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A web-based Smart Restaurant POS: An Iot-Powered POS System with E-Commerce Integration and Inventory Management in Iloilo City

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Abstract

The rapid advancement of technology has significantly impacted various industries, including the restaurant sector. This research explores the design and implementation of a web-based Smart Restaurant Point-of-Sale (POS) system powered by IoT, integrated with e-commerce and inventory management. Utilizing a Javascript Framework for the front-end and Firebase for the back-end, the system allows real-time sales monitoring, inventory tracking, and streamlined operations. The system used the Agile methodology, ensuring gradual improvements. Key features of the system include QR code ordering, e-commerce capabilities, and a systematic dashboard for data-driven decision-making. User evaluations revealed high satisfaction in terms of ease of use, accessibility, and effectiveness, highlighting the system's potential to enhance operational efficiency and customer experience. This study demonstrates the transformative potential of IoT-powered POS systems in modernizing restaurant management and aligning it with the demands of a technology-driven era.

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I. Introduction

Technology is becoming more advanced nowadays and it plays an important role in different fields [1]. When Iloilo's future as a technology hub looks promising, Iloilo started improving their connectivity, enhanced their technology curriculum, and elevated infrastructure in IT parks and business districts [2]. It was hard for the businesses to keep-up due to outdated technology, cost constraints, lack of technical expertise, integration challenges, and vulnerable security which became a significant loss in their business. Currently, most of the restaurants in Iloilo City use traditional ways of computing their sales, storing data in physical storage. This method works for most restaurants. However, it has disadvantages such as human error and is prone to data loss, resulting in less working efficiency, lesser accuracy, and data loss [3].

The restaurant industry has witnessed a significant transformation in recent years, driven by technological advancements. One such innovation that has gained prominence is the Point of Sale (POS) system. Traditional POS systems have evolved into sophisticated digital platforms capable of handling various operations, from order taking and payments to inventory management and customer relationship management.

The primary objective of this research is to explore the potential of IoT-powered POS systems in revolutionizing the restaurant industry. By combining the capabilities of IoT devices, cloud computing, and e-commerce platforms, the Smart Restaurant POS system aims to address the challenges and limitations faced by traditional POS systems. The Smart Restaurant POS system utilizes durable technology to develop the Smart Restaurant Point-of-Sale (POS) with Javascript Framework as the front-end and Firebase as the back-end all for the Point-of-Sale, E-Commerce, and Inventory System to monitor their sales in real-time and track their current inventory. Additionally, it integrates various IoT devices, such as tablets and mobile phones, to streamline operations and enhance inventory management.

II. Methodology

Research Design

The research design refers to the overall strategy that the researchers choose to integrate in different components of the study in a coherent and logical way, thereby ensuring to effectively address the research problem. It constitutes the blueprint for the collection, measurement, and analysis of data [4].

This research will employ a mixed-methods approach, combining both qualitative and quantitative research techniques to provide a comprehensive understanding of the proposed Smart Restaurant POS system.

System Development Life Cycle

The software development lifecycle (SDLC) is the cost-effective and time-efficient process that development teams use to design and build high-quality software. The goal of SDLC is to minimize project risks through forward planning so that software meets customer expectations during production and beyond. This methodology outlines a series of steps that divide the software development process into tasks you can assign, complete, and measure [5]. Basically, the methodology used in this design is the Agile method which is a combination of iterative and incremental process models with focus on process adaptability and customer satisfaction by rapid delivery of working software products. Specifically, this study used Agile methodology. Figure 1 shows the graphical representation of the Agile methodology.

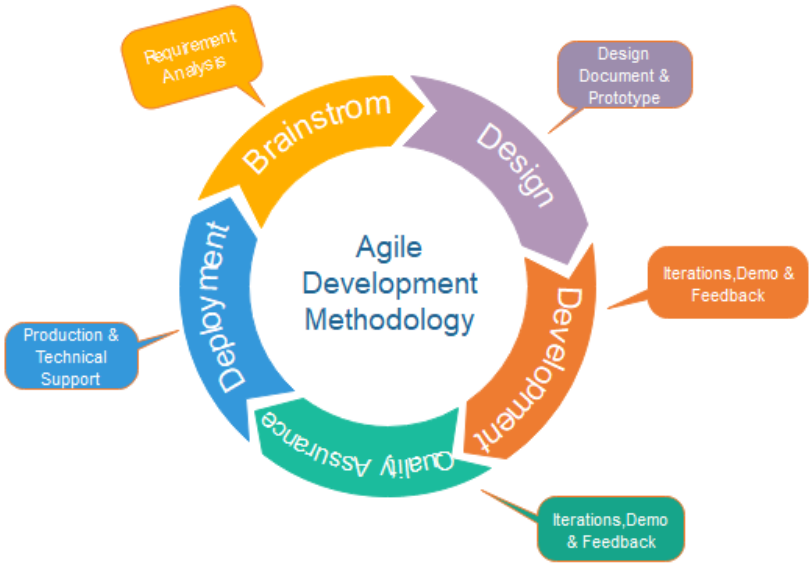

FIGURE 1.0 Agile Development Model

The **Agile Development Model** is an iterative, flexible approach to software development that emphasizes collaboration, customer feedback, and adaptability to changing requirements. It prioritizes working software, individuals and interactions, customer collaboration, and responding to change over rigid processes and documentation. Agile methodologies like Scrum and Kanban help teams stay organized and efficient. The goal is to deliver high-quality software quickly, while staying responsive to user needs and business changes.

In the context of developing an **IoT-powered Smart Restaurant POS system** in Iloilo, Agile's iterative process is crucial. It enables the development team to release functional system increments, gather real-time feedback from restaurant stakeholders, and refine the system based on evolving needs. This flexibility helps address challenges and ensures the system integrates the latest IoT technologies, cloud computing, and e-commerce platforms. Agile's emphasis on collaboration, security testing, and usability makes the system more user-friendly, adaptable, and cost-effective, which is particularly beneficial for budget-conscious restaurants in Iloilo.

The development process follows Agile's key phases:

1. **Planning Phase**: The development team and stakeholders will define goals, objectives, and initial requirements for the Smart Restaurant POS system, focusing on sales tracking, inventory management, and IoT integration.
2. **Design Phase**: The team will design the system's architecture, choosing technologies like JavaScript for the front-end and Firebase for the back-end, ensuring a user-friendly interface and efficient integration of IoT devices.
3. **Development Phase**: A Javascript Framework for the front-end and Firebase for the back-end will be utilized, allowing the system to monitor sales real-time, track inventory, and streamline operations. The core functionality is built in short sprints, with each sprint producing a usable system increment. Continuous testing and feedback ensure issues are identified early.
4. **Testing Phase**: The system will undergo thorough testing at the end of each sprint, including security, usability, and performance checks, ensuring it meets operational needs. Starting our product testing in a small-

based restaurant in Iloilo City where the customers and staff will use the system and report feedback using a survey. An online survey material, Google Forms, will be used as a tool.

5. **Deployment Phase**: The system is deployed in stages, starting with a small group of users to gather insights before full implementation.
6. **Review and Retrospective Phase**: After each sprint, the team gathers feedback from stakeholders and evaluates the development process to improve future iterations.
7. **Maintenance Phase**: Post-deployment, the system enters maintenance, with ongoing updates, bug fixes, and enhancements based on user feedback and emerging technologies.

Testing & Evaluation

For evaluation, user satisfaction will be assessed through a survey questionnaire on residents of Iloilo City, focusing on the system's ease of usage, accessibility, and effectiveness. Additionally, the system's efficiency will be measured by its ability to streamline operations and reduce manual tasks. The accuracy of inventory tracking and transaction processing will be verified to ensure reliability, while the security measures implemented within the system will be evaluated to ensure data protection and compliance with industry standards.

Process Model

Process modeling is the graphical representation of business processes or workflows [6]. The researchers used the Data Flow Diagram (DFD) to show its logical design in this research paper. The DFD is a graphic that illustrates the movement of data between external entities and the processes and data stores within a system [7]. Figure 2 shows the actions and distribution of data between the system and other external entities of the data flow diagram.

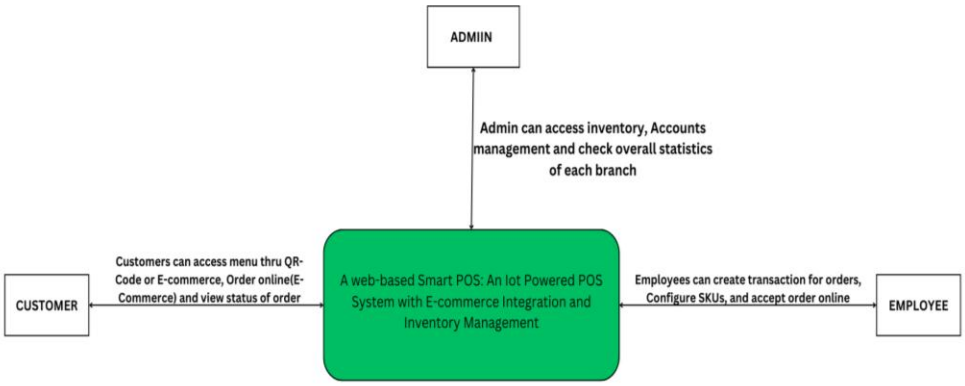

FIGURE 2

III. Result and Discussion

Question Categories	Percentage of Responses				
	1	2	3	4	5
Ease of usage		3.06%	9.18%	25.51%	62.24%
Accessibility	1.79%		10.71%	25.00%	62.50%
Effectivity	3.43%	5.57%	6.29%	20.29%	64.42%

Note: 1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree

The table presents a thorough examination of survey data reflecting user opinions of the Smart Restaurant POS system in three crucial areas: effectiveness, accessibility, and ease of use. A scale of 1 to 5 was used to score each category, with 1 representing "Strongly Disagree" and 5 indicating "Strongly Agree." The data shows distinct patterns regarding the system's functionality.

Ease of Usage

Most respondents (87.75%) expressed that the system is easy to use, with 25.51% agreeing and 62.24% strongly agreeing. This indicates that the majority of users find the system easy to use and intuitive. 9.18% disagreed and just 3.06% strongly disagreed, indicating that although a tiny percentage faced challenges, the user experience was generally favorable. The system's overall user-friendliness is demonstrated by the very low neutral response rate (25.51%), which highlights the tendency of users to develop firm judgments regarding this area.

Accessibility

The system is accessible, according to a remarkable 87.5% of respondents who either agreed (62.50%) or strongly agreed (25.00%). According to these findings, individuals believe the system is easily accessible and available on a variety of platforms and devices. The fact that just 10.71% disagreed and 1.79% strongly disagreed shows how uncommon accessibility problems are. There may be some variation in certain accessibility features or their applicability to various user needs, as indicated by the quarter of respondents (25.00%) who gave an indifferent response. However, the high agreement ratings attest to the system's accessibility as a major strength.

Effectivity

Similar high scores were given to the POS system's effectiveness, with 84.71% of respondents agreeing (64.42%) or strongly agreeing (20.29%) that it successfully fulfills its intended purpose. According to these answers, users believe the technology is very useful and accomplishes its objectives of enhancing restaurant operations. Although 5.57% disagreed and 3.43% strongly disagreed, the tiny percentage of negative comments suggests that the majority of users are happy with the system's functionality. Overall, users appear to think of the system as a useful tool, although the 20.29% neutral comments might be a reflection of different experiences with particular features or activities.

General Insights

The sum of the outcomes in each of the three areas clearly shows that the system is excellent in terms of efficacy, usability, and accessibility. Very few people have very negative attitudes about the Smart Restaurant POS system, which is confirmed by the high percentage of positive replies in all areas. The narrative presented in the supporting written material, which emphasizes the system's cutting-edge features like inventory management, QR code ordering, and real-time data insights, is consistent with these findings. Employees and business owners may improve customer experiences, optimize operations, and make data-driven decisions using the system's user-friendly interface, wide accessibility, and operational efficacy.

IV. Conclusion

This study showed the innovative potential of a web-based, IoT-powered Smart Restaurant POS system designed especially for the Iloilo City restaurant industry and linked with e-commerce and inventory management capabilities. The solution tackles important issues that traditional restaurant POS systems encounter, like data loss, human error, and operational inefficiencies, by utilizing cutting-edge technology like cloud computing, Internet of Things devices, and real-time data tracking.An important development in the current restaurant sector is the system's capacity to optimize operations, minimize human labor, and offer useful information for decision-making.

A dependable product that satisfies the changing needs of restaurant stakeholders may be delivered quickly thanks to the Agile methodology's assurance of flexibility, adaptability, and continuous improvement during system development. Positive comments from the restaurant community in Iloilo City demonstrate the system's potential for broad use and provide an affordable choice for companies looking to update and maintain their competitiveness in a market that is becoming more and more digital.

In conclusion, the Smart Restaurant POS system provides a strong, expandable, and user-friendly solution that has the potential to completely transform restaurant management in Iloilo City and beyond. Its effective implementation might set the standard for upcoming technical developments in the neighborhood restaurant sector, assisting companies in realizing the full benefits of cloud computing, e-commerce, and the Internet of Things for increased operational effectiveness and customer satisfaction.

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