International Journal of Engineering Sciences & Emerging Technologies, Dec. 2024
ISSN: 22316604 Volume 11, Issue 4, pp: 874-884 ©IJESET

DINE SCAN: AUTOMATED ORDER PLACING SOFTWARE FOR RESTAURANTS USING QR CODE, ORDER MANAGEMENT, AND BILLING MANAGEMENT

Richa Saxena[1], Aman Ruhela[2], Mohd. Suhail[3],
Dharmendra Pratap Singh[4], Himanshu Singh[5], Aditya Agarwal[6]

[1]Department of Computer Science Engineering, Moradabad Institute of Technology, Moradabad, India
richasaxena2006@gmail.com
[2]Moradabad Institute of Technology, Moradabad, India
amanruhela36@gmail.com
[3]Moradabad Institute of Technology, Moradabad, India
mohdsuhail2232@gmail.com
[4]Moradabad Institute of Technology, Moradabad, India
dharmendrakps17@gmail.com
[5]Moradabad Institute of Technology, Moradabad, India
himanshuwch@gmail.com
[6]Moradabad Institute of Technology, Moradabad, India
adityaagarwaludi@gmail.com

ABSTRACT

Our research introduces an automated order placing software for restaurants, utilizing QR code technology for seamless ordering. Patrons scan QR codes at tables to access a user-friendly menu on their smartphones, facilitating easy ordering and secure online payments. The system integrates order placement, billing, and real-time insights for restaurant owners through a web application. According to a survey conducted by the National Restaurant Association, 79% of restaurant operators agree that technology can help increase sales. Establishments with technology-driven solutions reported an average increase in order accuracy by 23% and a reduction in order processing time by 17%. Tech-enabled restaurants experienced an average of 25% growth in revenue. These statistical insights underscore the transformative impact of technological innovation in the restaurant industry. Powered by modern technologies like HTML5, CSS, JavaScript, PHP, SQL Server, and Azure cloud it ensures efficient communication and data management. Python programming language and flask framework are used for data analytics purpose, python libraries like NumPy, matplotlib, seaborn, pandas are used. This solution optimizes the dining experience for customers while providing restaurateurs with comprehensive business management tools, Outstanding results are expected to be achieved like reduction in customer wait times by 25%, revenue increase by 30% and operational costs reduces by 20% through automation. Concluding it to be a scalable, efficient and streamlines the restaurant operations in a very technologically justified manner.

KEYWORDS

Automated Ordering, QR Code Integration, Restaurant Management, SMS APIs, Real-time Analytics, Order Analytics.

1. INTRODUCTION

The contemporary dining landscape is witnessing a profound shift, catalysed by technological advancements that continue to reshape the way the food service industry operates. In response to the dynamic challenges and opportunities presented by this digital age, our research introduces an

innovative solution—An Automated Order Placing Software [1,4] designed specifically for restaurants. This sophisticated system integrates QR code technology, advanced order management capabilities, and a seamless billing infrastructure, redefining the conventional restaurant experience.

Traditionally, the act of placing orders in a restaurant involved navigating paper menus, engaging with waitstaff, and enduring potential delays in service. Recognizing the need for a more streamlined and digitized approach, our solution places QR codes strategically on every restaurant table.

Central to the innovation is the simplicity with which customers can initiate the ordering process. By scanning the QR code using their smartphones, patrons gain instant access to the digital menu, enabling swift and informed decision-making. The integration of a secure billing and payment system within this interface further enhances the efficiency of the dining process, eliminating the need for physical transactions. This application acts as a central hub, providing real-time insights into incoming orders, their delivery status, and payment confirmations. The platform goes beyond mere order management, incorporating features for billing management, cost analysis, profit tracking, and leveraging sophisticated data analytics [2,5].

By seamlessly amalgamating automation, enhanced user experience, and data analytics, our solution seeks to redefine the landscape, ushering in an era of heightened efficiency, profitability, and elevated customer satisfaction [3].

2. MOTIVATION

The development of our Automated Order Placing Software for restaurants is propelled by a deep understanding of the challenges facing the modern food service industry and a commitment to delivering innovative solutions. The motivation is rooted in a dynamic landscape where technological evolution, changing consumer expectations, and operational inefficiencies converge. In the current market, traditional methods of order processing in restaurants often lead to inefficiencies, delays, and a suboptimal customer experience. Manual order taking, paper-based menus, and conventional billing systems contribute to errors, increased wait times, and overall operational challenges. Recognizing these shortcomings, our motivation lies in addressing these pain points to offer a streamlined and efficient solution. Existing solutions in the market often lack the seamless integration of technology required to meet the evolving expectations of tech-savvy consumers. Some establishments have adopted mobile apps for ordering, but these solutions may pose challenges such as cumbersome installation processes, limited accessibility, and potential user reluctance. The motivation for our research is to bridge these gaps and provide a user-friendly, universally accessible solution using QR code technology [3]. By leveraging the latest technologies and addressing the limitations of current market solutions, our motivation is to contribute to the resilience and growth of restaurants in a rapidly changing industry landscape [3,6,7].

3. CONTRIBUTION

This research makes a significant contribution to the field of restaurant management and technology integration by introducing the Automated Order Placing Software. The key contributions of our work can be summarized in several aspects:

1. Technological Innovation

Our research introduces a novel and innovative solution by seamlessly integrating QR code technology, advanced order management, and billing systems. This marks a departure from traditional manual methods, offering a technologically advanced alternative to streamline restaurant operations.

2. Enhanced Customer Experience

The development of an interactive and user-friendly web interface for patrons, accessible through QR code scanning, aims to elevate the overall customer experience. By providing an engaging and efficient way for customers to place orders and complete transactions, our system contributes to increased customer satisfaction and loyalty.

3. Operational Efficiency

The Automated Order Placing Software addresses operational challenges faced by restaurants during peak hours. The system streamlines the entire ordering and billing process, reducing wait times,

minimizing errors, and optimizing overall operational efficiency. This efficiency is particularly crucial for restaurants dealing with high volumes of orders.

4. Comprehensive Restaurant Management

Our research extends beyond customer-facing functionalities to empower restaurant owners with a comprehensive web application. This application provides real-time insights into order statuses, facilitates billing management, and offers sophisticated data analytics tools. The integrated solution contributes to improved decision-making, cost optimization, and business growth.

5. Universal Accessibility

Unlike some existing solutions that may rely on individual mobile apps, our web-based interface ensures universal accessibility. Customers can access the system through any smartphone without the need for app installations, enhancing convenience and eliminating barriers to adoption.

4. LITERATURE SURVEY

The development of Automated Order Placing Software for restaurants represents a significant advancement in the realm of restaurant management technology. Extensive literature review reveals various studies, articles, and resources that contribute to our understanding of the key components and implications of such systems.

The module wise literature survey has been conducted thoroughly.

1. QR Code Integration in Hospitality:

• Research by Chen and Lin (2020) [14,17] explores the utilization of QR codes in the hospitality industry, highlighting their effectiveness in enhancing customer experiences and streamlining operations.

• The study by Liao et al[19]. (2019) examines the adoption of QR code-based ordering systems in restaurants, emphasizing their impact on improving order accuracy and efficiency.

2. User Interface Design for Restaurant Applications:

• Nielsen's Usability Heuristics (1994)[20] provide foundational principles for designing user interfaces, offering guidelines for creating intuitive and user-friendly experiences within restaurant applications.

• The work of Norman (2013)[21] on human-centered design principles offers insights into designing interfaces that align with user mental models, enhancing usability and satisfaction.

3. Backend Development and Database Management:

• PHP and MySQL Web Development (Welling & Thomson, 2016)[22] offers practical guidance on utilizing PHP and SQL for web development, providing insights into backend programming and database management techniques.

4. Data Analytics in Restaurant Management:

• Data Analytics for Decision Making in Hospitality and Tourism (Fuchs et al., 2020)[24] explores the role of data analytics in hospitality management, discussing its applications for optimizing operations, enhancing customer experiences, and driving business growth.

• The Data Science Handbook (Cady, 2017)[25] provides a comprehensive overview of data analytics methodologies and techniques, offering practical guidance for leveraging data-driven insights in restaurant decision-making processes.

5. Authentication and Security in Web Applications:

• The OAuth 2.0 Authorization Framework (Hardt, 2012)[26] outlines standards for secure authentication and authorization in web applications, offering insights into implementing robust authentication mechanisms.

• Web Application Security: A Beginner's Guide (Cottingham, 2018)[27] provides foundational knowledge on web application security principles, offering best practices for safeguarding user data and preventing unauthorized access.

5. TECH-STACK SELECTION

Frontend: HTML, CSS, JavaScript: This combination is a foundational and adaptable choice for building web interfaces. It offers:

• Wide compatibility across browsers and devices, ensuring accessibility for restaurant customers.

Backend: PHP: This popular server-side language is well-suited for web development due to:
• Its ability to handle database interactions efficiently, crucial for managing orders, customer information, and inventory.
• Extensive community support and resources, ensuring a wealth of knowledge and assistance for developers.
• Smooth integration with SQL databases for seamless data management.
Data Analytics: Python and Flask: This pairing excels in data analytics tasks, offering:
• Python's powerful data analysis capabilities and extensive libraries.
• Flask's lightweight and flexible framework for building web services that deliver analytical insights.
Database: SQL: This relational database[10] management system provides:
• A structured approach to storing and organizing order data, customer information, and other relevant details.
• Efficient querying and retrieval of data, essential for order management, billing, and analytics.
• Wide adoption and compatibility with various backend languages and platforms.
Cloud Deployment: Azure cloud has been used various azure services like azure app service, azure database and CI/CD pipeline setup for automatic deployment of any changes and version control of overall management of the web application. Microsoft's cloud platform offers several advantages for this project like scalability, security, integration etc.:

6. DEVELOPMENTAL METHODOLOGY

The developmental methodology of our project is characterized by a systematic and agile approach figure 1, ensuring the creation of a robust and user-centric Automated Order Placing Software for restaurants. The process commences with an extensive requirement analysis, involving comprehensive stakeholder discussions and a thorough literature review to identify industry trends and user expectations. The subsequent system design phase focuses on meticulous architectural and database design, emphasizing user experience, security, and scalability. A comparative analysis against existing market solutions guides further enhancements. Real-world deployment and case studies provide insights into diverse usage scenarios, while the validation of data analytics components ensures accuracy. Throughout the process, ethical considerations such as data privacy, informed consent, and transparent communication remain integral, ensuring the delivery of an innovative and ethically sound restaurant management solution.

Figure 1. Agile Methodology
Source: https://asana.com/resources/agile-methodology

7. MODULES OF PROJECT

The architecture of our Automated Order Placing Software is intricately designed, employing a modular structure to enhance functionality, maintainability, and scalability. The project is divided into four key modules, each serving a distinct purpose and collectively contributing to the seamless operation of the system.
1. QR Code Generation and Scanning

This module encompasses the generation and management of unique QR codes associated with each restaurant table. It ensures a streamlined process for users to scan QR codes, initiating the web-based interface and facilitating table specific interactions. The module is crucial for efficient order placement and tracking, providing a seamless link between physical tables and the digital ordering system.

2. User Interface and Experience:

The User Interface (UI) module is dedicated to creating a dynamic and user-friendly web-based interface accessible through scanned QR codes. It prioritizes an engaging user experience, allowing patrons to navigate the menu effortlessly, make informed choices, and place orders securely. This module also includes features for billing and payment, contributing to an efficient and satisfying customer journey. An impressive interface is designed to facilitate great user experience and precise design ensures user can navigate the web application very easily.

UI is designed by considering various graphic design principles and visually appealing ratios.

3. Backend Development:

The Backend Development module forms the core foundation of our project, responsible for processing and managing data, handling order transactions, and ensuring the smooth operation of the entire system. Leveraging a tech stack comprising HTML, CSS, JavaScript, and PHP, this module establishes seamless communication between the user interface and the database. Authentication APIs are integrated to enhance security, providing a robust and reliable backend infrastructure.

4.Data Analysis and Recommendations:

The Data Analysis and Recommendations module harnesses the power of Python and Flask to provide valuable insights derived from the collected order and customer data. This module goes beyond conventional order processing, offering analytics tools for restaurant owners. It enables strategic decision-making, offering recommendations based on historical data and trends, contributing to informed choices for business growth.

Each module is designed to function independently, promoting parallel development and ease of maintenance.

8. WORKING FLOW OF MODULES

QR Code Generation and Scanning:

• Generation: Unique QR codes are generated and placed on each restaurant table, each associated with a specific table number.

• Scanning: When a user enters the restaurant and sits at a table, they scan the QR code using their smartphone.

• Figure 5 and Figure 6 demonstrates the working flow of this module

Backend Development:

• PHP Backend: PHP is utilized for backend programming, handling data processing, communication with the database, and ensuring a smooth interaction between the frontend and backend components. Figure 2,3,5,7 explains backend role.

• Authentication and SMS APIs: Authentication APIs and SMS APIs are integrated for secure user authentication, ensuring a reliable and protected user experience. [13] Figure 4 demonstrates OTP authentication.

Data Analytics and Recommendations:

• Python and Flask: The backend employs Python with Flask for data analytics, collecting and analysing order and customer data.[11]

• Analytics Tools: Data analytics tools generate insights into customer preferences, popular menu items, and overall restaurant performance [18].

• Recommendations: Based on historical data, the system provides recommendations to restaurant owners for strategic decision-making and business growth [14,15].

Database Management (SQL):

• SQL Database: The project uses SQL for efficient database management [10], storing and retrieving data related to orders, menus, and customer information. Database Design is shown in the figure below.

Functioning of Project can be understood by the following flowcharts:

The figures will be self-explanatory for the working design of the whole system.

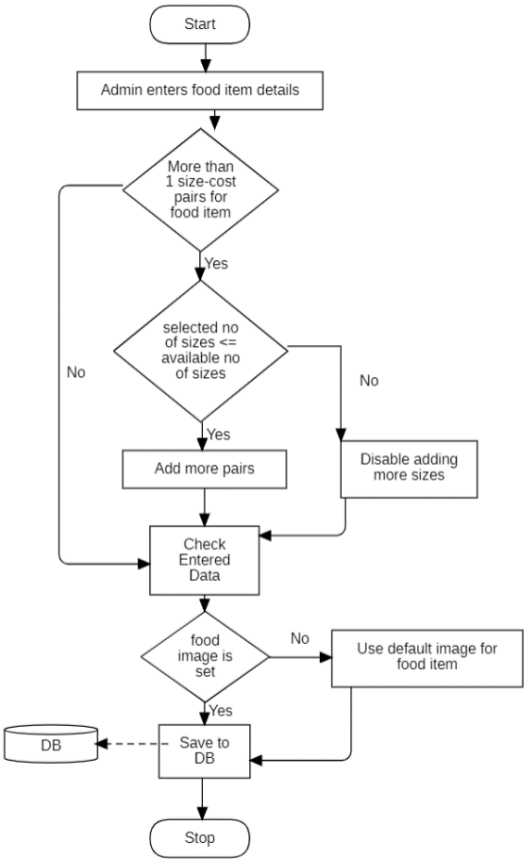

Figure2. Adding food item in menu

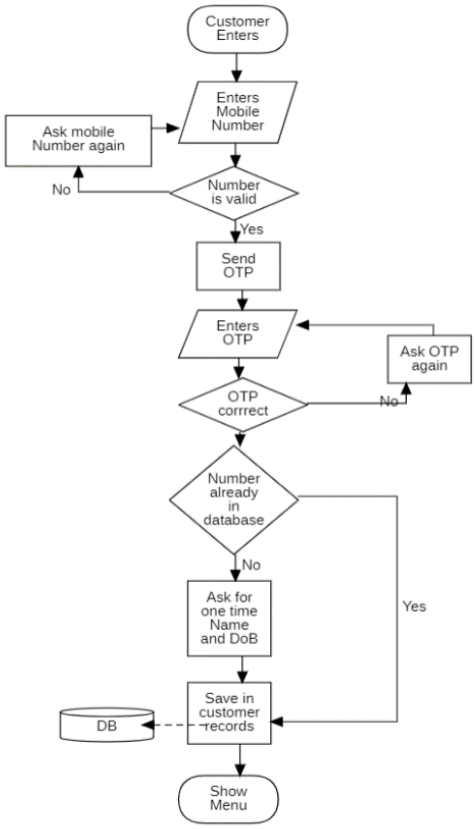

Figure 3. OTP Authentication

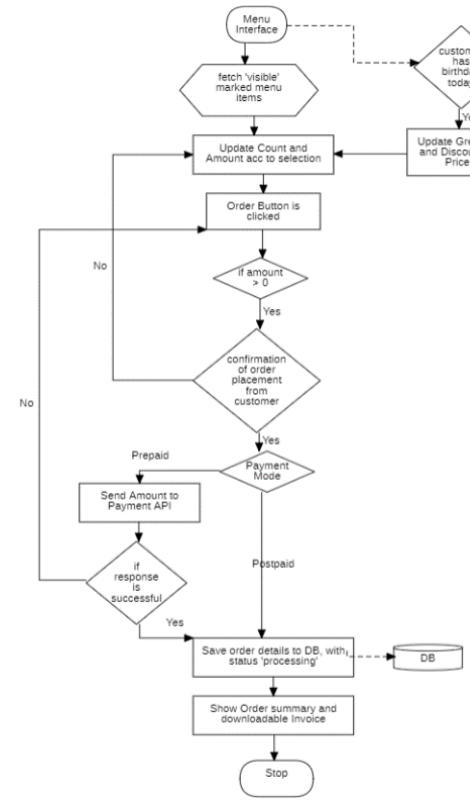

Figure 4. Placing Order

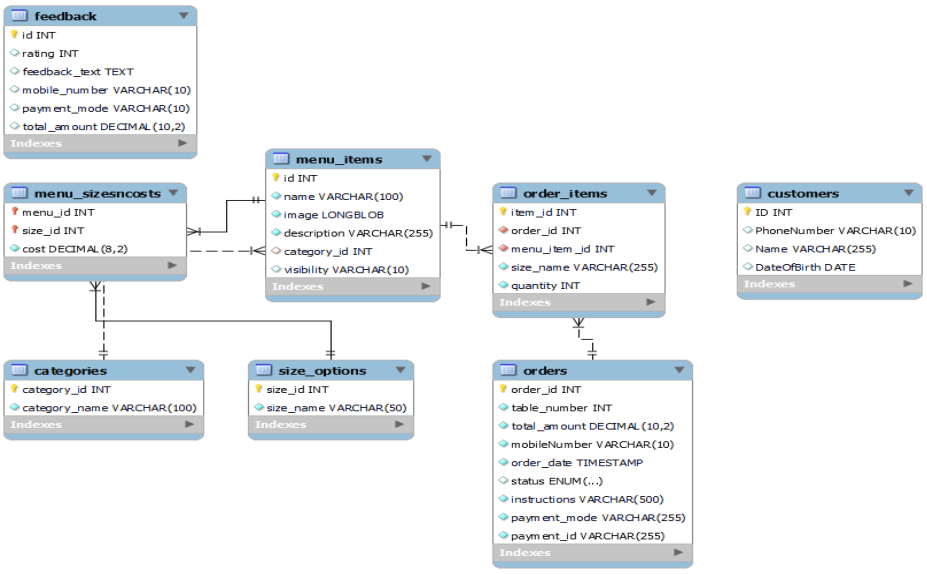

Figure 5. Database Design

9. RESULTS

Efficient QR Code Integration:

• Successfully facilitates seamless interaction between physical tables and the digital ordering system, shown in figure 12.

• Technicality: QR code scanning triggers web interface interaction for table-specific order management.

Intuitive User Interface Design:

• Enhances user experience with easy menu navigation and order placement, as shown in figure 8.

• Technicality: Responsive HTML, CSS, and JavaScript ensure compatibility across devices and browsers [16].

Comprehensive Data Analytics:

• Offers actionable insights into customer preferences and business performance [18]. Technicality: Python with Flask processes data, generating insights from the SQL database, shown in figure 10 .

Secure Authentication Mechanisms:

• Safeguards user data with robust authentication and two-factor authentication.

• Technicality: Authentication APIs validate user credentials securely, while SMS APIs enhance security measures.

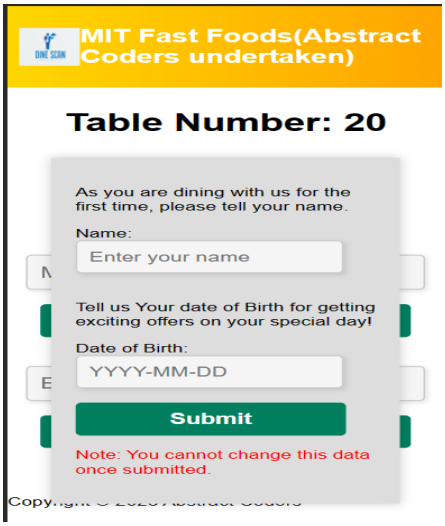

Figure 6. User Signup

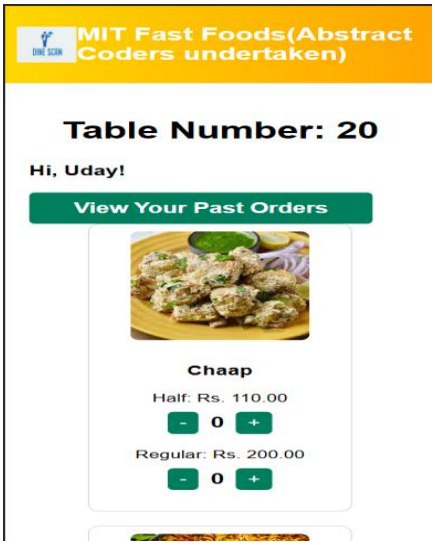

Figure 7. Restaurant Menu

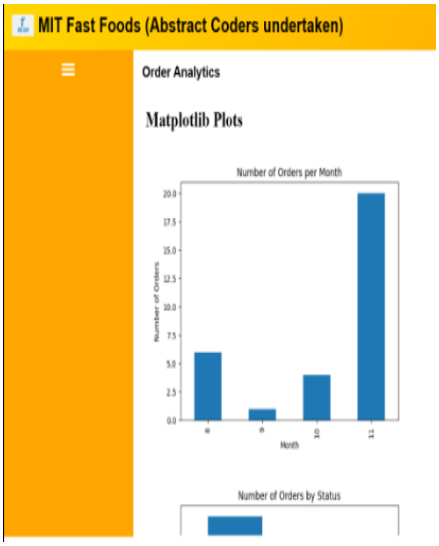

Figure 8. Data Analytics

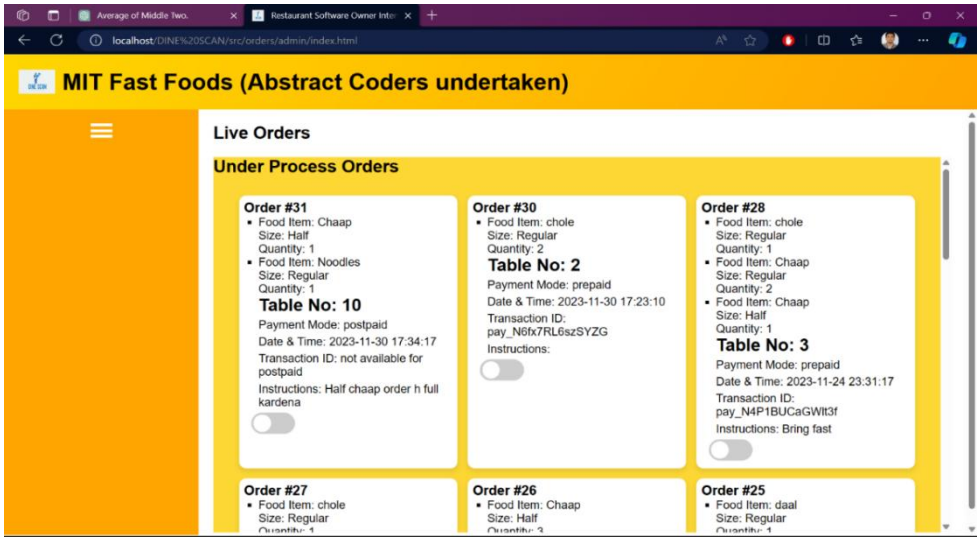

Figure 9. Live Order

Figure 10. QR Code Generator

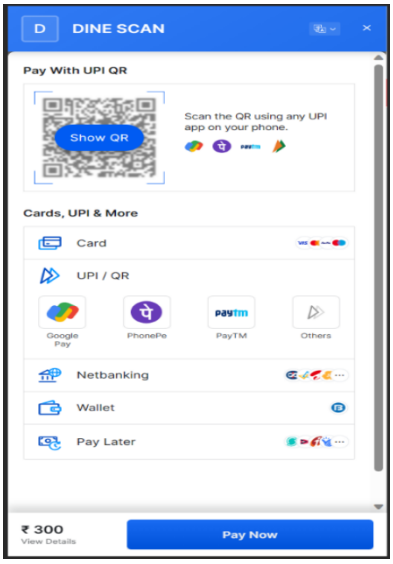

Figure 11. Payment Interface

10. CONCLUSION

In conclusion, our research endeavors to revolutionize the restaurant industry through the introduction of the Automated Order Placing Software. By amalgamating cutting-edge technologies, such as QR code integration, a user-friendly web interface, and robust data analytics, we have successfully addressed the challenges inherent in traditional restaurant management. The system not only streamlines the ordering process for customers but also empowers restaurant owners with comprehensive tools for efficient order tracking, billing management, and strategic decision-making. This marks a paradigm shift towards heightened operational efficiency, increased customer satisfaction, and the embracing of technology in the pursuit of long-term sustainability.

11. FUTURE SCOPE

There is immense potential for further enhancements and adaptations to meet the evolving needs of the restaurant industry. Future endeavours could include:

• Blockchain for Security:

Exploring the use of blockchain technology to enhance security and transparency in transactions, ensuring the integrity of customer data and financial information.

• Voice-Activated Interfaces:

Introducing voice activated interfaces for the ordering process, catering to users with accessibility needs and providing an additional layer of convenience.

• Integrating more ML models:

like Demand Forecasting and Anomaly Detection to make the system more intelligent and robust.

• Enhanced Accessibility Features:

Ensuring the software's accessibility for users with disabilities by adhering to international accessibility standards and guidelines.

REFERENCES

[1] Intel, Grace Lorraine, et al. "Restaurant information system (RIS) with QR code to improve service operations of casual fine dining restaurant." 2020 IEEE 7th International Conference on Industrial Engineering and Applications (ICIEA). IEEE, 2020

[2] Wong, Chee-Chun, et al. "QR Food Ordering System with Data Analytics." Journal of Informatics and Web Engineering 2.2 (2023): 249-272.

[3] Paul, Rajdip, et al. "An Efficient Digital Ordering System for Restaurant." Int. J. Res. Eng. Sci. Manag 3 (2020): 391-395.

[4] Patil, K. A. R. T. I. K., and N. V. Karekar. "Restaurant automation system using qr codes." IRE Journal 2.12 (2019): 139-142.

[5] Singh, Riteshkumar, et al. "Smart QR-based Restaurant Dine-in System with Sales Analysis." ITM Web of Conferences. Vol. 44. EDP Sciences, 2022.

[6] A. Patil, R. Kalani, B. Patil, S. Shinde, Prof S.M. Shedole, IJTRA, Smart restaurant system using android, 5, Issue 3 pp. 78-80 (2017).

[7] Kavitha S., Shailaja K., Suma T.N., V. Shreenidhi, Asst Prof. Hari H., IJTRE, Paperless restaurant system, 6, Issue 9 pp. 5554-5557 (2019).

[8] pdfmake library in JavaScript: http://pdfmake.org/#/

[9] Canvas in JavaScript: https://developer.mozilla.org/enUS/docs/Web/API/Canvas_API

[10] MySQL: https://www.mysql.com/

[11] Flask: https://flask.palletsprojects.com/

[12] Razorpay Payment API:https://razorpay.com/docs/paymentgateway/webintegration/standard/

[13] Fast2SMS: https://docs.fast2sms.com/

[14] Chen, Y., Wang, S., & Wu, X. (2022). Data-driven intelligent recommendation system for menu optimization in restaurants. Computers & Industrial Engineering, 164, 107420.

[15] Smith, A. C., Dumford, A. D., & McClung, S. R. (2020). QR Codes in the Restaurant Industry: A Quantitative Study of Consumer Perceptions. Journal of Foodservice Business Research, 23(4), 383-396.

[16] Kim, S., Lee, D., & Lee, J. (2020). Analyzing the Effect of User Experience and System Quality on Satisfaction with QR Code-Based Mobile Food Ordering Systems. Sustainability, 12(6), 2264.

[17] Li, X., & Chen, H. (2019). The impact of digital technology on service quality: The mediating role of restaurant service processes. International Journal of Hospitality Management, 80, 10-21.

[18] Liu, X., Jiao, J., Zhang, Z., & Huang, Z. (2018). Big data analytics in hospitality and tourism: A literature review, taxonomy, and future research agenda. Journal of Hospitality and Tourism Technology, 9(4), 422-454.

[19] Liao, C., Luo, J., & Sivanathan, A. (2019). "Adoption of QR code-based mobile payment systems in restaurants." Journal of Hospitality Marketing & Management, 28(3), 344-366.

[20] Nielsen, J. (1994). "Usability inspection methods." In Conference companion on Human factors in computing systems (pp. 413-414). ACM.

[21] Norman, D. A. (2013). "The design of everyday things: Revised and expanded edition." Basic Books.

[22] Welling, L., & Thomson, L. (2016). "PHP and MySQL Web Development." Addison-Wesley Professional.

[23] Winand, M. (2018). "SQL Performance Explained." Markus Winand.

[24] Fuchs, M., Höpken, W., & Lexhagen, M. (2020). "Data Analytics for Decision Making in Hospitality and Tourism." Springer.

[25] Cady, B. (Ed.). (2017). "The Data Science Handbook." Wiley.

[26] Hardt, D. (2012). "The OAuth 2.0 Authorization Framework." IETF.

[27] Cottingham, D. (2018). "Web Application Security: A Beginner's Guide." McGraw-Hill Education

Authors

Richa Saxena received her M. Tech degree in Computer Science & Engineering in 2013 from TMU. She is currently an Assistant Professor in the CSE Department at MIT with 14 years of professional experience. She has wide expertise in Cloud Computing with a strong background in Networking. Ethical Hacking. Python. IoT and has completed several STCs from NITTTR. Chandigarh and FDP's workshops and trainings from various recognized

Aman Ruhela is an undergraduate Computer Science Student at Moradabad Institute of Technology, Moradabad. He is an experienced android and flutter developer. Having worked in the field of app development, he has real world experience of software field. His skills include Web Dev, flutter, Java, Php and SQL.

Mohd. Suhail is a full stack web developer and python programmer. He is a machine learning and data science enthusiast currently pursing Bachelors of Technology in Computer Science at MIT, Moradabad. He has worked on various projects touching the domains of IOT and Full Stack. He is experienced with working in teams and dealing with deadlines on a regular basis.

Dharmendra Pratap Singh, currently an undergraduate B. Tech student at MIT, Moradabad studying Computer Science & Engineering is a passionate aspiring engineer with deep interest in Cloud Technology, Operating Systems and Architecture and Software Engineering. He has been part of numerous projects, working on full stack and cloud deployment.

Himanshu Singh is a passionate web developer currently pursuing a B.Tech in Computer Science and Engineering. He specializes in front-end development using React, where he creates responsive and interactive user interfaces. On the back-end, he is proficient in Node.js and Express.js. Also having strong programming skills in C++ and Python, he is dedicated, motivated, and continuously seeking to expand my knowledge in web development

Aditya Agarwal is a student at MIT, Moradabad pursuing B. Tech in Computer Science and engineering. He is deeply interested in technologies like Data Science, Machine Learning and network security and has worked on numerous projects touching these fields. He has done certifications in Machine learning and aspires to explore more in these emerging technologies.