
                content: Text("Oops, OTP send failed"),
            ),
        );
    }
}

void verifyOTP() async {
    bool isVerified = await myauth.verifyOTP(otp: _otp.text);
    if (isVerified) {
        ScaffoldMessenger.of(context).showSnackBar(
            const SnackBar(
                content: Text("OTP is verified"),
            ),
        );
    } else {
        ScaffoldMessenger.of(context).showSnackBar(
            const SnackBar(
                content: Text("Invalid OTP"),
            ),
        );
    }
}

@Override
Widget build(BuildContext context) {
    return Scaffold(
        backgroundColor: Colors.white,
        appBar: AppBar(
            title: Text("Verify Email"),

```

```
backgroundColor: Colors.pink.shade900,  
),  
body: Container(  
    child: Padding(  
        padding: const EdgeInsets.all(15),  
        child: Column(  
            mainAxisAlignment: MainAxisAlignment.center,  
            children: [  
                Card(  
                    child: Column(  
                        children: [  
                            Padding(  
                                padding: const EdgeInsets.all(8.0),  
                                child: TextFormField(  
                                    controller: email,  
                                    decoration: InputDecoration(  
                                        hintText: "User Email",  
                                        labelText: "Email",  
                                        labelStyle: TextStyle(  
                                            color: Color(0xFF880E4F),  
                                        ),  
                                        enabledBorder: UnderlineInputBorder(  
                                            borderSide: BorderSide(color: Color(0xFF880E4F)),  
                                        ),  
                                        focusedBorder: UnderlineInputBorder(  
                                            borderSide: BorderSide(color: Color(0xFF880E4F)),  
                                        ),  
                                        ),  
                                        ),  
                                ),  
                            ),  
                            ElevatedButton(  
                                onPressed: () async {  
                                    validateEmail();  
                                },  
                                style: ElevatedButton.styleFrom(  
                                    backgroundColor: Color(0xFFDA80A9),  
                                ),  
                                child: const Text("Send OTP"),  
                            ),  
                        ],  
                    ),  
                ),  
            ],  
        ),  
    ),  
    child: Column(  
        children: [  
            Padding(  
                padding: const EdgeInsets.all(8.0),  
                child: TextFormField(  
                    controller: otpController,  
                    decoration: InputDecoration(  
                        hintText: "OTP",  
                        labelText: "OTP",  
                        labelStyle: TextStyle(  
                            color: Color(0xFF880E4F),  
                        ),  
                        enabledBorder: UnderlineInputBorder(  
                            borderSide: BorderSide(color: Color(0xFF880E4F)),  
                        ),  
                        focusedBorder: UnderlineInputBorder(  
                            borderSide: BorderSide(color: Color(0xFF880E4F)),  
                        ),  
                    ),  
                ),  
            ),  
        ],  
    ),  
);
```

```
        controller: _otp,
        decoration: InputDecoration(
          hintText: "Enter OTP",
          labelText: "OTP",
          labelStyle: TextStyle(
            color: Color(0xFF880E4F),
          ),
          enabledBorder: UnderlineInputBorder(
            borderSide: BorderSide(color: Color(0xFF880E4F)),
          ),
          focusedBorder: UnderlineInputBorder(
            borderSide: BorderSide(color: Color(0xFF880E4F)),
          ),
          ),
        ),
        ElevatedButton(
          onPressed: () async {
            if(status_mail){
              verifyOTP();
            } else{
              Fluttertoast.showToast(msg: "Please enter a valid
              email id.");
            }
            style: ElevatedButton.styleFrom(
              backgroundColor: Color(0xFFDA80A9),
            ),
            child: const Text("Verify"),
          ),
        ],
      ),
    ),
  ),
),
);
}
}
```

Appendix C: CO-PO And CO-PSO Mapping

Course Outcome

Sl No.	Description	Blooms Taxonomy Level
CSD334.1	Think innovatively on the development of components, products, processes or technologies in the engineering field.	Knowledge (Level 1) Analyse (Level 4)
CSD334.2	Apply knowledge gained in solving real life engineering problems.	Evaluate (Level 2) Understand (Level 5)

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CSD334.1	-	3	-	2	-	-	1	-	3	2	1	3
CSD334.2	3	2	3	2	2	-	-	2	3	2	-	1

CO-PSO Mapping

	PSO1	PSO2	PSO3
CSD334.1	3	-	1
CSD334.2	3	3	2

Justifications for CO-PO/PSO Mapping

Mapping	Low/Medium/High	Justification
CSD334.1-PO4	M	Conduct investigations of complex problems : I used research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
CSD334.1-PO7	L	Environment and sustainability : I understood the impact of the professional engineering solutions in societal and environmental contexts, and demonstrated the knowledge of- and the need for- sustainable developments.
CSD334.1-PO9	H	Individual: We were able to function effectively as an individual, in multi-disciplinary settings.
CSD334.1-PO10	M	Communication : We were able to communicate effectively on complex Engineering activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

CSD334.1-PO11	L	Project Management and finance : Demonstrated knowledge and understanding of the Engineering and management principles and apply these to ones own work, to manage projects and in multi-disciplinary environments.
CSD334.1-PO12	H	Life-long learning : Recognized the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CSD334.1-PSO1	H	Computer Science Specific Skills : Was able to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science.
CSD334.1-PSO3	L	Professional Skills : Was able to apply the fundamentals of computer science to formulate competitive research proposals and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.
CSD334.2-PO1	H	Engineering Knowledge : Applied the knowledge of Mathematics, Science, Engineering fundamentals, and an Engineering discipline to the solution of complex engineering problems.
CSD334.2-PO2	M	Problem analysis : We were able to identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and Engineering sciences.
CSD334.2-PO3	H	Design/Development of solutions : Designed solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

CSD334.2-PO4	M	Conduct investigations of complex problems : Used research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
--------------	---	--

CSD334.2-PO5	L	Modern Tool usage : Created, selected, and applied appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
CSD334.2-PO8	M	Ethics : Applied ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice.
CSD334.2-PO9	H	Individual: We were able to function effectively as an individual, and in multi-disciplinary settings.
CSD334.2-PO10	M	Communication : Communicated effectively on complex Engineering activities with the Engineering Community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
CSD334.2-PO12	L	Life-long learning : Recognized the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
CSD334.2-PSO1	H	Computer Science Specific Skills : We were able to identify, analyze and design solutions for complex engineering problems in multi-disciplinary areas by understanding the core principles and concepts of computer science.

CSD334.2-PSO2	H	Programming and Software Development Skills : Acquired programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products.
---------------	---	---

CSD334.2-PSO3	M	Professional Skills : Applied the fundamentals of computer science to formulate competitive research proposals and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.
---------------	---	--