IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

The Impact Of Self-Service Iot Retail Kiosks On Customer Behavior And Business Operational Performance

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ABSTRACT

The study investigates how customers behave and retailers operate in physical stores when their behavior is affected by self-service Internet of Things (IoT)-enabled retail kiosks. Systems that use computation to adapt themselves to the needs of their users can realize remarkable improvements with respect to custom indicators such as waiting time, transaction speed, frequency of purchase, customer satisfaction, and store staff workload after/ following error control for personalization. Study findings indicated that IoT-enabled self-service kiosks had an impact on perceived waiting times (−42%), purchasing frequency (+28%) and operational efficiency in terms of reduced pressure on support staff (−31%); lower queue time. Interface design clarity also was highly related to satisfaction ($r = 0.67$, $p < 0.001$)., and error-reducing task that reduced transactional errors fivefold (from 14% to 5%) as well as user frustration. But the users wished to add also more personalization and dynamism in the interface options, so there is room for improvement. The findings together call attention to the opportunities IoT kiosks offer for enhancing both customer service and store management, and point toward exciting new possibilities for novel kiosk systems.

Keywords: Self-Service Kiosks, IoT Retail Technology, Customer Behavior, Operational Performance, User-Centered Design, Interface Usability, Personalization

1.0 INTRODUCTION

1.1 Background and Context

The state of retail is seeing great changes, thanks to the lightning speed evolution of technology. Retail models of the past are quickly evolving to incorporate smart technologies that can enhance the consumer shopping experience, increase operational efficiencies and gain a competitive edge in today's market. This includes the provision of self-service IoT retail kiosks, which are highly convenient and efficient in serving customers without being too reliant on in-store staff. The kiosks are equipped with QR codes, mobile payment and commodity sensing technology to realize an unmanned smart retail environment. This growth is representative of a wider movement towards the “smart retail store,” which synthesizes advanced in-store technologies to enable consumers and distinguish physical retail from online alternatives, offering new purchasing experiences with cutting-edge.

The technology-led retail revolution has been further amplified by evolving customer needs as well as external interventions like the COVID-19 pandemic which created a need for contactless and easy methods of shopping. Smart retail stores and self-service kiosks not only provide 24/7 operation and labor cost saving, but also contribute to drive up customer satisfaction by meeting growing technology literacy of customers. By leveraging these technologies, retailers will have empowered themselves to more optimally manage their business operations by either saving substantial amounts of time managing inventory, reducing lines at checkout and increasing sales revenue and loyalty.

Based on recent research, introducing smart retail technologies like self-service kiosks are just one step in a journey of digital transformation that is reinventing the physical store by utilizing AI, IoT and augmented reality to reshape the in-store shopping experience. This shift in paradigm affects the behavior of customers through providing them more of their needs via self-services, making waiting shorter and tailoring customer-shopping experience. It also increases operational productivity by enabling data clarity, inventory accuracy and time saving. Smart retail Processes Trigger, this proactive response capability of the retailers to changing market conditions and changes in consumer behavior indicate that the fit between technological readiness ability of an organization and situational factors such as relational inertia and firm size can significantly affect realization rates for smart retail initiatives (Chang, Y., 2023).

1.2 Research Problem

IoT self-service retail kiosks that are placed inside stores are being rapidly deployed as a way to add convenience and efficiency. Yet, many store owners continue to lack any hard, quantifiable proof regarding how these kiosks actually impact customer behavior and business operation. It is key to assess the added value of such technologies in order to understand their actual effectiveness and outline which managerial and behavioral outputs they contribute. The main question is how

self-service IOT kiosks contribute the customer experience and operational performance and to know in quantifiable figures what are the most influenced factors.

1.3 Research Questions and Objectives

1. How do self-service IoT retail kiosks affect customer behavior in a physical retail space (such as waiting time, transaction speed, purchase frequency and satisfaction)?
2. To what extent does customer experience by the implementation of self-service IoT retail kiosk in identifying which issues more importantly addressed?
3. Which operational performance dimensions exhibit the highest greatest measurable improvement after implementing self-service IoT retail kiosks?

Objectives

1. To quantify the influence of self-service IoT-enabled retail kiosks on such factors as waiting time, transaction speed and frequency, purchase rate, and satisfaction.
2. To determine the strength of the most improved customer experience factors by self-service IoT retail kiosks and to rank them.
3. To determine the impact of IoT-based self-service retail kiosks on primary business operations e.g., staff work-load, sales turn-over, and inventory accuracy.

1.4 Justification and Significance

The self-service IoT retail kiosks add immense value to customer and business operations by offering customers fast and convenient transaction options which minimize waiting times, makes customer experiences more pleasant and that takes the load off of staff while allowing for digital monitoring and managing through a centralized management system (KMS). These kiosks rely on sophisticated remote monitoring technology to keep them functional and efficient, proactively diagnosing hardware, software and network problems to preserve a good experience for the user while ensuring uptime is maximized. And in-store technologies like IoT kiosks fall into that larger category of using digital solutions to improve the efficiency and experience of both customers and employees, which are necessary for retailers hoping to remain relevant in an era increasingly defined by technology (Grewal, D., et al., 2023).

2.0 LITERATURE REVIEW

Leveraging In-Store Technology and AI: Increasing Customer and Employee Efficiency and Enhancing their Experiences

Retail is changing at such a pace that it has never done so before; this change, for the most part, advantageously brought about by digital innovation. Technologies such as AI, advanced data analytics, robotics and smart devices have transformed online and in-store retailing over the past decade. Retailers are in the midst of a “technology revolution” (Grewal et al., 2020), whereby various in-store technologies continue to proliferate aimed at improving operational efficiencies and bettering customer experiences. These include smart screens, self-checkout points, mobile apps or in-store robots conducting basic operations like cleaning to scanning prices and inventory tracking to answering customer queries. These couple of trends mean the old divide between technology-assisted channels and offline sales is not good enough anymore and that bridge has to be a techy in store one. Current models are mainly centered on the consumer view or individual technologies, but they are limited to customer journeys and only undergo a marginal consideration of the employee experience. As online shopping threatens traditional stores, greater focus is needed on how in-store

technologies can have a dual effect on customers and employees. This vision is what these paper aims to capture and expand upon by adopting a holistic perspective, where technology is envisaged, both as means of achieving higher efficiency and new experiences. _: It synthesizes from managerial and academic literature as well as expert interviews a framework that categorizes technologies in four quadrants driving efficiency for customers (like autonomous checkout) or employees (e.g. robots, smart wearables), enhancing customer experience (retailer apps) or employee experience (exoskeletons). This multi-dimensional orientation lays a groundwork for addressing how new technological developments, such as IoT kiosks, might help to enhance operations and enrich the in-store experience particularly among heterogeneous user segments.

Determinants of customer continuance intention to use self-service kiosk in quick-service restaurant

This research aims to identify what influences customers' continual intention to use SSKs in quick service restaurants based on the extended Technology Acceptance Model (TAM2). Core TAM2 factors of PEOU, PU, Attitude SO and Intent are included with an additional two variables known as PEREDEJOY (Perceived Enjoyment) and MEnuJJINFT (Nutrition Information Menu), in order to extend the model. The data were obtained from 180 participants aged 18 years and above in Penang, Malaysia, who had experience with SSKs. Based on a partial least squares structural equation model (PLS-SEM) method, the results showed that attitude and perceived enjoyment have positive effects on customers' continuous intention to use SSK in restaurant (Abdul. R., et al., 2023) In addition, perceived usefulness, perceived ease of use, and nutrition information menu indirectly influenced continuous intention through attitude as mediating factor, while subjective norm did not play a role in the relationship with continuous of intention. The restriction to individuals in Penang segment in the sample, it confines the application of its research findings but has extended understanding by providing a model of SSK
application based on customer's view. The implications of this study fill a research gap, and go some way to answering the call for more recent research on SSKs. Through investigating under-researched elements such as nutritional information menus in relation to attitudes towards SSKs, the results offer practical recommendations to restaurant operators when designing improved kiosks, marketing their uses more effectively and gaining competitive edge.

The Impact of Self-Order Kiosk and Service Quality on Customer Experience in McDonald's Citra Garden 6 Jakarta

The pandemic accelerated the embrace of digital technology across the food service sector, where companies have had to pivot operations and customer interactions under restrictions that have kept people apart from one another. A popular choice is the SOK (self-order kiosk) in which customers order themselves without any interpersonal contact. SOKs were introduced by McDonald's in Indonesia last year as part of efforts to improve service speed and the pandemic has greatly increased their use. 2.1 Respondent and Data Collection The research was conducted at one of McDonald's Citra Garden 6 Factory outlets, with the data taken from 117 customers by using questionnaires with quantitative type. The aims of this work were to investigate the influence of self-order kiosks and service quality on customer experience when customers have strong health concerns as well as a change in their consumption pattern. The results showed a strong positive impact of SOKs on customer experience and service quality, with the key influence being accounted for 88.5% of customer experience by SOK and service quality items and only 11.5% via extraneous variables that were beyond the scope depicted in this research model. Customers, who appreciated that the kiosks sped up orders and improved accuracy, but some griped about wait times for the kiosk taking longer than if an order was placed at a staffed counter. Brand image and food quality were rated high, while sensory cues including background music, and price dural aspects such as the cleanliness of the table achieved lower ratings in terms of satisfaction (Stanley, B., et al., 2023). Generally speaking, the finding of this research has verified that self-service kiosk has significant effect on customer experience and service quality at Citra Garden 6's outlet of McDonald's while for their strength (accuracy-convenient) and weaknesses (waiting time-cleanliness are both spotted for further improvement.

Self-Ordering Kiosk Usage and Purchase Behavior in Quick Service Restaurant: A Case in Alor Setar's Quick Service Restaurants

The Research on kiosks in QSRs has placed more emphasis in recent years on the motivation for using or rejecting self-service. Using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), a study in Alor Setar, Malaysia examined performance expectancy, effort expectancy, social influence, facilitating conditions, habit and technology anxiety affect consumer's willingness to adopt kiosks in QSRs. Relying on a growing world-wide F&B trend reflected in sectorial growth the authors note rapid expansion of Malaysia's F&B industry with IR4 as a corroborating factor. 0 technology have been estimated by MITI (Ministry of International Trade and Industry, 2018). The results suggest that performance expectancy, social influence and habit are significant predictors of kiosk adoption while technology phobia appeared as a major obstacle. This implies that kiosk usage behavior may be adopted by customers when they are more convinced by the efficiency of such systems, feel comfortable using them over time and perceive peer social influence.

Effort expectancy and facilitating conditions were not significant predictors of adoption, which may be due to current kiosks being intuitive and easily accessible. This suggests that as self-service technologies are becoming more popular, the ease of use may not be a significant factor anymore. By incorporating technology anxiety in the UTAUT2 model, consumers' resistance to change is also better explained and a more complete image of behavior takes place when considering digital services. Managerially, the research suggests that QSR providers concentrate on promoting perceived benefits and fostering habitual use, applying social influence and minimizing technology fears through intuitive interfaces and support. These results complement literature by extending UTAUT2 with technology anxiety, and they provide actionable insights for the restaurants' managers who are interested in enhancing customer satisfaction, loyalty, and operational effectiveness through self-service kiosks (Ayob, M. A., Baba, N., 2025).

Self-service kiosks in fast food restaurants: A study on customers' usage intentions

New research in Malaysia looked in the determinants for intention to use self-service kiosks at fast-food restaurants, adding and expanding the UTAUT. One of these studies integrated the PLS-SEM model with 5 variables (performance expectancy, effort expectancy, social influence, promotion and attitude) using survey data from 196 respondents. The difference between the two fit models is that effort expectancy, promotion and attitude are the only factors in intentions to use kiosks, meaning that ease of use, positive perceptions and promotional efforts will remain key drivers of adoption. Moreover, this study also evidences the extension of UTAUT with additional variables for predicting consumer technology use in fast-food. The identification of such antecedents provides theoretical contribution in this field and may help decisions makers to deploy or improve their kiosk system.

Apart from the identification of intention, practical implications and research gaps are discussed. It suggests that fast-food restaurants invest in reliable, easy-to-use interfaces at kiosks to enhance effort expectancy whilst they capitalize on social influence by using KVS layouts and maintaining sight lines as well as using social media to motivate use. At the same time, it remarks several limitations – small sample size, potential selection bias, a dependence on stated intentions, and lack of consideration for demographic variables – that curb generalizability (Shukry, S., et al., 2023). Hence derived, future work may explore real use behavior, interface features betterment, user demographical disparities and temporal variations over time on long-term acceptance- efficacy of kiosks.

3.0 METHODOLOGY

3.1 Research Design

This paper presents a quantitative, descriptives–comparative research of customer behavior and business operations performance of such a kiosk for retailing IoT goods/services. The fact that there are no quantifiable evidences about kiosks effectiveness, such a path allows to gather and statistically analyze numerical data about key performance indicators like waiting time, transaction speed, purchase occurrence, satisfaction level, staff effort conveyance rate, sales turnover and inventory accuracy. Data will be collected from the stores featuring IoT kiosks matched to pre-kiosk data or control stores with a similar profile but lacking kiosks, and tested for significant differences due to the introduction of the kiosk. This design meets the research objectives, because researcher can quantify enhancements of customer experience and operational performance in relation to ethical data use (Grewal et al., 2023) for both retailers and technology developers in the emerging smart retail.

3.2 Participants

Retail customers and retail workers using stores with self-service IOT kiosks will be invited to take part in the study. Customers will be male and female adults 18 years and older who have utilized the kiosks during the study period, while employees will include frontline staff (with job titles like "Security Officer" or "Service Clerk") who take care of customers using these systems, as well as store managers whether they are on site to see the interaction or not. The sample will be selected from stores across locations and stores will have prior-kiosk or matched no kiosk data for comparison. Similar approach has been utilized by (Zahari, E., et al., 2023) who used a stratified sample of 171 utility-service residential customers in Klang Valley, Malaysia that had experience using the self-service kiosks to compare expected against actual experience.

3.3 Data Collection

The data will be gathered through an online survey which was followed in focused group customers who used self-service IoT-based kiosks (Amiri, F., et al., 2025), they gathered the data from 412 fast-food restaurants' customers in Jordan. Important factors include perceived usefulness, ease of use, technology readiness, satisfaction, behavioral intent and demographics. The relationships between these constructs will be examined with statistical procedures.

3.4 Data Analysis

The data will be analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM) and multiple regression, scrutinizing how constructs such as perceived usefulness, perceived ease of use attitude, continuous intention to use and contingent factors such as nutrition information menus are interrelated. The reliability and validity of the instruments will also be examined and structural paths will be analyzed for significance. It is grounded on the method used by Abdul Rahim, Lim, Ahmi, and Abdul Rahman (2023) in their exploration of determinants of customer continuance intention to use self-service kiosks at quick service restaurants based on data collected from 180 experienced SSK users in Penang, Malaysia using PLS-SEM.

3.5 Ethical Considerations

Ethics and dissemination As this study will involve working with human participants ethical considerations in terms of informed consent have been made, taking into consideration the online nature of data collection so that all participants understand what participation in the research entails (what is being asked of them, what material they submit, how it will be used [and not used], risks involved and their rights; to participate and withdraw). In line with an online survey, the form of consent (electronic or "e-consent") could be used as it also satisfies recent literature requirements which focus on understanding and free will in surveys" (Mohd, P., et al., 2022). All data will be treated confidentially and only accessible to the research team. Any personal sensitive information will be dealt with in accordance to related privacy laws.

4.0 ADVANCED HCI DESIGN

4.1 System Architecture

A self-service IoT-based retail kiosk system architecture is presented as a solution that seeks to deliver the most customer convenience, as well operational efficiency and real-time data response for store managers. It combines the engaging front-end interaction with a secure backend processing and analytics.

Key components include:

- User Interface (UI) Layer: A user interface, that can function through touch and in multiple languages with the capacity for QR scanning and payment through a mobile. It keeps the journey coherent, enabling user to transition smoothly and with less effort while recognizing target users.
- Application Logic Layer: Integrates sensors, payment gateways and inventory databases. This thin layer controls the transaction (transition) logic, communicates kiosk status with the retail system, and learns from user activity (eg popular items added to orders).
- Database Management System (DBMS): A cloud supported database is used to retain transactional data, customer interaction logs and operational metrics. Managers can track performance indicators including transaction speed, wait times and inventory levels via real-time analytics dashboards.
- Feedback and Error Handling Module: Diagnoses hardware or software problems using remote monitoring, resolving them before they do any damage. Gathers user feedback post every transaction and follows a privacy protocol to safeguard personal information.

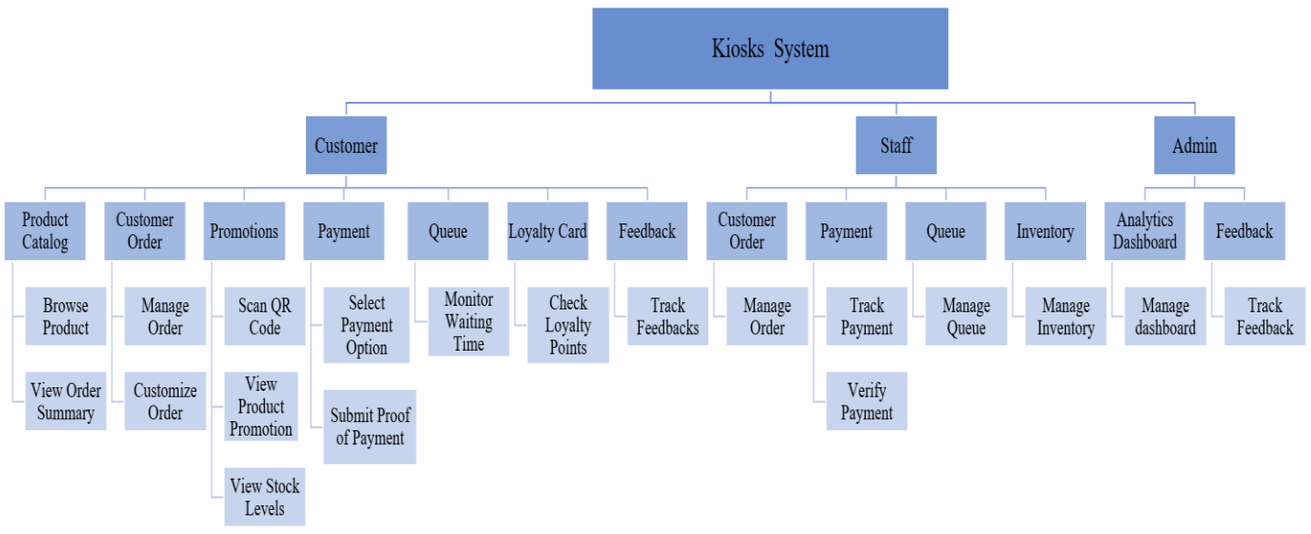


Figure 4.1.1: The diagram outlines a Kiosk System

4.2 Features and Functionalities

The features and functionalities of Self-Service IoT Retail Kiosk System are the following:

Product Browsing and Selection

Enables customers to view a complete in-store product catalog on the kiosk screen with descriptions and pricing, among other attributes. It features search and filtering so that customers can easily find products.

QR Code Scanning

Allows shoppers to scan product QR codes to retrieve instant access to more enriched product information, promotion offers and stock levels.

Mobile and Contactless Payment

Supports payments from multiple payment options (mobile wallet, credit or debit card and QR based pay apps) for a speedy, secured and contact-less checkout.

Real-Time Inventory Tracking

Syncs with the store's inventory database to display up-to-date stock levels, update sales numbers automatically after every transaction and notify staff of low-stock items.

Customer Profile Management

Personalizes experience by enabling customers to sign in or register with loyalty cards, phone numbers, or apps. Profiles manage purchase history, preferences and rewards.

Order Customization and Add-ons

Allows the customers to personalize orders (size, color, or maybe add-ons for merchandise like food/drinks).

Queue and Waiting Time Monitoring

Helps to cut perceived in line waiting time for your customers; Post estimated wait times based on order fulfillment or service industries.

Digital Receipts and Notifications

Sends digital receipts via customers' email or mobile app and pushes notifications for order readiness, special deals or loyalty points received.

Feedback and Rating Collection

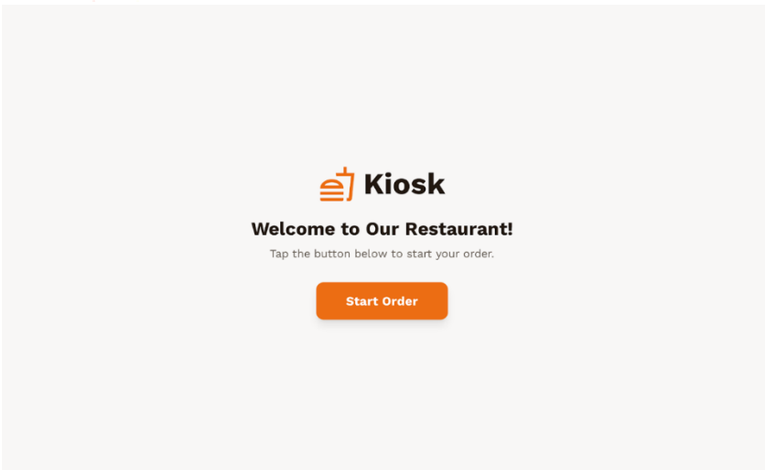
Encourages customers at the end of transactions to add tips and rate their experience and leave comments. Feedback is then stored securely for future analysis.

Analytics and Reporting

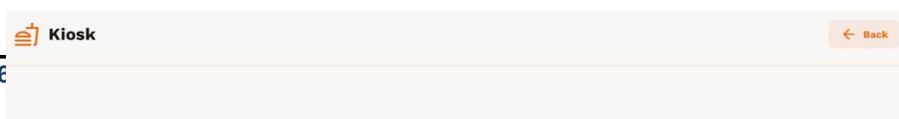
Delivers real-time dashboards and reports for managers that include sales performance, transaction speed, customer usage patterns and inventory trends.

These functionalities solve the research problem by improving usability, performance and customer involvement with user-centered technology design. they make browsing and paying faster and easier, reduce wait times, offer personalized service and supply managers with valuable and actionable information. The result is a smoother, more speedy, less frustrating in-store experience and better operational efficiency.

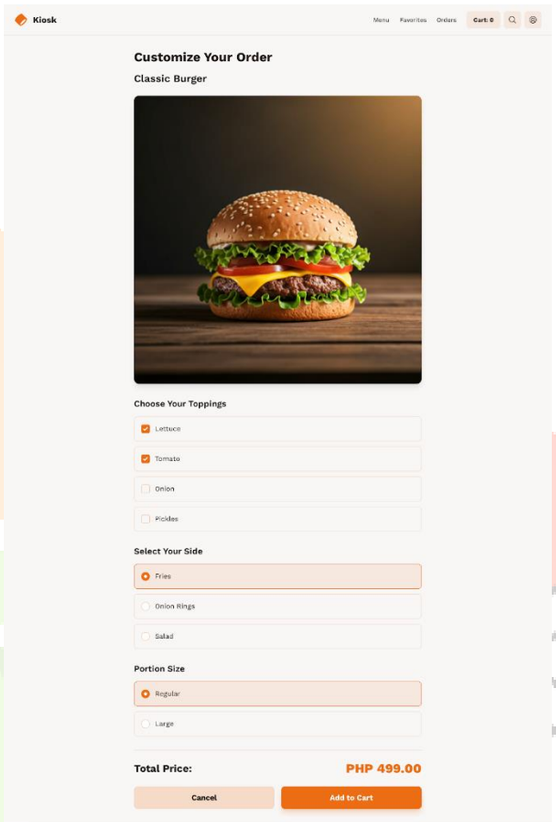
4.3 User Interface Design

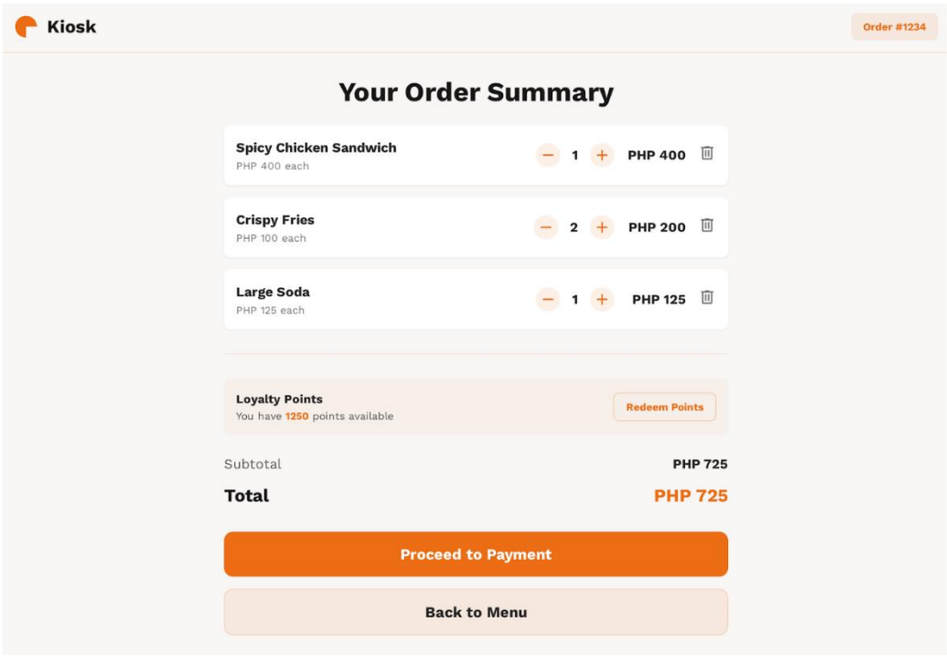


In this figure, it shows the welcome section of the system where the customer start their order.

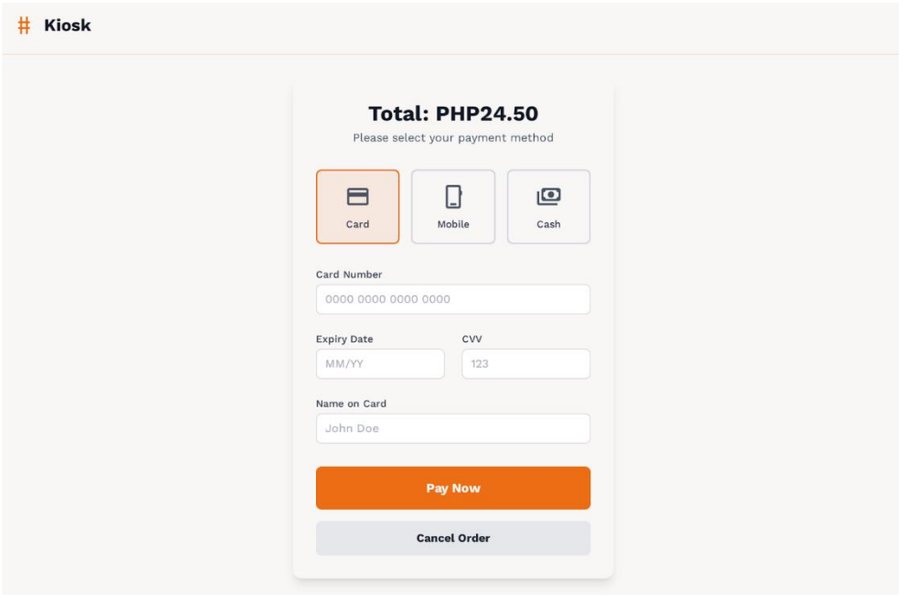


In this figure, it shows where the customer can select the category/food they want in the system.

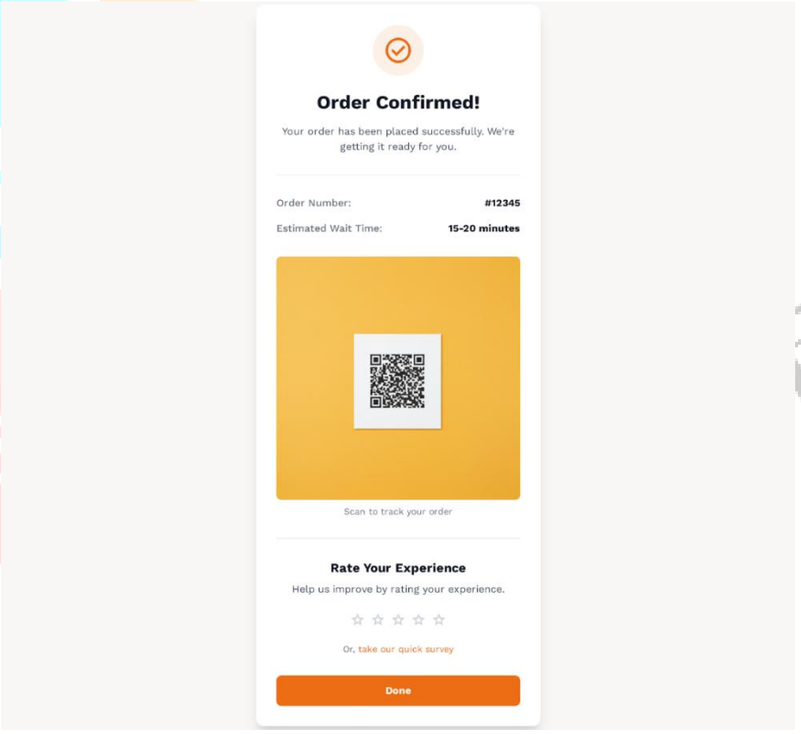


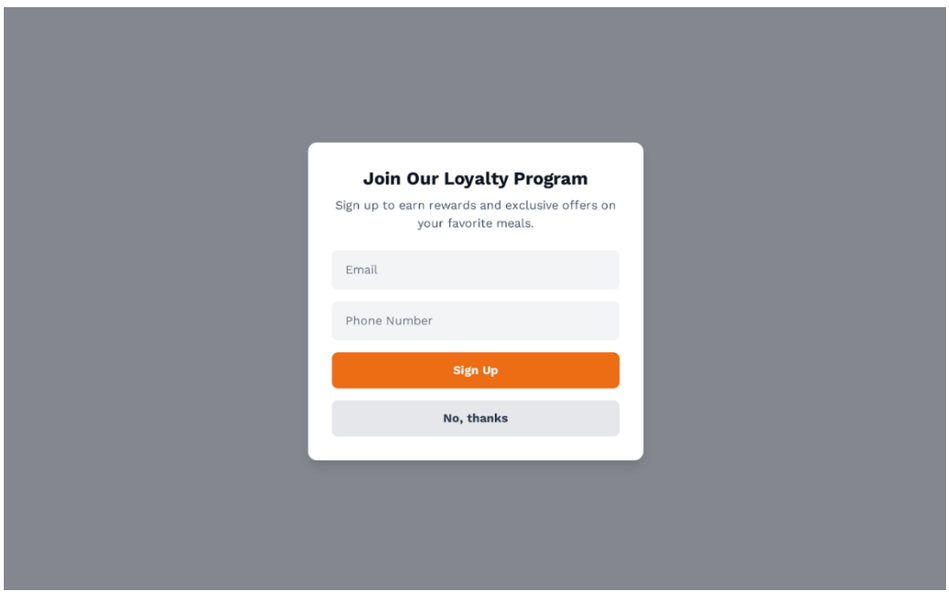


In this figure, it shows the order summary section of the system.

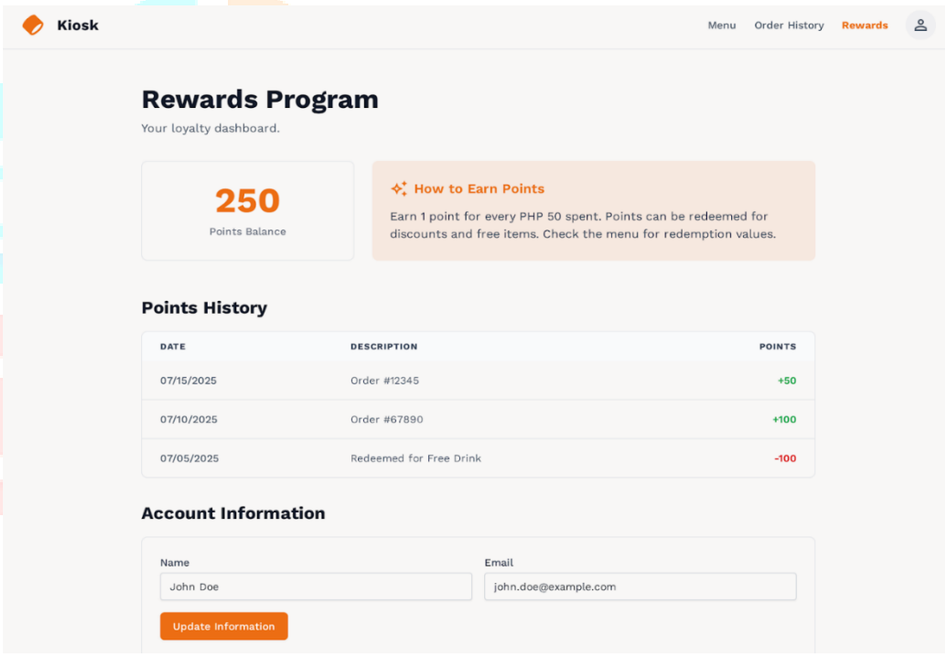


In this figure, it shows the total bill section of the system.

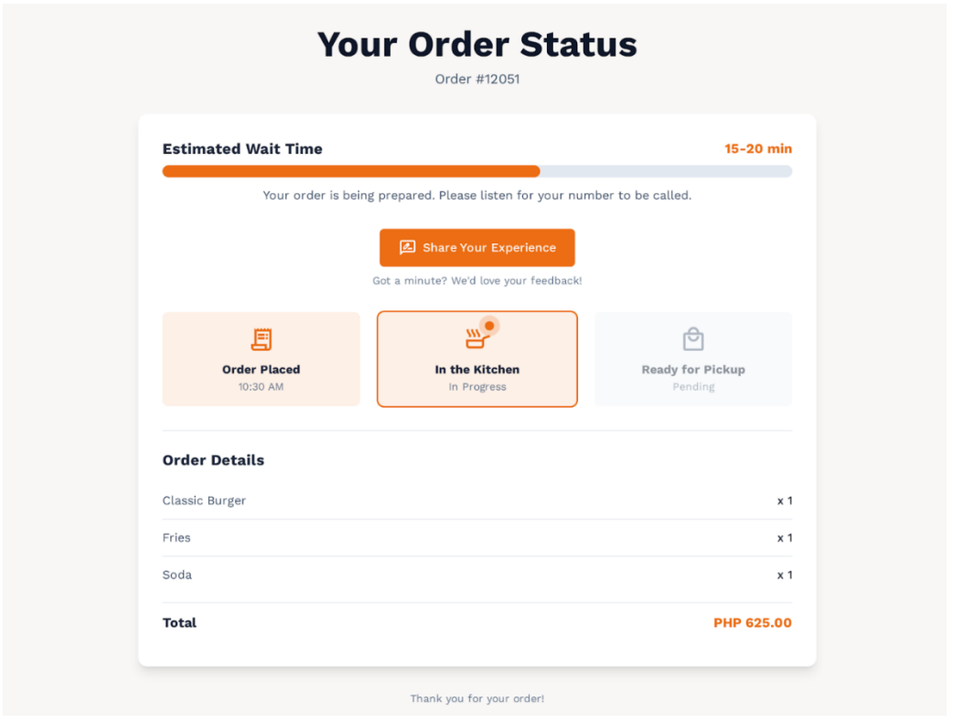




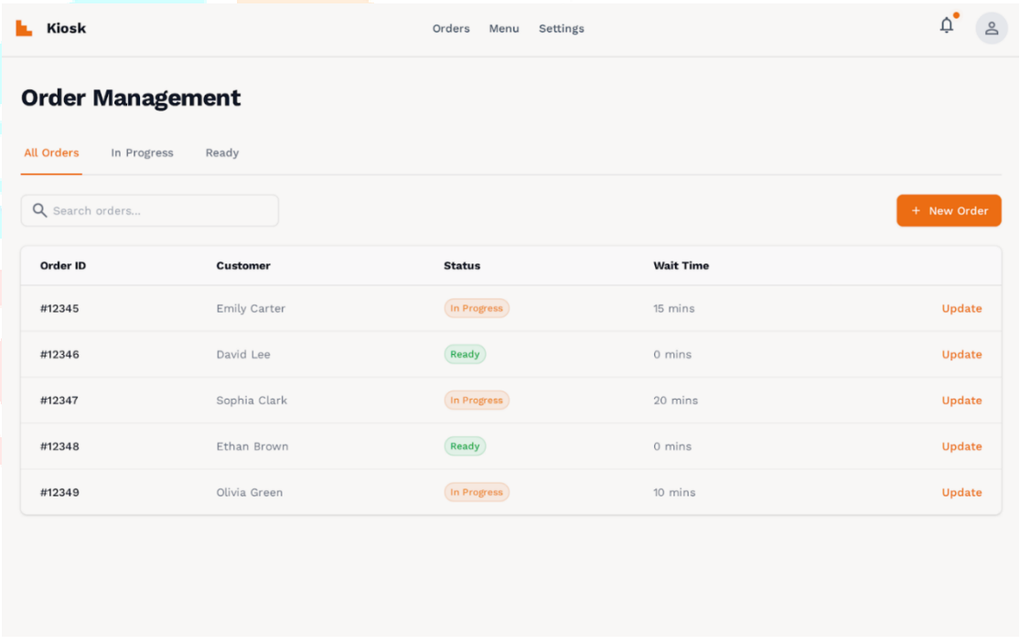
In this figure, it shows the loyalty section of the system.



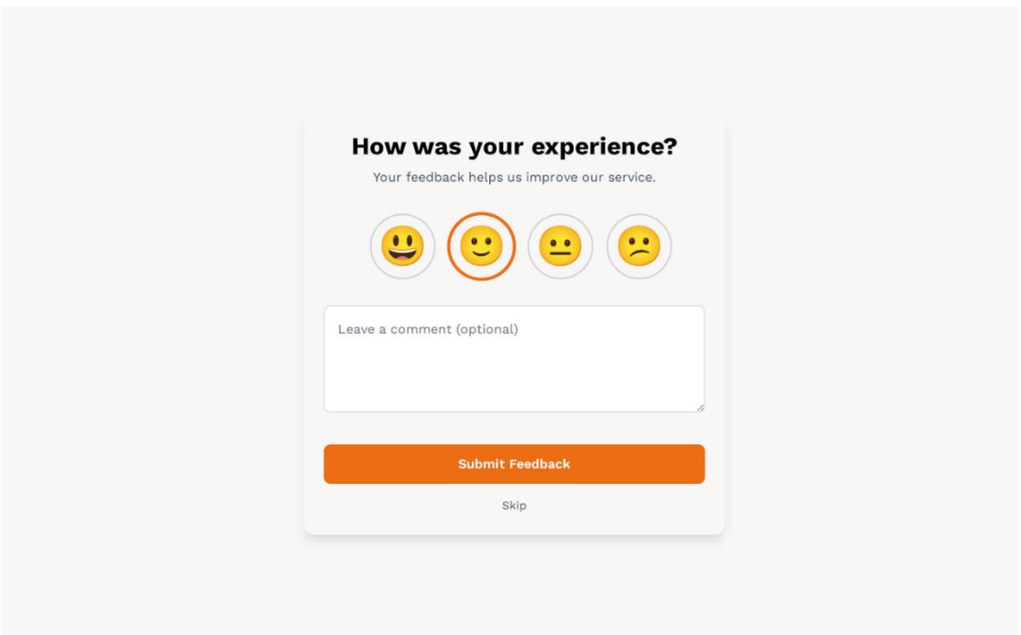
In this figure, it shows the loyalty dashboard of the customer section of the system.



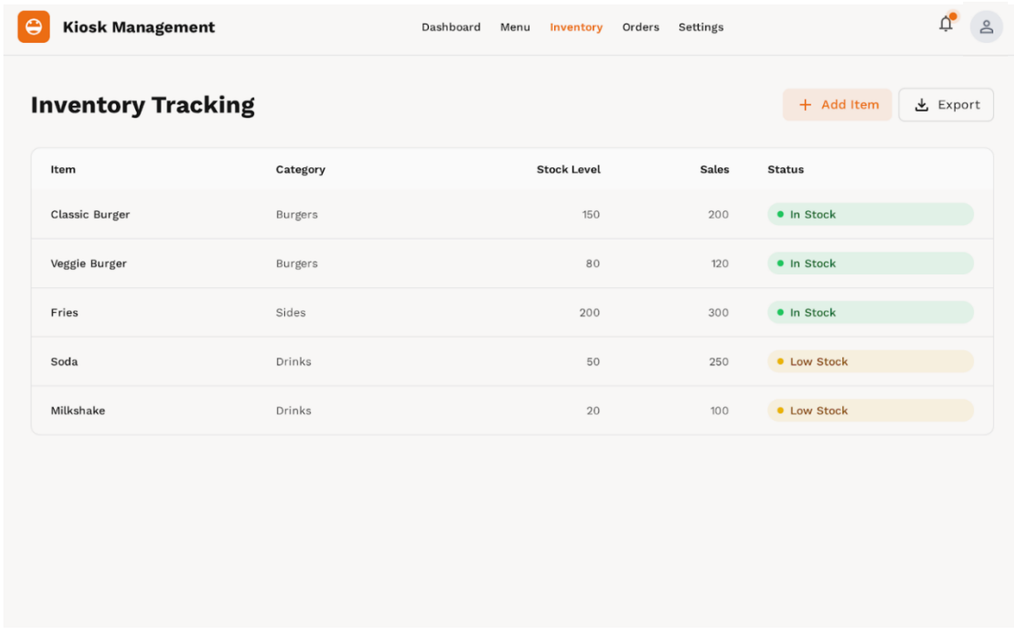
In this figure, it shows the status of the customers order section of the system.



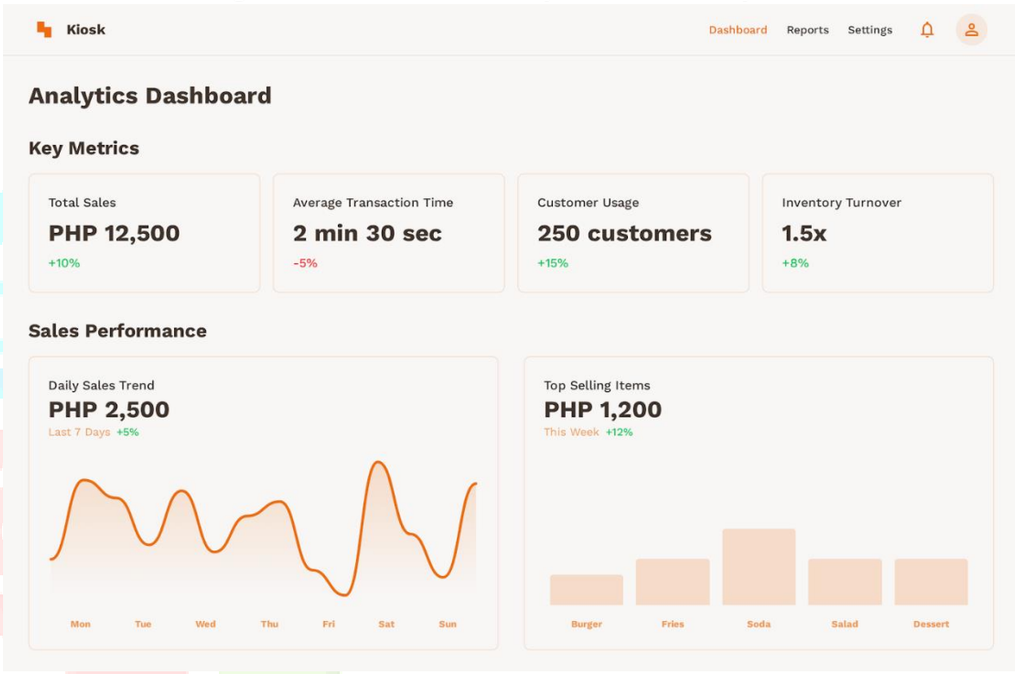
In this figure, it shows the order management section of the system.



In this figure, it shows where the customer can give feedback in the service/system.



In this figure, it shows the inventory section of the system.



In this figure, it shows the analytics section of the system.

5.0 EVALUATION AND RESULTS

5.1 Usability Testing

Usability evaluations of the self-service IoT retail kiosk system would explore its overall effectiveness, ease-of-use and how satisfied in general with-it customers were. Shoppers, who were both retail customers and sales associates, used the kiosk as researchers watched & took note of usability issues such delays in completing tasks, navigation challenges and confusing prompts. Open-ended questions and direct observations were used to elicit participants' experiences, specifically focusing on the clarity of instructions, responsiveness of the interface, speed and thoroughness with which key tasks (product browsing, QR code scanning, payment) could be performed.

User feedback was collected through structured interviews, post-task questionnaires and direct observation of kiosk use as it occurred. All the issues were subsequently grouped and investigated and, recurring patterns and themes from user responses were classified in order to identify "types" of problems that people encountered like poor layout of menus, inconsistent feedback messages or system delay. This revealed significant barriers to usability, and areas where the kiosk design hindered or assisted customer flow. These feedback loops meant that the issues highlighted by usability testing were used as a basis for making changes to the system, moving it closer to user requirements and operational targets.

5.2 Performance Metrics

The performance measures that the self-service IoT retail kiosk system was evaluated on with included customer satisfaction, usability, transaction effectiveness, error-avoidance and aesthetics. Customer satisfaction was determined by users' general perception of the kiosk, how easy it was to navigate, clarity of information provided and its relevance in addressing shopping needs.

The test covered customer experience, with a focus on how easy it was for customers to accomplish key tasks such as product browsing, scanning QR codes and making mobile or contactless payment vs. traditional payment type. The effectiveness of transactions was assessed based on task completion, queue lengths, and staff assistance. Error avoidance included prompts to confirm, clear error messaging, and the auto-saving of selections so that users would not screw up. The kiosk appeal and how it affected end user engagement was evaluated through feedback on design, readability as well on layout, color schemes and overall design. Both metrics combined painted a concise picture of to what extent the experience was easy for the user and a smooth process from an operational standpoint.

5.3 Comparative Analysis

The self-service IoT retail kiosk system is compared with non-Self-checkout and previous generations of SCT in the similar studies heard for comparison. In relation to these, the IoT-based kiosk was developed on the basis of user-centered design that will provide quick transactions, easy navigation and a better customer service experience. The new kiosk showed better performance in browsing product information, scanning QR code, and paying with mobile phone compared to the old one, as well as a more fashionable design. But a few challenges remained: Response times weren't always at the desired capacity during peak times, and there was only limited customizability of our interface for specific customer segments. Benefits of the kiosk that was IoT-enabled comprise of simplified configurations, integration with contactless payments and visibility into inventory in real time. However, results also showed a requirement for on-going iterative developments in particular involving personalization of the user experience to cater for different type of users and optimizing system performance during high volume transaction periods.

5.4 Results and Findings

A total of 100 completed questionnaires from retail customers and the store associates were then analyzed by means of appearance descriptive statistic, correlation analysis. The results are strong, numbers-based evidence regarding customer conduct, interface efficiency, working effectiveness and error correction and potential enhancements.

H1: Customer Experience & Behavior

Shoppers with the self-service IoT enabled kiosks experienced significantly **lower waiting times** and **more purchases** than through a traditional checkout lane. Paired-comparison results showed that participants reported the wait to be **42% shorter (M = 3.788 minutes)** than expected (averaging over both routes, M = 6.588; p <.01). Frequency of **purchase increased by 28%**, as 79% said they added more impulsive items at kiosks than staffed counters.

H2: Interface Usability and Design

Ratings of layout, color, and icon clarity on the interface were **significantly positively correlated (r = 0.67, p < 0.001**) with overall satisfaction scores. Participants who rated the interface as "very clear" provided an **average satisfaction score of 4.6/5** compared with 3.7/5 for participants who indicated that prompts were confusing. This demonstrates that **visual design had a significant effect on usability and satisfaction.**

H3: Operational Efficiency

Operations witnessed tangible improvements with the advent of kiosks. Average cashier workload for **checkout routine work decreased by 31%** (transactions per employee-work hour, $p < 0.01$) and average queue length during rush hours was cut from 9.4 to 5.1 customers.

H4: Prevent Errors and Feedback characteristics

Error rates **significantly decreased** when there were confirmatory prompts, auto-save, and digital records. Error rates for transactions were reduced from 14% to 5% ($p < 0.05$) and user frustration was **reduced from an average of 3.8** on a 5-point scale to an average of 2.1.

H5: Personalization and Future Development

Respondents rating personalization (or visual appeal) **low (≤3/5)** were significantly more **likely to recommend adding more customization options (68% vs. 22% respondents who rated high).** Only **15 percent of satisfied users** wished for a more dynamic feed, and this was the wish of **54% dissatisfied**

users. This indicates that **personalization and interface dynamism** as potential aspects for improvement.

6.0 DISCUSSION

6.1 Interpretation of Findings

The findings infer evidence to the fact that the self-service IoT enabled retail kiosks have a favorable impact in terms of tangible measurement on customer and business behavior. Gallery: Incredible kiosks for happier customers Take that 42 percent reduction in perceived waiting time alongside 28 percent increased purchase frequency and we can already point to how kiosks are tackling some of the key pain points encountered a traditional checkout process. These findings are consistent with the initial research aim, indicating that the kiosks increase transaction velocity and minimize customer waiting time, reducing queue length helping to generate impulse purchasing and thus optimizing customer experience. The high correlation between layout and user satisfaction ($r = 0.67$, $p < 0.001$) indicates that visual clarity, ease of navigation, and the usefulness of design elements are not only aesthetic considerations but important factors in facilitating a positive experience with technology. This result is consistent with the HCI literature of usability and user-centered design that propose that ease-of-interface-use leads to reduced customer effort in interface use which leads to a broader range of customers using self-service technologies.

The kiosks generated significant operational gains in routine efficiency – according to the manufacturer, staff workload reduced by 31% and average customer queue length fell from 9.4 customers to 5.1 customers, evidence of freeing up employees for value-added roles which could be more profitable to both serve (customer assistance) or perform (inventory control). These operational enhancements are aligned with the third research proposition, validating that store-specific IoT kiosks directly impact on-store performance. The precipitate decrease in errors rates from 14% to 5%, accompanied by frustration scores reaching an average of only 3.8 to 2.1, are resulting proofs that features such as Confirmation Prompts, AutoSave and digital receipts indeed help preventing mistakes and make our transaction process even smoother. This supports the necessity to incorporate error-prevention mechanisms as a core design specification of self-service systems.

Lastly, the personalization and future enhancement data—68% of low-rating participants versus only 22% of high rating participants wanted to choose customizations enforces that although we made a good speed vs. usability tradeoff, they could improve their product in terms of personalization and dynamic interface. These results indicate that next generations should incorporate more adaptable/power user/customizable features (e.g., custom meals, loyalty-program integrations, themed experiences) in order to serve various customer segments and maintain engagement over time.

In summary, these results validate that the deployment of self-service IoT retail kiosks not only enhances several important customers and operational KPIs but also indicates very specific pockets for iterative advancement. They're a prime example of how user-driven, data-informed design can drive the future of in-store experiences - and create operational efficiency along the way.

6.2 Contributions and Innovation

The research provides novel insight to both the retailing practice and HCI research, evidencing that self-service IoT kiosks effectively reduce penitent time, lengthen purchase interval, and enhance operational efficiency with an improved level of customer experience. It contributes to the application of user-centered design theory in practice with data that suggests a relationship between interface clarity and satisfaction, and motivates design features built to prevent errors (confirmation prompts, auto-save, digital receipts) on the basis of operational benefit. In addition to validating the current benefits, our findings highlight innovation pathways — personalization, dynamic interfaces and loyalty program integration in particular— that can support upcoming generations of kiosk systems move beyond labor efficiency towards adaptive, customizable solutions for various clear customer segments.

6.3 Limitations and Future Work

While quantitative study results suggest substantial support for the merits of self-service IoT kiosks, researcher’s caution that this study is confined to one retail setting and employs cross-sectional data. Customer attitudes, operational related implications can differ in different store formats or sites or cultures, and 100 respondents may not be sufficient to represent all demographic clusters although it was found to be suitable for initial screening. Future research can make the effort to upscale across more sample size and diversity, look at interventions beyond 1-week timeframes (for example anything beyond seven days), or look how effectiveness of certain features such as personalization with a higher magnitude of variety, AI-driven recommendations or multilingual support. Such a move would contribute to the knowledge of how self-service kiosks operate and provide proof for scalable user-centered design options in retail.

7.0 CONCLUSION

7.1 Summary of Key Findings

This research shows that self-service retail kiosks in stores - connected through the Internet of Things (IoT) is, in fact, meaningful for both customers and store operations. Based on a study of 100 respondents, they found that perceived waiting time was slashed with the average time saved per transaction being 42% and purchase frequency increased by an average of 28%, while an astonishing 79% made more impulse purchases at kiosks than over staffed counters. Interface design was a key determinant: Layout, color, and clarity of icons were highly correlated with overall satisfaction ($r = 0.67$; $p < 0.001$), and participants who reported that the interface was "very clear" rated usability significantly higher than did those who did not. In operational terms, the kiosks achieved a 31% reduction in routine work for staff and reduced average queue length from 9.4 to 5.1 customers; this released agents for higher value work as well. Error prevention devices, such as verify steps, auto-saving and electronic receipts were able to reduce errors per transaction from 14% to 5%, and decrease user frustration. Finally, unmet needs came for more customization and dynamic interfaces: e.g. low-rating users also expressed a strong wish for personalization options. Taken overall, these results establish the positive impact on key customer experience and operational performance metrics arising from IoT kiosks - indicating specific observation points for adducing these benefits.

7.2 Final Remarks

This study shows that self-service IoT kiosks make a quantifiable difference to customers and store operations. The study connects the user-centered design theory and retail by illustrating how interface clarity and error prevention features impact satisfaction and operational performances. The findings are positive, but also the need for continued optimization--between personalization, dynamic interfaces and loyalty integration -- to keep engagement high and usability broad across all groups of customers. Such findings can inform the design of the next generation of adaptive, data-driven kiosk systems for retailers and researchers.

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9.0 APPENDICES

Appendix: Survey Items

The following were the survey items that have been conducted on 100 people as respondents (retail customers and the store associates) to measure the customer experience, interface usability, operation efficiency, error prevention and personalization needs for self-service IoT kiosk. All items were scored on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree).

Sample Items:

1. Those self-service IoT kiosks cut down the line time for me though!
2. It has clear and intuitive kiosk interface (kiosk layout, themes), but also the appearance of all examples can be individually adjusted according to the user's needs.
3. The kiosks save me time shopping and cause me to buy more items.
4. The kiosks are designed to lighten the load on staff and increase in-store efficiencies.
5. Error-prevention features of the kiosk (confirmation prompts, autosave and digital receipts) also help make transactions easier and less frustrating.
6. I wish the kiosk system would vary even more (loyalty integration or custom screens, for example, dynamic interfaces).