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FarmAssist: Fostering Connection in Direct Produce Exchange for Agricultural Commerce in the Philippines

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Abstract. The agricultural sector in the Philippines faces numerous challenges, including limited market access, price volatility, and dependency on intermediaries. In response to these challenges, this study introduces FarmAssist, an e-platform designed to redefine agricultural trade dynamics through peer-to-peer produce exchange. The study aims to enhance the efficiency, transparency, and accessibility of agricultural trade by addressing the inherent gaps and difficulties faced by farmers. Through the development of FarmAssist, key objectives including establishing a robust peer-to-peer produce exchange platform, defining technical blueprints emphasizing scalability, security, and usability, and conducting comprehensive user evaluation using the System Usability Scale (SUS) and User Experience Questionnaire (UEQ) have been achieved. Results indicate a positive reception to FarmAssist, with high usability and user satisfaction ratings. The successful implementation of FarmAssist highlights its transformative potential in empowering farmers, fostering direct connections, and creating a more equitable marketplace in the agricultural sector.

Keywords: FarmAssist, e-Platform, Agricultural Trade, mobile app, SUS, UEQ

1. Introduction

The agricultural trade presents the Philippines with a variety of issues. For small-scale farmers, limited market access is a major obstacle caused by poor infrastructure and logistical problems [1]. Weather and market demand, among other things, can cause price volatility in the agricultural sector, which can affect the stability of farmers' incomes [2]. Because mediators play a vital but occasionally exploitative role in the supply chain, farmers' profit margins are often lowered as a result of their dependence on intermediaries [3].

A large percentage of the world's population depends on agricultural trade for their food and livelihoods, making it a pillar of global economies [4]. However, inefficiencies, difficulties gaining access to markets, and price discrepancies are frequent features of existing agricultural trading systems that negatively impact farmers, especially smallholders [5]. Farmers often have lower profit margins as a result of the involvement of multiple intermediaries, which exacerbates these problems [6].

Amidst these obstacles, there is a chance to use technical advancements to transform the agricultural trade environment completely. This study explores the current situation of agricultural commerce, looking at the challenges farmers confront and the flaws in the institutions in place. It presents a novel e-platform called "FarmAssist," which embraces a peer-to-peer produce exchange paradigm in order to reshape the dynamics of agricultural trade.

By addressing the inherent gaps and difficulties in the current agricultural trade procedures, the study FarmAssist is poised to make a substantial contribution. The study intends to close gaps that impede equitable pay, market access, and overall profitability for farmers by exploring the nuances of the trading landscape. By building an electronic platform called FarmAssist that allows for peer-to-peer exchange of produce, this project aims to empower farmers, lessen their need for mediators, and establish a more transparent and equitable agricultural trade environment.

1.1. Objectives of the Study

The general objective of the study is to design and develop "FarmAssist: Fostering Connection in Direct Produce Exchange for Agricultural Commerce in the Philippines" with the aim of enhancing the efficiency,

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transparency, and accessibility of agricultural trade, ultimately empowering farmers and fostering a more equitable marketplace. Other specific intents of the study include:

- To establish a robust peer-to-peer produce exchange platform.
- To define the technical blueprint, emphasizing scalability, security, and usability.
- To develop a user-friendly interface with design principles to enhance the overall user experience.
- To conduct comprehensive testing, including user acceptance assessments using the SUS and UEQ Usability model.

2. Literature Review

2.1. Challenges in Agricultural Trade

1) Traditional Agricultural Trade Landscape

An intricate web of mediators between producers and buyers has defined the landscape of traditional agricultural trade. Although this structure makes distribution easier, it frequently leads to inefficiencies, a lack of transparency, and lower farmer profitability. Research elucidates obstacles such as capricious pricing, postponed payments, and a lack of communication between producers and final consumers.

The difficulties farmers encounter in the conventional trading system are highlighted by the Department of Agriculture Press Office [7]. Reaching larger markets, negotiating reasonable rates, and building a direct relationship with customers are often challenges faced by farmers.

2) Impact of Intermediaries on Farmers

Although they are essential to the agricultural sector, intermediaries can often exacerbate problems for farmers. The impact of intermediaries on pricing dynamics is highlighted in the study of Alvarito Nito (2017) since these entities frequently set terms that may not be advantageous to farmers [8]. The absence of a direct connection between producers and final consumers further hampers transparency in transactions.

The Asian Development Bank (ADB) (2018) case study clarifies the power relationships between farmers and mediators, emphasizing the necessity for policies that empower farmers by lowering their reliance on intermediaries [9].

2.2. Features and Functionalities in E-Platforms

1) Existing E-Platforms in Agricultural Trade

E-platforms have become the game-changing solutions for commerce in agricultural products. Direct connections between farmers and consumers are made possible by platforms such as AgriLink and Harbest Manila, which have gained popularity. The Food and Agriculture Organization's (2017) report highlights the potential of these platforms to improve farmers' access to markets and guarantee equitable compensation [10].

ADB's (2017) research sheds light on the function of current e-platforms by showcasing successful scenarios in which farmers have profited from dealing directly with one another and have been less dependent on intermediaries [11].

2) Effective Features for Addressing Farmer Challenges

Farmers can overcome obstacles with the help of efficient features in e-platforms. FAO (2021) highlights the importance of real-time pricing systems, direct communication channels, and transparent transaction records in order to address issues in agricultural trade [12]. The World Bank (2019) is investigating the incorporation of blockchain technology as a way to improve transaction transparency and traceability [13].

All of the research points to the necessity of characteristics that empower farmers, facilitate direct customer engagement, and provide an environment that is transparent and fair for trading.

2.3. Technical Specifications in E-Commerce Platforms

1) Importance of Technical Specifications

The foundation of agricultural trade e-commerce platforms is made up of technical standards. Barreira et al. (2016) underscore the significance of precisely stated technological specifications in guaranteeing the

efficacy and usefulness of said platforms [14]. Well-defined specs facilitate a smooth user experience and direct the development process.

Kim et al.'s research from 2023 explores the importance of matching technical requirements to industry-specific requirements, taking into account things like safe transactions and real-time data processing [15].

2) Scalability, Security, and Usability in Successful Platforms

Usability, security, and scalability are important factors in e-commerce platform success. The necessity for scalable platforms that can adjust to changing transaction volumes was brought to light in the works of Rey et al. (2023) [16]. Rey and Baccay (2022) emphasize the importance of security measures, such as encryption and data protection, in fostering user confidence and guaranteeing the integrity of transactions [17]. Rey and Rolluqui (2021) consider usability as a critical component of e-platform adoption, highlighting the necessity of user-friendly interfaces that accommodate a range of technical proficiency levels [18].

2.4. User Interface Design Principles

1) User Interface Design in E-Commerce

A key factor in improving the overall user experience on e-commerce platforms is effective user interface design. The concepts of user interface design are explored in research by Gunawan et al. (2021) and Arambepola (2020), which emphasize the importance of visual appeal, responsive design, and intuitive navigation [19][20]. The user interface serves as the portal, making it easier for farmers, customers, and other users to interact with the platform.

In their 2012 study, Zamzami and Mahmud emphasize the significant impact that a well-designed interface may have on user engagement and retention while delving deeper into the relationship between user interface design and satisfaction [21]. The user interface's design decisions have a big impact on how users interact with the platform and how they experience it overall.

2) Inclusivity and User Proficiency

In UI design, inclusiveness is critical, especially in the agriculture industry, where consumers may have different degrees of technical expertise. The 2019 study by Pitale and Bhumgara explores interface design tactics that accommodate users with varying technological backgrounds, guaranteeing accessibility for all players in the agricultural trading ecosystem [22]. Usmani et al. (2023) stress the significance of user interface design in promoting inclusivity by making the platform easy to use for both consumers and farmers [23]. By emphasizing inclusivity, the user interface is made to be flexible enough to meet the needs and preferences of a wide range of users in the context of agricultural commerce.

3. Methodology

3.1. Research Paradigm

The input, process, output, and feedback stages of the study are delineated in Figure 1's Research Paradigm. During the input phase, various factors are considered, such as the study backdrop, knowledge requirements, respondent identification, data collecting, and instrument selection.

Fig. 1: Research Paradigm

3.2. Software Development

As seen in Figure 2, the software development for this project uses a systematic methodology that includes phases for planning and analysis, system design, development, testing, and assessment.

Fig. 2: Software Methodology Model

- **Planning and Analysis:** In order to determine the layout and features of the system, the researcher gathered requirements, clarified the goals, objectives, and scope of the project, and examined user and stakeholder demands. In order to guarantee the mobile application functions flawlessly, we also took into account the back-end coding specifications.
- **System Design:** In this stage, the researcher created the system's general design and structure, detailing how different components are processed and managed. Ensuring a visually beautiful and user-friendly interface was the primary goal of the mobile application's user interface (UI) and user experience (UX) design.
- **Development:** The researcher implemented the system using the pre-planned design, which included front-end and back-end development. While back-end development required handling data storage, creating functionality, and integrating APIs or services, front-end development sought to create a user-friendly interface.
- **Testing:** Extensive testing was done to confirm the system's operation, dependability, and quality. Unit, integration, and system testing were all included in this. The mobile application was put through a rigorous testing procedure to find and fix any bugs, mistakes, or usability problems. This process continued until the program met all requirements for release.
- **Evaluation:** The system was evaluated using the System Usability Scale (SUS) and User Experience Questionnaire (UEQ). This required determining the target audience, establishing KPIs, establishing usability targets, performing user interviews and surveys, and keeping extensive records. The main goal of the evaluation procedure was to confirm that the application provided a generally good user experience by appropriately attending to the demands and preferences of the user.

3.3. Defining Technical Blueprint

1) Technical Specifications

After a thorough examination of the technological structures of several e-commerce systems already in use, the FarmAssist technical blueprint was created. This required describing the precise technical requirements, such as the architecture of the database, the server setup, and the data processing methods. The objective was to provide a solid basis that guarantees the platform's usability, security, and scalability. Through the integration of features, including safe transaction protocols and real-time data processing, the technological specifications were matched to the particular needs of agricultural trading. Figure 3 displays the architecture of the system.

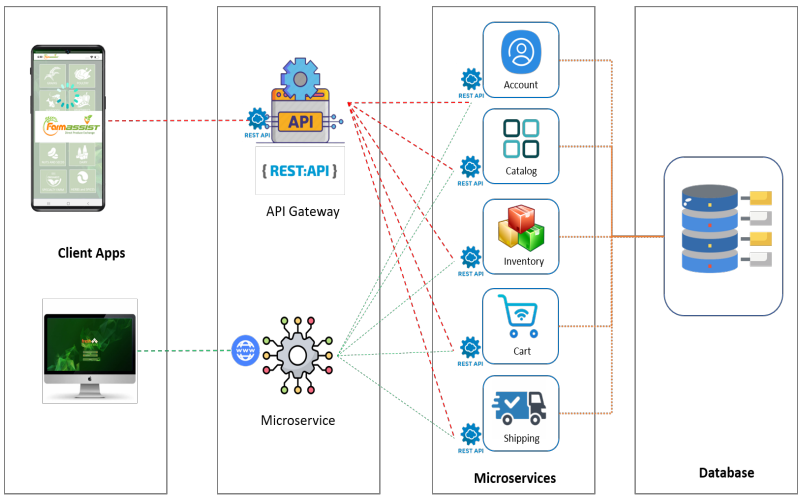

Fig. 3: FarmAssist System Architecture

2) Scalability, Security, and Usability Assessment

A thorough evaluation was carried out to guarantee FarmAssist's scalability, security, and usability. In order to assess scalability and identify how well the platform performed at different transaction volumes, simulated scenarios were used. Security measures were put in place to secure sensitive data, such as encryption and data protection procedures. In order to evaluate the usability and accessibility of the platform, possible users with a range of technical skills were involved in usability testing. The technological blueprint was refined based on the iterative input obtained from these assessments.

3.4. Designing an Intuitive User Interface

1) User Interface Development

Inclusion and ease of use were given top priority in the design of FarmAssist's user interface. Design components were developed with users of different technical skill levels in mind so farmers and consumers could both benefit from accessibility. Prototyping and user testing were used in an iterative design approach to improve the interface in response to input. The design prioritized visual attractiveness, user-friendly navigation, and clear information communication to create a satisfying experience for users.

2) Incorporating Design Principles

Well-established e-commerce and user experience approaches influenced the design of the FarmAssist interface. These guidelines included responsiveness across various devices, clarity in the presentation of information, and uniformity in visual aspects. A seamless and pleasurable user experience was the goal, taking into account the distinctive qualities of the agricultural trade participants. To improve usability and engagement, FarmAssist matched the design to user expectations and preferences.

4. Results and Discussion

4.1. Technical Specifications Implementation

The development phase's technical specifications were executed with great care and attention to detail, conforming to the particular needs of the agricultural trade. The infrastructure and architecture were created and then translated into physical components, making sure that FarmAssist functions with security, scalability, and efficiency at its heart.

Deploying a strong server architecture to manage fluctuating transaction volumes was part of the implementation phase. In order to guarantee that FarmAssist could adapt to the changing landscape of agricultural trade, scalability was a crucial factor. Strict integration of security measures, such as encryption methods and secure data management, was necessary to protect sensitive data and foster user confidence. Another key component of the technical blueprint was usability, which was converted into a responsive and user-friendly platform design. The foundation of a dependable and robust e-platform is formed by the technological specifications that FarmAssist has implemented.

4.2. FarmAssist Mobile Application

1) User Interface Design and Principles Application

The implementation of design concepts to improve the overall user experience was given priority during the user interface development process. Strict attention to detail was taken to ensure that the interface was snappy, visually appealing, and straightforward enough to accommodate users of different technical skill levels. Figure 4 illustrates how the iterative design approach, informed by user testing and feedback, made sure the interface was not only very useful and accessible but also aesthetically beautiful.

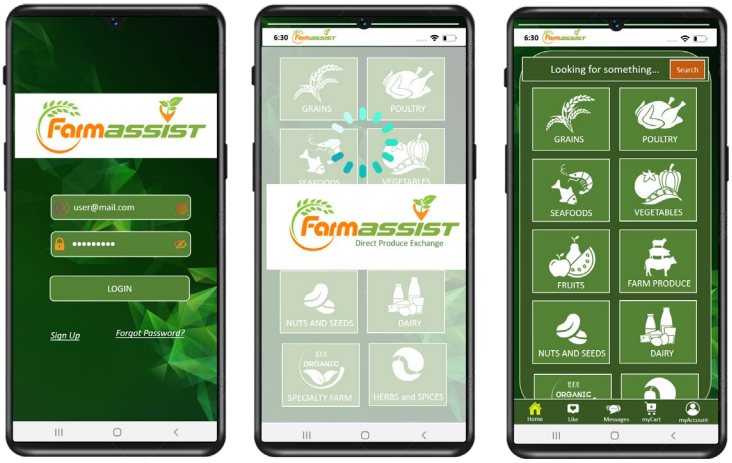

Fig. 4: FarmAssist User Interface

Design principles are used in a way that prioritizes inclusion over beauty. FarmAssist is easy to use for both farmers and consumers, regardless of their level of technology expertise. As demonstrated in Figure 5, the user-centric design encourages good interactions between users and the platform, simplicity of use, and increased engagement. The interface acts as a conduit, bringing farmers and consumers together directly and supporting the main objective of lowering dependency on intermediaries.

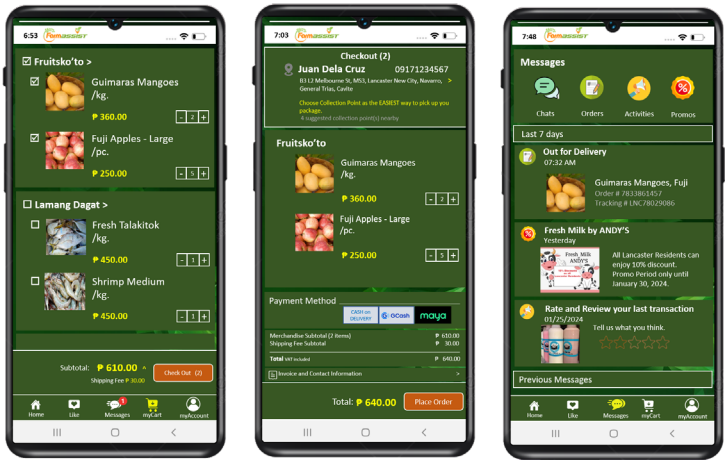

Fig. 5: FarmAssist Transactions

4.3. User Testing

1) Feedback Collection

User testing turned out to be an important stage in the creation of FarmAssist, with an emphasis on obtaining insightful input from possible users. Farmers, customers, and other users interacted with the site, sharing their experiences, difficulties, and recommendations for enhancements. To get a range of viewpoints, structured feedback gathering techniques like surveys, interviews, and usability testing were used.

The feedback-gathering process revealed important information about user preferences, problems, and potential improvements. Producers underlined the value of user-friendly features to present their goods, and buyers underscored the necessity of clear transaction procedures. Iterative feedback sessions were held in order to guarantee that the opinions of users were vital to the development of the platform.

2) Iterative Development

The insights gained from user feedback guided the iterative development phase. FarmAssist was continuously improved, taking into account user feedback and resolving difficulties found. Iterations included improvements to the peer-to-peer trading paradigm, tweaks to the user interface, and general platform functionality optimizations.

FarmAssist was able to adapt to user expectations by means of a dynamic feedback loop that was established through iterative development and user testing. The platform's overall user-friendliness was adjusted, features were upgraded, and navigation paths were made better. FarmAssist closely conforms to the requirements and preferences of its main customers, who are farmers and consumers, thanks to this iterative method.

4.4. System Performance Evaluation

1) Stress Testing

FarmAssist was put through a comprehensive stress test to see how well it performed in various usage circumstances. Simulated stress scenarios with significant transaction volumes and concurrent user interactions were carried out to assess the platform's robustness. The goal of the stress testing stage was to locate any possible weak points, bottlenecks, and places in need of optimization.

The outcomes of the stress tests validated FarmAssist's scalability, showing that it can manage higher user activity levels without sacrificing functionality. Stress testing insights led to modifications in server capacity and data processing methods, guaranteeing that the platform can adapt to the ever-changing needs of the agricultural trade environment.

2) Performance Assessment:

In-depth performance evaluations were carried out to determine FarmAssist's dependability. Table 1 displays the metrics that were taken into consideration, including perceived load speed, responsiveness, performance, visual stability, load time, and interactivity.

Table 1: Performance Test Results

Measurement	Parameters	Ideal Value	Measured Value	Remarks
Overall Performance Scoring			88	Moderate
First Contentful Paint (FCP)	Perceived Load Speed	[0, 1000ms]	2.2 s	Fast
First Input Delay (FID)	Responsiveness	[0, 100ms]	3.0 s	Fast
Largest Contentful Paint (LCP)	Performance	[0, 2500ms]	3.5 s	Moderate
Cumulative Layout Shift (CLS)	Visual Stability	[0, 0.1]	0	Fast
Speed Index (SI)	Load time	[0 – 4.3s]	2.8 s	Fast
Time to Interactive (TTI)	interactivity	[0 – 3.8s]	3.0s	Fast

Performance evaluations verified that FarmAssist meets the requirements needed for a successful e-platform and runs consistently and effectively. The platform operates optimally and provides a seamless user experience since areas of improvement found during testing and assessments were methodically addressed.

4.5. System Usability Scale (SUS) Assessment Results

Table 2 presents the results of a system usability test conducted with 100 participants. Each participant responded to ten usability questions (labeled Q1 through Q10) on a scale from 1 to 5, with 1 representing strong disagreement and 5 indicating strong agreement with statements regarding the system's usability. The responses were used to calculate an overall System Usability Scale (SUS) score for each participant, displayed in the "SUS Score" column. Additionally, columns X and Y seem to represent calculated values derived from the individual responses. The table shows an average SUS score of approximately 87.475 across all participants, corresponding to an "Excellent" rating. This suggests that the system under evaluation received high usability ratings from participants, indicating a favorable perception of its usability and effectiveness.

Table 2: System Usability Results

Q>	1	2	3	4	5	6	7	8	9	10	X	Y	SUS Score
1	5	1	5	2	5	2	4	1	4	1	18	18	90.00
2	4	1	5	2	5	2	5	1	5	2	19	17	90.00
3	4	1	4	1	5	2	4	2	5	2	17	17	85.00
4	4	2	4	2	5	2	5	1	4	1	17	17	85.00
…	…	…	…	…	…	…	…	…	…	…	…	…	…
Average													87.475
Grade													A
Adjective Rating													Excellent

4.6. User Experience Evaluation Results

The User Experience Questionnaire (UEQ) was employed to assess various dimensions of user experience in the FarmAssist system. Table 3 presents the mean scores and variances across different UEQ scales. The graphical representation of UEQ means of scales is shown in Figure 6.

Table 3: UEQ Scales (Means and Variances)

UEQ Scales	Mean	Variance
Attractiveness	1.948	0.17
Perspicuity	1.980	0.23
Efficiency	1.980	0.20
Dependability	1.910	0.21
Stimulation	2.058	0.18
Novelty	1.945	0.18

Participants in the study reported positive perceptions of FarmAssist across various dimensions of user experience. The system received a mean score of 1.948 for attractiveness, indicating a generally appealing visual design. With a mean score of 1.980 for perspicuity, users found the system to be clear and understandable. FarmAssist demonstrated efficient task facilitation, earning a mean score of 1.980 for efficiency. However, there is room for improvement in terms of dependability, as indicated by a mean score of 1.910, suggesting potential enhancements to ensure reliability. The system excelled in user engagement, scoring 2.058 for stimulation, and was perceived as innovative, scoring 1.945 for novelty. These insights provide valuable guidance for further refinement and enhancement efforts to optimize the user experience of FarmAssist.

Overall, this provides a comprehensive view of users' experiences, highlighting positive perceptions across various dimensions, with some variations in opinions on clarity and efficiency.

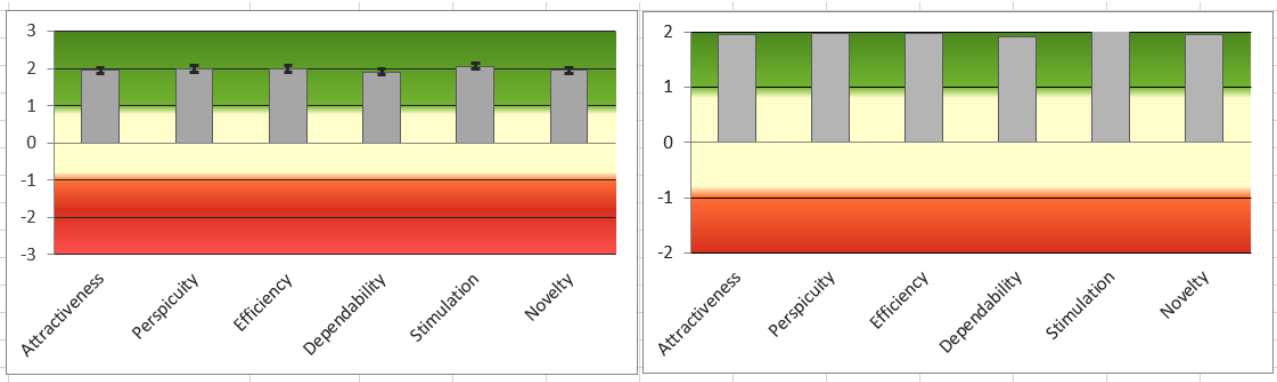

Fig. 6: Graphical Representation of UEQ Means of the Scales

1) Discussion on Various Aspects of User Experience

Table 4 presents the assessment of both pragmatic and hedonic qualities in the FarmAssist system, shedding light on different aspects of user experience. The graphical representation is shown in Figure 7.

Table 4: Pragmatic and Hedonic Quality

Pragmatic and Hedonic Quality	
Attractiveness	1.95
Pragmatic Quality	1.96
Hedonic Quality	2.00

The evaluation of FarmAssist's user experience reveals a balanced blend of pragmatic and hedonic qualities. With a score of 1.95 for attractiveness, users find the system visually appealing and engaging. The pragmatic quality, reflected in a mean score of 1.96, indicates the system's effectiveness in fulfilling practical needs. Additionally, the hedonic quality, with a mean score of 2.00, highlights positive emotional responses and enjoyment from interacting with the system. This balanced assessment underscores FarmAssist's ability to meet both practical requirements and emotional satisfaction, contributing to an overall positive user experience.

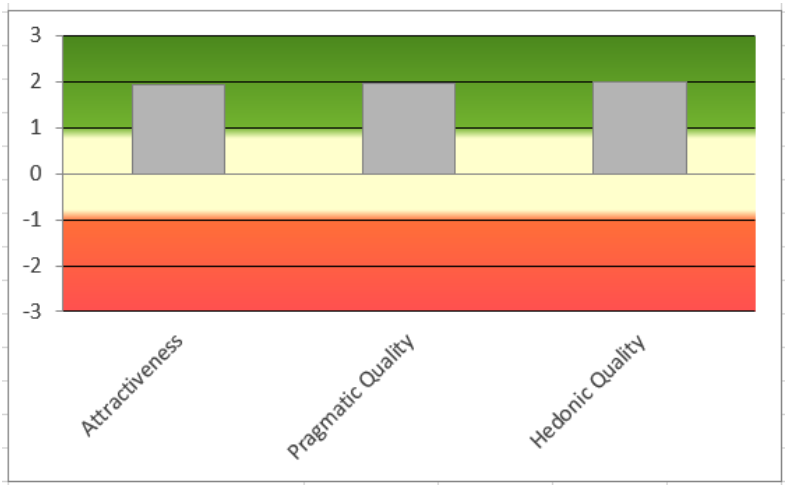

Fig. 7: Graphical Representation of Pragmatic and Hedonic Quality

2) Key Performance Indicator (KPI) for Attractiveness

In the context of the User Experience Questionnaire (UEQ), the specific scale under consideration is "Attractiveness." The Key Performance Indicator (KPI) for Attractiveness is determined to be 1.96, as shown in Table 4, signifying a notably positive average user rating. This KPI is derived from user responses on a scale that typically ranges from 1 to 7 or a similar span, where higher values indicate more favorable evaluations.

Table 5. Key Performance Indicator for Attractiveness

KPI	STD	Confidence
1.96	0.23	0.05

The Standard Deviation (STD) for Attractiveness is calculated to be 0.23. This measurement reflects the degree of variation or dispersion in user responses. A lower standard deviation, as observed here, suggests that user opinions regarding the Attractiveness scale are relatively consistent and closely clustered around the mean.

The Confidence Interval (CI) for Attractiveness, established at a confidence level of 95% (p=0.05), is reported as ranging from 1.868 to 2.028. This interval signifies a high level of confidence that the true population mean for attractiveness lies within this specified range based on the sampled data.

5. Conclusion

In conclusion, FarmAssist has successfully achieved its objectives as outlined in the study. Through the development of a robust peer-to-peer produce exchange platform, FarmAssist has enhanced the efficiency, transparency, and accessibility of agricultural trade in the Philippines. The technical blueprint, emphasizing

scalability, security, and usability, has been meticulously defined and implemented, resulting in a platform that meets the needs of farmers and users alike. User testing and evaluations, including the System Usability Scale (SUS) and User Experience Questionnaire (UEQ), have provided valuable insights into the platform's effectiveness and user satisfaction, with FarmAssist receiving high ratings across various dimensions. Overall, FarmAssist stands as a testament to the potential of technology to revolutionize agricultural trade, empowering farmers, fostering direct connections, and creating a more equitable marketplace.

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