Original Research Article

Tech-enabled solutions for student hunger: A comprehensive analysis of food surplus, community dynamics, and usability

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Abstract

In this study, we explore the interconnected issues of food wastage, student hunger, and the potential of technology to facilitate food sharing. We begin by examining the general problem of food insecurity on university campuses and its impact on student well-being and academic performance. Through a mixed-methods approach involving 30 participants (13 Males (43%) and 17 Females (57%)), we gather both qualitative and quantitative data to understand attitudes towards surplus food and the challenges of accessing food when needed. Our quantitative findings reveal that while 69.6% of participants are willing to share surplus food, only 39.1% have access to a viable network for food distribution. Qualitative insights further uncover the profound effects of food insecurity on students, who advocate for technological solutions featuring financial tracking, transparent food distribution, and privacy measures to enhance the food-sharing experience. Building on these findings, we conduct a heuristic evaluation of a low-fidelity prototype designed to address the identified challenges. The results underscore the need for a user-friendly interface that aligns with students' preferences, with key areas for refinement highlighted for future development. Following this, we refine the application and evaluate it using the System Usability Scale, which provides valuable insights into user experiences with the FeedLine prototype. While the overall impressions are positive, the feedback also highlights the need for improved onboarding support and clearer communication of the app's capabilities. This research contributes to the development of a technology-driven solution aimed at alleviating food-related challenges among students.

Biological: AgriTech.

Keywords: *Food sharing, food wastage, heuristic evaluation, student hunger, system Usability Scale, technology-driven solution, user interface.*

1.0 INTRODUCTION
1.1 Background of study

Hunger is a pressing and immediate global issue affecting millions of individuals worldwide (Mansvelt et al., 2022). This problem extends beyond geographical boundaries, impacting both developed and developing countries. Its consequences are severe, leading to widespread suffering and malnutrition, which can have long-lasting effects on people's health and well-being. While

hunger is often associated with developing nations and low-income communities, it is also a harsh reality for a significant number of college students (Hagedorn-Hatfield et al. 2022). These young adults, despite their pursuit of higher education, often find themselves in challenging circumstances where they struggle to meet their basic needs (Broton et al., 2022). These needs include access to nutritious food, stable housing, and the means to fund their education. Research has highlighted the prevalence of food insecurity among college students, with studies indicating a wide range, from 9% to over 50% (Mansvelt et al., 2022). The adverse impact of food insecurity on these students is well-documented, affecting their physical and mental well-being, academic performance, and graduation rates (Arria & Payne, 2017) (Wagner et al., 2021). Therefore, addressing the issue of hunger among college students is imperative to ensure their welfare and success.

1.2 Problem and opportunity

Some students experience food insecurity due to financial constraints, unforeseen circumstances, or incidents like theft, resulting in instances where they go to bed hungry. Lack of immediate access to food resources can negatively impact their well-being and academic performance. Also, some students who are frequently on the move, such as those traveling, face challenges in managing excess food items. This can lead to food wastage as they might not find someone to give the excess food to before it goes bad. There is an opportunity to create a platform that addresses the issue of student hunger by facilitating easy access to food resources. The platform aims to connect students in need with donors or student donors willing to provide food assistance. By doing so, it seeks to mitigate hunger-related challenges and enhance the overall welfare of students facing food insecurity. There is an additional opportunity to create a feature within the platform that allows students to share or donate excess food items before they go bad (Krupp et al., 2022). This feature aims to minimize food waste and create a community where surplus food can be shared among students, ensuring that no edible items are discarded.

1.3 Aim

The study aims to mitigate student hunger and reduce food waste through the establishment of a platform. This platform serves as a connection point, linking students facing food insecurity with donors, thus fostering a supportive community within the university environment.

Based on the stated aim, the specific objectives for the study are:
  a. To develop a user-friendly and accessible platform to facilitate the efficient redistribution of surplus food from donors to students experiencing food insecurity.
  b. To foster a sense of community and solidarity within the university environment by promoting collaborative efforts in addressing the issues of student hunger and food waste.
  c. To implement effective mechanisms for ensuring the safety, quality, and traceability of donated food items, adhering to relevant regulations and best practices.
  d. To evaluate the impact of the platform on reducing food waste levels and alleviating food insecurity among students through comprehensive data collection and analysis.
  e. To identify and address potential barriers to adoption and sustained engagement with the platform, including concerns related to privacy, stigma, and operational challenges.

1.4 Scope of problem

The scope of the problem is limited to addressing the issue of hunger and food waste among a university community in the Southwest of Nigeria. The focus is on the challenges faced by students

who may go to bed hungry due to financial constraints or unexpected situations, as well as the problem of food wastage when students are unable to consume or store their food items. The study involves universities in southwestern Nigeria, including Obafemi Awolowo University, University of Ibadan, and University of Lagos, where the platform will be implemented to connect students experiencing food insecurity with potential donors. This initiative aims to foster a supportive community within these universities, encouraging food sharing and reducing waste

2.0 LITERATURE REVIEW
2.1 Related works

Hunger elimination constitutes a vital effort to ensure that everyone has reliable access to ample, safe, and nutritious food, catering to their dietary requirements for an active and healthy life (Sehgal et al., 2024). This objective aligns closely with Sustainable Development Goal 2 (SDG 2), a key component of the United Nations' 2030 Agenda for Sustainable Development. SDG 2 aims to eradicate hunger, attain food security, enhance nutrition, and encourage sustainable agriculture by the year 2030. This goal is pivotal within the broader framework of 17 adopted UN goals, given that hunger and malnutrition pose substantial obstacles to human development, health, education, and overall well-being. It was further reported that over 820 million people grappled with chronic hunger in 2023, and a staggering 2 billion faced varying degrees of food insecurity in recent year. Furthermore, addressing hunger and malnutrition contributes significantly to accomplishing other interconnected SDGs, spanning poverty reduction, improved health outcomes, quality education, gender equality, climate change mitigation, and fostering peace.

Technology and human-computer interaction (HCI) can play a vital role in helping to eliminate hunger and achieve SDG 2 (Arogundade et. al, 2021). Technology can provide innovative solutions for improving food production, distribution, consumption, and waste management (Arogundade et. al, 2021). For example, technology can enhance crop yields, reduce pest infestation, monitor soil quality, optimize irrigation, track food supply chains, increase access to markets, promote dietary diversity, and raise awareness of nutrition (Arogundade et. al, 2021). HCI can design user-friendly interfaces and systems that enable farmers, consumers, policymakers, and other stakeholders to access and use technology effectively and efficiently. For example, HCI can design mobile applications that provide information on weather forecasts, crop prices, best practices, or nutrition guidelines. HCI can also design interactive platforms that facilitate communication, collaboration, and learning among different actors in the food system.

Parlasca et al. (2020), evaluated the impact of a mobile phone-based nutrition education intervention on the dietary diversity and nutritional status of rural households in Kenya. The intervention used voice messages and interactive voice responses to deliver information on nutrition guidelines, healthy recipes, and behavior change strategies. The paper found that the intervention improved dietary diversity and reduced stunting among children under five years old. However, the paper also identified some limitations, such as low literacy levels, technical issues, cultural barriers, and evaluation challenges.

Chowdhury et al. (2022), explored the impact of a community-driven mobile application in Bangladesh aimed at addressing food security challenges in rural areas. The application facilitated information exchange on agricultural practices, food production, and local markets. Positive outcomes included increased awareness and collaborative efforts within communities. Nevertheless, the study recognized potential barriers related to internet connectivity and

smartphone accessibility, emphasizing the importance of tailoring interventions to specific regional contexts.

Montesi (2023), presented a case study of designing an interactive system that aims to raise awareness of food security issues among urban dwellers in India. The system used a combination of physical and digital components, such as posters, stickers, QR codes, and a website, to provide information on food production, consumption, and waste. The paper found that the system increased the engagement and knowledge of the users on food security topics. However, the paper also acknowledged some limitations, such as scalability, sustainability, and impact measurement.

Frank et al. (2021), however, described the development and evaluation of a mobile application that aims to reduce food waste and feed hungry students on a university campus. The application, called Free Food on Campus (FFC), allows users to post, view, and claim free food items that are available on campus. The paper reports the results of a user study that showed positive feedback from the users and potential benefits for the environment, social justice, and student well-being. However, the paper also discusses some limitations, such as user engagement, data accuracy, and scalability.

Garcia et al. (2021), also described a partnership between the Children's Hospital of Philadelphia and two food organizations to deliver fresh produce to food-insecure families during the COVID-19 pandemic. The paper shows how Food Connect used technology to coordinate and optimize the delivery process using text messaging, delivery integrations, and routing algorithms. The paper also assesses the impact of the delivery on the food security, health, and well-being of the families. The paper finds that the delivery improved the food security, nutrition, and health outcomes of the families. However, the paper also recognizes some limitations of the delivery, such as selection bias, self-reported data, and lack of comparison group.

2.2 Existing apps

Here, we scrutinized existing mobile applications dedicated to combating hunger and reducing food waste. Food For Orphans shines for its dedication to providing nutritious meals to orphans globally, offering various donation options such as one-time, monthly, and yearly contributions in the United States. However, the platform primarily emphasizes monetary donations for meal provisions without specifying additional support beyond nutrition. Helpi operates a network of Sharing Centers aimed at fostering community support and resource distribution to mitigate food waste in Poland. While individuals can engage with Helpi by establishing or registering centers, financial limitations are evident, as evidenced by the need for independent financing for new centers due to the limited availability of funds for existing ones. ShareTheMeal, developed by the United Nations World Food Programme and its headquarters based in Rome, addresses global hunger by enabling smartphone users to make small donations and track project progress. Despite its success in facilitating millions of shared meals and raising significant funds, ShareTheMeal heavily relies on monetary contributions, emphasizing the importance of user engagement and awareness of its effectiveness. Similarly, Zero Hunger App facilitates the distribution of leftover food from restaurants to those in need, but its success relies on the active involvement of stakeholders and user awareness to maximize impact in India.

Furthermore, the exploration of existing mobile applications aligns with the overarching goal of the study on Tech-Enabled Solutions for Student Hunger, which aims to address student hunger

and food waste through innovative technological interventions. Just as Food for Orphans and Helpi leverage technology to provide nutritious meals and foster community support, the proposed platform aims to serve as a connection point between students facing food insecurity and donors within the university environment. Similar to ShareTheMeal and Zero Hunger App, the platform facilitates food distribution and reduces waste by connecting surplus food with those in need. By examining the functionalities and limitations of existing apps, the study gains valuable insights into the design and implementation of a tailored solution to mitigate student hunger and promote a supportive community dynamic within academic settings.

However, our app stands out from ShareTheMeal and Zero Hunger App by specifically targeting student hunger within university communities, offering a more focused and impactful solution for this demographic. Unlike the broader global focus of ShareTheMeal, our app not only provides a platform for students to receive food but also encourages them to share or donate excess food, fostering a supportive, community-driven environment that addresses both food security and food waste. Additionally, our app emphasizes non-monetary contributions, allowing students to donate surplus food items directly, which broadens participation beyond just those with financial means. Furthermore, our app is designed to integrate with university infrastructure, leveraging existing campus resources such as cafeterias, student organizations, and administrative support, enhancing its relevance and effectiveness within the university setting with a feature not prioritized by the other apps.

2.3 Gap in literature

The existing literature highlights valuable initiatives utilizing technology to address food insecurity, particularly in diverse contexts such as rural households in Kenya, urban areas in India, and university campuses. However, a gap emerges in the specific context of student hunger, warranting a comprehensive analysis of food surplus management, community dynamics, and usability factors within educational institutions. While the discussed studies in section 2.1 provide insights into technological interventions for broader food-related challenges, there is a need for research specifically investigating the dynamics of surplus food distribution systems, user engagement, and the overall usability of tech-enabled solutions tailored to the unique circumstances of student populations. This gap paves the way for this paper titled "Tech-Enabled Solutions for Student Hunger: A Comprehensive Analysis of Food Surplus, Community Dynamics, and Usability," aiming to delve into the intricacies of mitigating student hunger through innovative technological interventions within academic settings in the Southwest of Nigeria.

3.0 METHODOLOGY

Before the development of an appropriate technology to address this problem, qualitative and quantitative data-gathering methodologies were used. We engaged with a total of 30 participants with 43% male and 57% female participants respectively.

3.1 Quantitative data collection

For the quantitative methodology, we used questionnaires created via google forms using a smartphone as our instrument for data gathering and a total of 23 people responded (11 females with 52% and 11 males with 48% respectively). Our interest here was to understand in general how people handle food wastage or surplus. As illustrated in Figures 1a and 1b, 69.6% of the respondents are willing to share food surplus, and only 39.1% have a means or network to leverage when in need of food.

Themed Edition – Food System Management Towards a Sustainable End to Hunger (SDG 2)
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On further probe with open-ended questions to understand the problem of hunger amongst students, the following were deduced:

a) **Willingness to share surplus food**: Most respondents expressed a willingness to share surplus food with fellow students in need. This indicates a sense of community and solidarity among students.

b) **Impact on well-being and academic performance**: Food insecurity negatively affects the physical and emotional well-being of students, with many mentioning difficulties concentrating on academic tasks when hungry. Food insecurity is reported to have a direct impact on academic performance and focus. Several students mention that hunger makes it challenging to concentrate while studying.

c) **Role of technology**: Many students believe that technology plays a crucial role in food sharing, particularly in terms of logistics, delivery, and connecting those with surplus food to those in need. Students suggest features such as a financial status tracker for those sharing food, transparency, and effective means of food distribution. They also emphasize the importance of privacy and anonymity in food sharing.
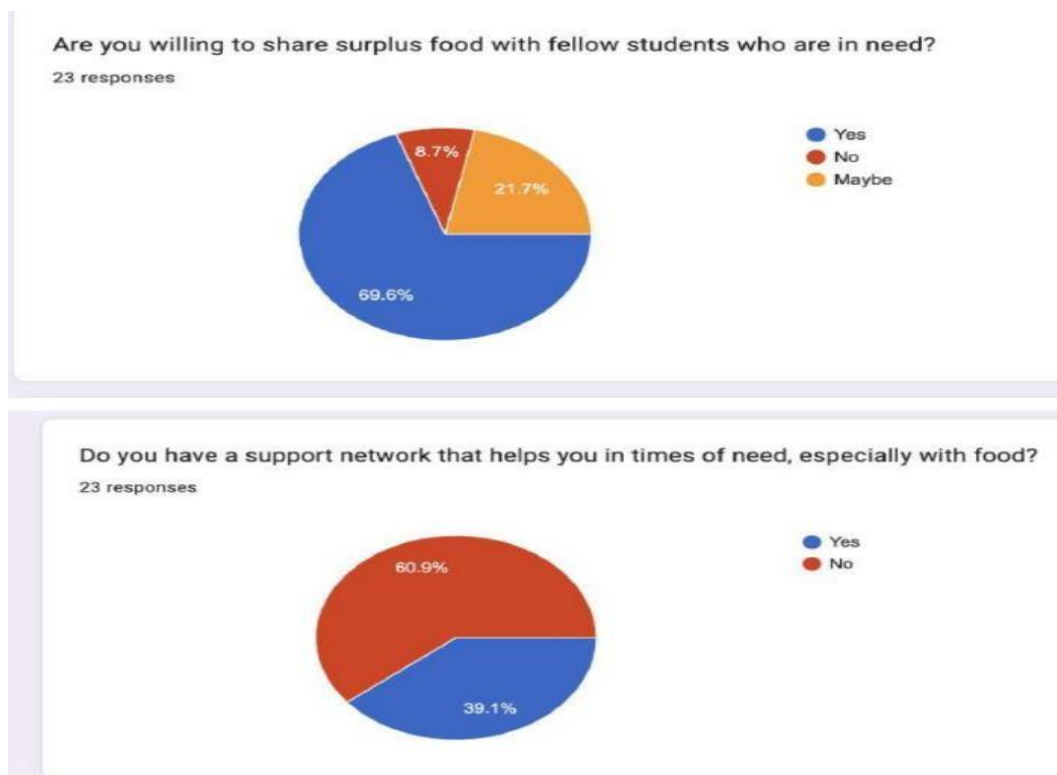
Figures 1a and 1b: Illustration on the Need for Support at University of Ibadan (24th December 2023)

3.2 Qualitative data collection

While gathering data for FeedLine, we engaged in open-ended interviews with seven individuals representing potential users. The study area is geographically situated between the coordinates of approximately N07°26'850" to N07°27'087" latitude and E003°53'899" to E003°53'552" longitude. The research involved participants from the University of Ibadan, specifically targeting

students aged between 18 to 25 years. These students had been using the app for a period ranging from 3 to 6 months. We aimed to understand their perspectives on the platform's functionalities and to determine which usage scenario resonated most with them. The interviews were conducted in a semi-structured format, allowing participants to express their candid thoughts and preferences using the features below:

a. **Background:** We set the stage by presenting a common scenario to all interviewees: imagine you purchased a half-bag of rice last week, but now you've learned that you will be traveling at the end of the month and won't be able to consume it all. You'd like to ensure the rice doesn't go to waste, so you decide to share it with others. FeedLine offers a solution for this situation. We also introduced another scenario, where individuals are in dire need of food due to unforeseen circumstances. We discussed the two following scenarios:

b. **Scenario 1:** In this scenario, a donor has excess food, which they communicate to FeedLine. The platform collects and stores the food items, making them available for those in need. When a receiver seeks assistance, their request is reviewed and approved, leading to the fulfillment of their needs.

c. **Scenario 2:** In this alternative scenario, donors directly notify FeedLine about their available food items. Receivers, in need of assistance, search for donors through the platform and connect with them to receive the food.

3.3 Justification for using semi-structured interview
a. **Richness of Data:** In our interviews, we allowed open-ended, exploratory conversations with participants. This format encourages the users to express their thoughts, opinions, and experiences in their own words, providing rich and detailed insights.

b. **In-depth understanding:** The qualitative data gathered through unstructured interviews helped us gain an in-depth understanding of participants' perspectives, attitudes, and motivations. It allows for the exploration of complex and nuanced issues.

c. **Flexibility:** The semi-structured interviews are flexible and adaptable. We were able to ask follow-up questions and probe deeper into specific areas of interest during the conversation. This flexibility enables the collection of comprehensive data.

d. **Contextual information:** The qualitative data, obtained through semi-structured interviews, often includes contextual information that is crucial for understanding the "why" and "how" behind participants' responses. This context adds depth to the analysis.

e. **Exploratory research:** These interviews are particularly valuable in the early stages of research when the goal is to explore a problem space, generate hypotheses, or identify emerging themes. We were able to generate ideas and refine the research questions.

3.4 Data collection outcome
Our interviews with potential FeedLine users shed light on various preferences and considerations. While Scenario 1 received more support, the importance of anonymity, proximity, and security were recurring themes. These insights guided us in refining FeedLine to meet the diverse needs

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and expectations of our users, ensuring it becomes a valuable tool in the fight against hunger and food waste. The responses and insights gathered from the interviews have several significant impacts on the Feedline project:

a) **Anonymity and privacy concerns:**
Impact: Anonymity emerged as a critical factor, both for donors and receivers. Privacy concerns should be addressed in the platform's design to ensure users feel secure in participating.

Action: Implement robust privacy measures, allowing users to engage in food-sharing while maintaining anonymity.

b) **Proximity-based searching:**
Impact: Proximity is a key consideration for interviewees, indicating a preference for location-based searching. Users value the convenience of connecting with nearby donors or receivers.

Action: Prioritize the development of features that enable users to find and connect with others based on their geographical proximity.

c) **Involvement of agents and warehouses:**
Impact: Some interviewees suggested involving agents in the distribution process and establishing warehouses strategically. This could enhance the efficiency of food distribution.

Action: Explore the feasibility of incorporating agents and strategically located warehouses into the platform to streamline food-sharing logistics.

d) **Appreciation mechanism:**
Impact: Interviewees highlighted the importance of expressing appreciation within the platform. This feature can foster a positive and supportive community.

Action: Incorporate a mechanism for users to express and receive appreciation within the platform, promoting a sense of community and gratitude.

e) **Review processes for donors and receivers:**
Impact: Suggestions were made for implementing review processes for both donors and receivers to prevent misuse of the system.

Action: Develop a transparent and fair review process that evaluates the credibility of users, fostering trust within the community.

3.5 Conceptual framework
With the use of a storyboard and paper prototype, we came up with a sketch of digital design to address food distribution. According to Sakpere & Kayem (2015), the use of these tools helps to identify early enough technological ideas for low-literate people and foster collaboration. These illustrations are represented in Figures 2 and 3.
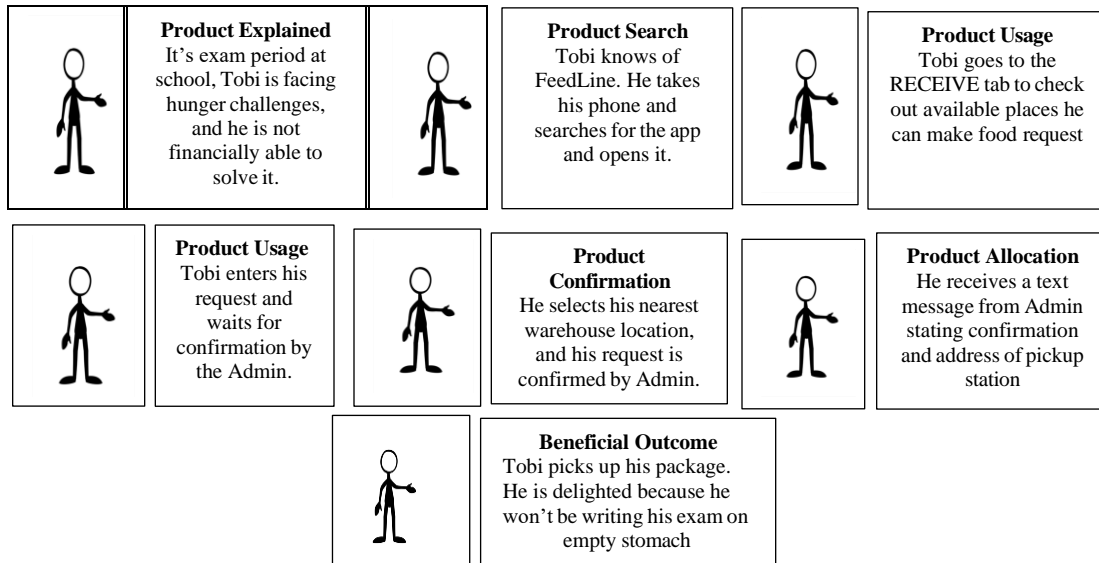
Figure 2: A Storyboard showing how to receive a food package when in need

3.6 Heuristic evaluation

Before the digital implementation of our app, the sketches were tested and evaluated by 9 people using Jakob Neilsen's heuristic evaluation which is a standard for evaluating interactive designs from a technical standpoint (Nielsen, J., & Molich, 1990). 55.6% of the evaluators were females and 44.4% were males. 66.7% of them were students and the remaining 33.3% were non-students. The choice of 9 people for the evaluation purpose is based on previous research that a minimum of 5 people suffice to evaluate an interactive application (Rogers, 2022). After a comprehensive heuristic evaluation of our low-fidelity prototype, it became clear that some of the usability heuristics, following Jakob Nielsen's principles, were not consistently followed. The identified violations shed light on crucial aspects that require attention and refinement in subsequent iterations. These violations are:

a) **Visibility:** One of the prominent observations pertained to the visibility concept, with a resounding sentiment from users that our low-fidelity prototype was not sufficiently clear. 11.1% of evaluators expressed difficulty in perceiving the information presented, citing an overload of data that hindered immediate comprehension.

b) **Error prevention:** Concerns related to error prevention surfaced, indicating a lack of clarity on graceful exit points within the interface. A notable 33.3% of users were uncertain about the effectiveness of error prevention measures, while others explicitly stated that the prototype did not distinctly display all available options for users to gracefully exit.

c) **Recognition:** The recognition concept faced challenges, as 11.1% of users reported difficulty in quickly grasping the meaning of certain interface elements. This led to requests for clarification, highlighting the need for improvements in ensuring immediate user understanding.

d) **Aesthetic and minimalist design:** A significant critique was directed at the aesthetic and

minimalist design aspect, with nearly 45% of users expressing dissatisfaction. The consensus was that the prototype lacked clear aesthetics and simplicity, emphasizing the necessity to enhance the design for improved user comprehension and visual appeal. Users found the design too simplistic, which affected their overall experience, making it harder to navigate and understand the app's features. The feedback indicates that enhancing these visual components is crucial to improve user engagement and comprehension.

e) **Error recovery:** Approximately 22.2% of users indicated a perceived deficiency in the system's ability to assist users in recognizing, diagnosing, and recovering from errors. This finding aligned with concerns raised in the error prevention section, emphasizing the need for a more user-friendly error recovery process.

f) **Help and documentation:** A notable user pointed out a violation regarding Help and Documentation, noting the absence of a dedicated module for assistance. Additionally, the limited availability of explanatory notes further hindered user understanding, signaling a need for comprehensive support features.

3.7 High fidelity prototype

Recognizing the importance of a clear and visible user interface, we acknowledge the need for a redesign that prioritizes visibility and addresses all the violations pointed out in section 3.4. In the high-fidelity prototype of Feedline, we employed a more intuitive and user-friendly design, ensuring that information is presented in a visually comprehensible manner. This new design is illustrated in Figure 4.

Also, the platform plans to transport donations through a network of volunteers or local delivery partnerships, with temporary storage solutions available if beneficiaries are not immediately identified. Initially, operations may be focused on specific regions within Nigeria, with the potential for expansion based on success and scalability. Founders gain social impact recognition, potential funding, and the satisfaction of addressing food insecurity, with opportunities to scale the platform into a sustainable business model.
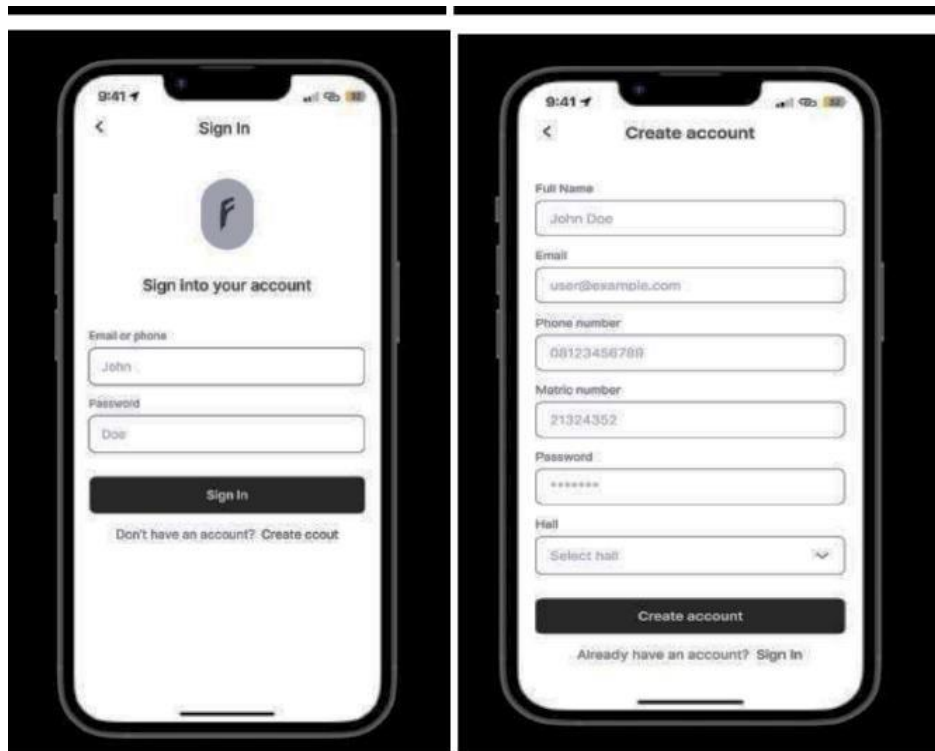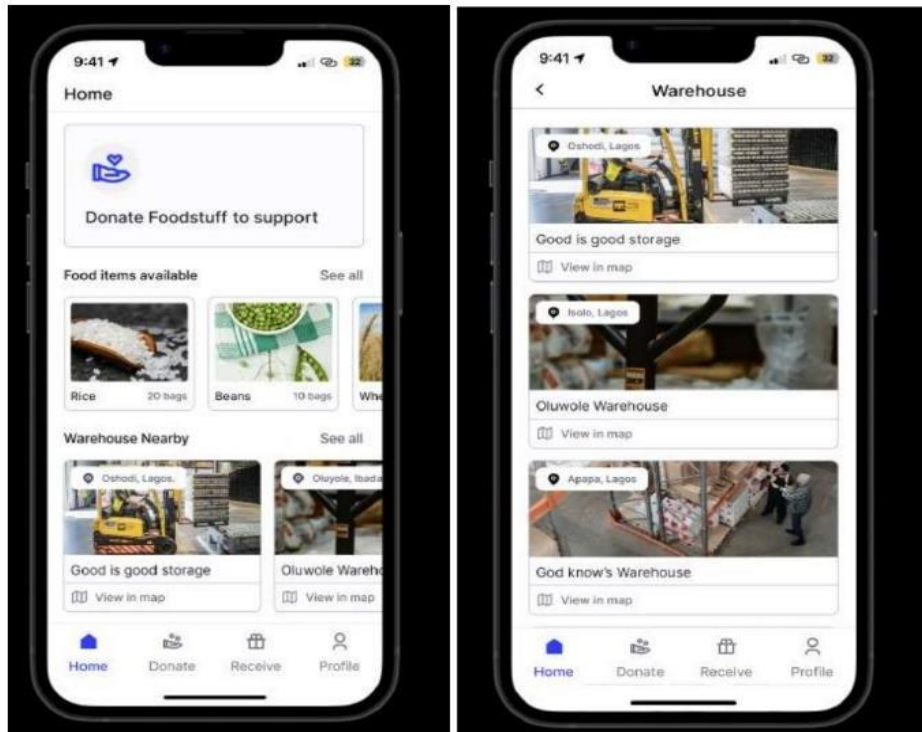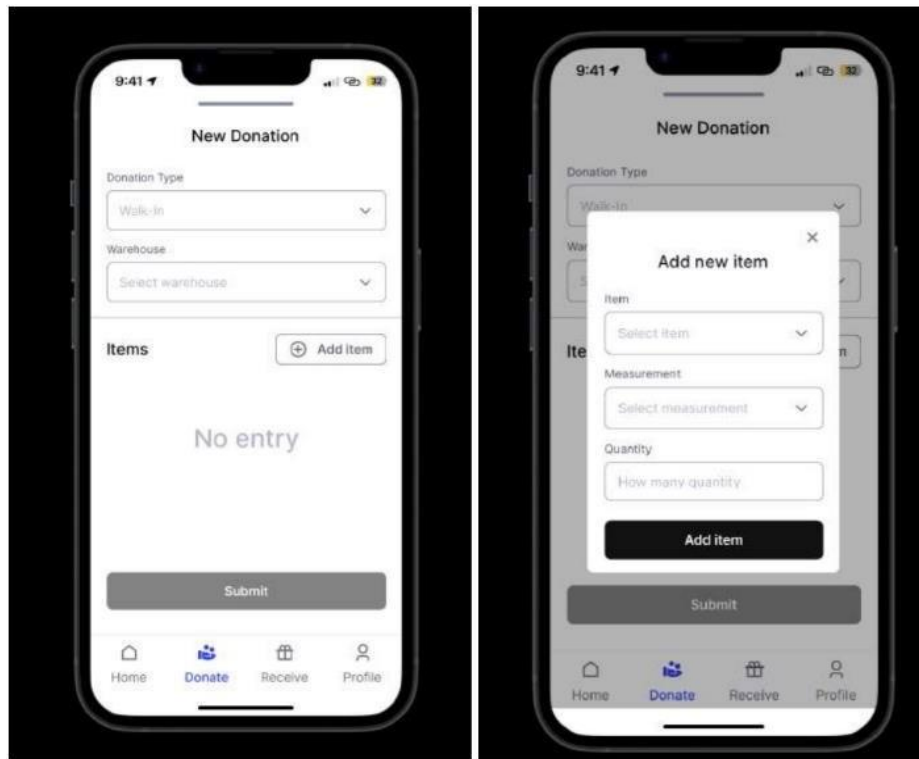
Figure 3: An illustration of the interactive design

3.7.1. User and task descriptions

The FeedLine serves two main user groups:

a) **Donors:** These are individuals or organizations who have surplus food items they wish to donate to those in need. Donors may include students or FeedLine community members.

b) **Receivers:** Receivers are individuals or families facing food insecurity and require food assistance. They may have encountered unexpected financial challenges, emergencies, or other situations that prevent them from accessing sufficient food.

3.7.1.1 User Tasks for Donors

a) **Registration:** Donors must create a profile on the FeedLine platform. This involves providing essential information such as name, contact details, and location.

b) **Food donation:** Donors can notify the platform about available surplus food items they are willing to donate. This includes specifying the type of food, quantity, and pick-up or drop-off preferences.

c) **Interaction with receivers:** Donors may communicate with receivers through in-platform messaging to coordinate the transfer of food items.

d) **Feedback and ratings:** Donors have the option to provide feedback and ratings after completing a donation to encourage responsible use of the platform.

3.7.1.2 User tasks for receivers

a) **Registration:** Receivers also need to create a profile on FeedLine, providing details such as name, contact information, and location. Additionally, they may be required to verify their need for assistance.

b) **Request for food:** Receivers can browse available food items on the platform and submit requests for specific items that meet their dietary and nutritional needs.

c) **Request approval:** Submitted requests are reviewed and approved by platform administrators to ensure they are genuine and align with the user's circumstances.

d) **Communication with donors**: Receivers may use the platform's messaging system to communicate with donors for coordination and collection of food items.

e) **Feedback and ratings:** Similar to donors, receivers can provide feedback and ratings after receiving food items to help maintain platform integrity.

3.7.1.3 User tasks for administrators

a) **User account management:** Administrators are responsible for managing user accounts, verifying the authenticity of user profiles, and ensuring compliance with platform rules.

b) **Request approval:** Administrators review and approve food requests to prevent misuse of the platform and verify that users are genuinely in need. Administrators verify food requests by requiring users to provide valid student identification and cross-referencing their information with university records. The platform also implements a scoring or referral system where trusted community members vouch for users. Additionally, historical data from the platform is analyzed to identify patterns that indicate genuine need, while potential misuse is flagged for further investigation.

c) **Platform monitoring:** They monitor platform activity, respond to user inquiries, and address any issues or disputes that may arise.

3.7.2 Use Case

a) **A use case title**: Donor Initiates a Food Donation Primary Actor: Donor (A typical University Student)

b) **Supporting actors**: FeedLine Platform, Receiver

c) **Preconditions:** The Donor has a registered and verified account on the FeedLine platform. The Donor is logged into their FeedLine account.

3.7.2.1 Main success scenario

The Donor navigates to the "Donate" section within the FeedLine app.

The Donor provides details about the surplus food items available for donation, including the type of food, quantity, and any preferences for pick-up or drop-off.

The Donor submits the donation details, triggering a notification to the FeedLine platform.

3.7.2.2 Extensions
Extension 1 - Donation approval

If the FeedLine platform identifies any inconsistencies or issues with the donation details, it prompts the Donor for clarification. The Donor provides the necessary clarifications and resubmits the donation request.

Extension 2 - Receiver interaction

If a Receiver expresses interest in the donated items, the Donor receives a notification. The Donor and Receiver can communicate through the in-platform messaging system to coordinate the transfer of food items.

Extension 3 - Feedback and ratings

After the donation is completed, both the Donor and Receiver have the option to provide feedback and ratings on the FeedLine platform.

Postconditions: The FeedLine platform records the donation information, making it visible to potential Receivers. The Donor's profile is updated with the donation history. If the food items are successfully transferred, both the Donor and Receiver can share feedback and ratings. Exception

Conditions: If the FeedLine platform identifies any violation of platform rules or suspicious activity, the donation request may be flagged for manual review by platform administrators.

4.0 RESULT AND DISCUSSION

After the iterative refinement process, the enhanced FeedLine prototype underwent further evaluation through a System Usability Scale (SUS) study, a widely accepted standardized instrument for assessing the usability of interactive systems among end-users (Brooke, 2013). The usability study was carried out by 5 people to evaluate the parameters such as ease of use, complexity of the system, need for technical support, consistency, and learnability.

Using a 5-likert scale from strongly disagree to strongly agree, 40% strongly agree they would like to use the system frequently while the remaining 60% agree. With respect to learnability, 20% strongly agreed the system was easy to quickly learn how to use, another 80% agreed and none disagreed or was neutral. Finally, 40% strongly agreed they felt confident using the system and another 60% agreed with non-disagreeing or neutral. With respect to the need for technical people to use the system, 40% agreed they would need help while the remaining 69% strongly disagreed. These yielded invaluable insights into the participants' perceptions and experiences with the FeedLine prototype, shedding light on its strengths, limitations, and areas for improvement. A comprehensive analysis of the key findings is presented below:

a) **Technology support for food connection:** The participants' responses regarding the role of technology in facilitating the connection between food donors and recipients were diverse. While a substantial 40% expressed strong support for leveraging technological solutions, an equal proportion (40%) exhibited a moderate stance, and the remaining 20% perceived limited support from technology. This divergence in responses underscores the need for the FeedLine platform to cater to users with varying levels of technological

proficiency and comfort, ensuring a seamless and inclusive experience for all user segments.

b) **Prevalence of food scarcity and wastage:** A striking 80% of the participants reported having experienced food scarcity, highlighting the pervasive nature of this issue among the target audience. Congruently, an equal proportion (80%) acknowledged facing challenges related to food wastage, emphasizing the dual problem that FeedLine aims to address effectively through its innovative approach.

c) **Technology access and usage for donation:** The study revealed that the majority of participants had access to technological resources, indicating that leveraging technology-driven solutions is a viable approach. However, only 20% of the participants had previously utilized technology for food donation. This finding presents an opportunity for FeedLine to bridge the gap and encourage more users to contribute to the cause through the platform, potentially by implementing educational campaigns and incentive programs.

d) **Appraisal of feedLine:** Most participants expressed positive sentiments towards the FeedLine app, describing it as simple, straightforward, intuitive, and highly appealing. These favourable impressions signify a strong foundation for user acceptance and engagement, indicating that the app's design and functionality are aligned with user expectations and preferences.

e) **Challenges and assistance needs:** While the overall reception was positive, 40% of the participants found the prototype difficult to use, and an equal percentage expressed the need for assistance during their initial interactions with the app. Additionally, 20% of the participants noted inconsistencies within the prototype. These findings underscore the importance of refining the user interface to enhance its intuitiveness and usability, as well as providing sufficient onboarding support and guidance to ensure a seamless user experience.

f) **Overall benefit of feedLine:** The participants expressed optimistic sentiments about the potential benefits of FeedLine in addressing the pressing issues of food scarcity and waste among students. They acknowledged the app's great promise and its potential to be highly beneficial in alleviating these challenges, further validating the need for such a platform within the target community.

While some participants expressed uncertainty about the app's ability to solve food wastage effectively, others remained optimistic, emphasizing the convenience and accessibility it could bring to students in need. These varying perspectives highlight the need for effective communication strategies to educate users about the app's capabilities and benefits, fostering a deeper understanding and appreciation of its potential impact.

However, in comparison, the usability study of FeedLine reveals several points of alignment and divergence with these existing platforms. FeedLine has been designed with specific attention to user feedback, resulting in a highly intuitive interface that addresses common usability concerns identified in similar studies. For example, where ShareTheMeal's interface is praised for

simplicity, FeedLine incorporates advanced features that enhance user engagement while maintaining ease of use.

Furthermore, while Zero Hunger's broader approach sometimes leads to complex user interactions, FeedLine has streamlined its processes to offer a more cohesive and user-friendly experience. This distinction is crucial, as it suggests that FeedLine not only addresses usability issues effectively but also offers enhancements that contribute to its superior performance in certain areas.

Overall, FeedLine's usability findings reflect both improvements and challenges when compared to existing studies. By aligning with successful strategies from platforms like ShareTheMeal while addressing areas of complexity noted in Zero Hunger, FeedLine presents a balanced and user-centric approach to food-sharing solutions.

5.0 CONCLUSION

This comprehensive research endeavour delves into the prominent and interrelated issues of food wastage and food insecurity within student communities, employing a robust mixed-methods approach that synergistically integrates both qualitative and quantitative methodologies. The findings illuminate a notable willingness and inclination among students to engage in food surplus-sharing initiatives, underscoring the potential for nurturing a sense of community solidarity and collective responsibility. However, the study also unveils persistent challenges, particularly the absence of robust support networks and infrastructures to facilitate effective food redistribution during instances of food scarcity.

The pivotal role of technology in addressing the logistical complexities associated with food-sharing initiatives emerges as a salient and recurring theme throughout the research. Students consistently acknowledged the potential of technological solutions and advocated for the incorporation of features such as financial tracking mechanisms and transparent distribution algorithms, underscoring the paramount importance of privacy protection and operational efficiency in these initiatives. The heuristic evaluation of a low-fidelity prototype provided invaluable insights into usability concerns, emphasizing the imperative for a more visually appealing, intuitive, and user-friendly interface design.

Specific issues related to visibility, error prevention, recognition, and adherence to the principles of minimalist design were identified, underscoring the necessity of aligning technological solutions with user preferences and expectations. This alignment is crucial to ensure seamless adoption and sustained engagement with the proposed interventions.

In essence, this research contributes valuable and multidimensional insights into the multifaceted challenges surrounding food wastage and hunger among student populations, proposing the integration of technological interventions to establish a supportive and sustainable food-sharing ecosystem within educational institutions. The study not only underscores the imperative of clear and intuitive user interfaces but also emphasizes the critical aspects of fostering a sense of community, safeguarding privacy, and ensuring operational efficiency in addressing these pressing issues.

The findings of this research serve as a foundational framework for subsequent iterations and the development of impactful solutions tailored to the specific contexts and experiences of student

communities. By considering the holistic experiences, preferences, and perspectives of students, this research paves the way for the development of robust and effective interventions that can catalyze positive change in mitigating food wastage and alleviating food insecurity within educational settings.

6.0 FUTURE WORKS

Based on the comprehensive research and findings presented, here are some potential future works that could be pursued:

a) **Develop and implement a fully functional platform:** Building upon the insights from the high-fidelity prototype evaluation, the next step could be to develop a fully functional, visually appealing, and user-friendly platform that incorporates the desired features and addresses the identified usability concerns.

b) **Conduct large-scale pilot studies and field trials:** Once the platform is developed, large-scale pilot studies and field trials could be conducted within various educational institutions to assess its real-world impact, adoption rates, and effectiveness in reducing food waste and alleviating student hunger.

c) **Explore gamification and incentive mechanisms:** To foster sustained engagement and encourage more active participation, future research could explore the integration of gamification elements and incentive mechanisms within the platform, promoting a sense of community and rewarding positive behaviors.

d) **Investigate collaborative models and partnerships:** Exploring collaborative models and establishing partnerships with local businesses, non-profit organizations, and government agencies could enhance the platform's reach, resources, and overall impact, potentially leading to a more holistic and scalable solution.

e) **Develop educational and awareness campaigns:** In conjunction with the platform's implementation, future efforts could focus on developing educational and awareness campaigns to address stigma, promote responsible food consumption, and encourage community-wide participation in food-sharing initiatives.

f) **Conduct longitudinal studies and impact assessments:** Longitudinal studies and comprehensive impact assessments could be undertaken to evaluate the long-term effects of the platform on student well-being, food waste reduction, and the fostering of sustainable practices within educational institutions.

These potential future works could build upon the solid foundation established by the current research, enabling the development of more comprehensive, scalable, and impactful solutions to address the critical issues of food waste and food insecurity within educational settings and beyond.

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