International Journal of Research Publication and Reviews

Digitization of Babcock University Cafeteria Ticket Management System

Ajayi Oluwabukola, Precious Fortune, Koleoso Ifeoluwa, Tamunowari Joshuana

Department of Computer Science, Babcock University, Ilishan-Remo, Ogun State, Nigeria
Email: Ajayioluwa@babcock.edu.ng , fortuneprecious17@gmail.com, colesobr@gmail.com, tamunojoshuana@gmail.com
DOI: https://doi.org/10.55248/gengpi.4.623.45226

ABSTRACT:

The existing manual process of ticket distribution in Babcock University Cafeteria has remained largely unchanged since its inception. However, this system has notable drawbacks, including delays in ticket issuance, labor-intensive production processes, vulnerability of paper tickets to misplacement or theft, and other concerns amplified by the growing student population. To address these issues, our team has proposed the development of a digitalized system that automates the ticket management process online. This project focuses on the development process of the system, along with additional details related to its implementation.

The primary objective of this project is to create an efficient and time-saving system for managing cafeteria tickets at Babcock University. The proposed solution involves transitioning from paper tickets to digital tickets using QR code technology. An attendant equipped with a QR code scanner device will be responsible for validating each student's digital ticket. The user interface of the system will be developed using the Progressive Web App Environment, which combines the benefits of web and native apps, utilizing the ReactJS framework. Data management will be handled using NodeJS and MongoDB, a real-time updating and secure cloud database. Instead of physically submitting receipts and documents, students will upload them onto the online platform for evaluation and verification by the administration. Additionally, QR codes for each student will be regularly updated to reduce security risks associated with static codes.

The implementation of this system will consolidate all necessary functionalities, streamlining the current process and reducing the time required. It will also eliminate the expenses associated with paper tickets and mitigate the risks of ticket loss, theft, or damage.

Keywords — QR Code, Progressive Web Application (PWA), Cafeteria Ticket Management System, Cloud Computing.

I. BACKGROUND

The cafeteria is an essential part of almost every school. It is a place where food is being served to students and it also provides where they can stay to eat the food (tables and chairs). Babcock University is no exception to this list of schools, it has a Cafeteria that provides food for every student that has paid for its service. Although Babcock's Cafeteria has made it impossible for students to get and eat their desired meal from the menu of available food, the process of obtaining the tickets needed for identification of authorized students (using the meal ticket) is quite old-fashioned and requires improvement.

Based on the empirical observation of the Cafeteria Ticket Management System in Babcock University, it can be noted that problems usually arise in the manual process which include: the time spent queuing for meal ticket for the semester is lengthy, the paper tickets after collection (by the student from the Cafeteria staff) could be lost, stolen or destroyed, which will lead to, increased cost for making a new one and affected mental health of the student throughout this period, the process taken in making the paper tickets is quite tedious and tasking as it is performed by a human being and could also lead to errors with the dates on it.

To tackle these problems, a digitized ticket management system was put forward. This management system has benefits to be explored to solve these problems. The implementation of this system solves all the problems listed above and creates a report for statistical analysis and drawing inferences for the cafeteria.

II. AIM AND OBJECTIVES

The aim of this project is to design and develop a digitized system for Babcock University Cafeteria Ticket System to replace the outdated, manual process that is currently in use.

The specific objectives of this project are to:

- Evaluate the existing ticket system.

- Design and evaluate proposed systems.

III. LITERATURE REVIEW

For the Babcock University Cafeteria, implementing an online, cloud-based Information Management System is the most suitable solution, considering that approximately 98% of students access the internet through their smartphones. The proposed system will utilize secure QR codes (SQRC) for validation and verification of students who have paid for their meals. This digital approach will streamline the ticket management process and improve efficiency compared to the current manual system.

A. Overview of Existing System

The present system being applied at Babcock University Cafeteria is heavily paper-based. It runs on a paper-based management system, which in today's time is outdated as improvements in technology have greatly changed the style and way information is being stored and managed.

The procedure applied in it is as follows;

Upon arrival, students must provide payment receipts and identification documents. However, the queue system used causes frustration and wastes time. Students receive paper meal tickets for collecting their meals, but this manual process is prone to errors and issues like theft or damage. The paper tickets lack tracking and feedback capabilities, hindering data analysis and decision-making.

B. Online Cafeteria Management System

An online cafeteria management system in [1] was developed to automate the process of ordering food items in a cafeteria. The system the author proposed is an online ordering system designed for use in college cafeterias, but just as applicable in any food delivery industry. The system allows users to register, browse food items, place orders, and make payments online. The system is designed to improve the efficiency of the cafeteria by reducing waiting times and minimizing errors in order processing. Additionally, the system provides an inventory management module to track the availability of food items and generate reports on sales and profits. The author used PHP, HTML, CSS, and MySQL to develop the system and tested it for functionality and usability. The study showed that the system can effectively streamline the ordering process and provide valuable insights into the cafeteria's operations.

C. PWA: Native App Experience on the Web

Cross-platform development has gained momentum as companies seek cost-effective ways to create mobile applications [7]. Native apps for different platforms can be expensive, leading to the rise of technologies like Flutter and React Native. However, their performance is often compromised. Recently, there has been a shift back to browser-based apps, with Progressive Web Apps (PWAs) emerging as a powerful solution [23]. PWAs leverage Service Workers APIs to enable offline functionality, push notifications, and background data synchronization. They consolidate app development efforts and eliminate the need for separate solutions for each platform.

While research suggests that PWAs have the potential to unify multi-platform development, their full capabilities are still being explored. In practice, PWAs offer fast performance, reliability even with limited connectivity, and engagement through notifications. They can be installed on users' devices and provide a mobile-like experience [13]. Therefore, adopting PWAs in the context of a cross-platform environment for students' mobile devices ensures efficient production, continuous engagement, and reliable functionality even with limited internet connectivity.

D. Implementation of SQRC for Secure Identification

Researchers are actively working on QR code-based information sharing systems to address data security and information exchange requirements [12]. Various studies have explored the characteristics of QR codes and proposed security systems using cryptography and steganography [17]. For example, one study implemented a three-layer security system using MATLAB, while another presented a secret QR sharing approach with a distributed system [11]. The use of RSA cryptographic algorithms has also been explored for secure QR code systems, offering feasibility and suitability for sensitive information sharing [5]. RSA emerged as the preferred choice due to its superior security, flexibility, and encryption performance compared to other algorithms. The popularity of QR codes is attributed to their cost-effectiveness, high data capacity, user-friendliness, and fast decoding [12]. Overall, these advancements provide options for ensuring secure QR codes for applications such as meal tickets.

IV. MATERIALS AND METHODS

A. Requirements Elucidation and Analysis

In the development process, requirement analysis was conducted to gain information of what kind of management system that met the requirement. The analysis was carried out by interviewing students on campus combined with direct observation of the services provided in the cafeteria. This process resulted conclusion that the ticket management system is expected to have main functions involving:

- All the scanning, verification, and validation processes of students and their meal tickets are done by cafeteria attendants,

- In order to save time, the meal tickets will be automatically generated on request and also saved for a short time before being scanned by the attendant,

- The system will be able to track and compile automatically the report if every student transaction with the cafeteria and generate information from it,

- The system will be able to verify each student before offering them a digital meal ticket.

The Cafeteria ticket management system has three main components:

- Secure QR code generated on the student's phone.

- Camera on the attendant phone or connected to the computer to read the QR code.

- The administrator's system for management of all the ticket transactions.

Fig. 1 The general architecture of the cafeteria ticket management system

By carrying out analysis and elucidation, we were able to define the specific functionalities and features that the system should possess to meet the needs of its users. We will outline the functional requirements for our project, detailing the specific actions, tasks, and behaviors that our system must be able to perform.

TABLE I FUNCTIONAL REQUIREMENTS OF THE ADMINISTRATOR

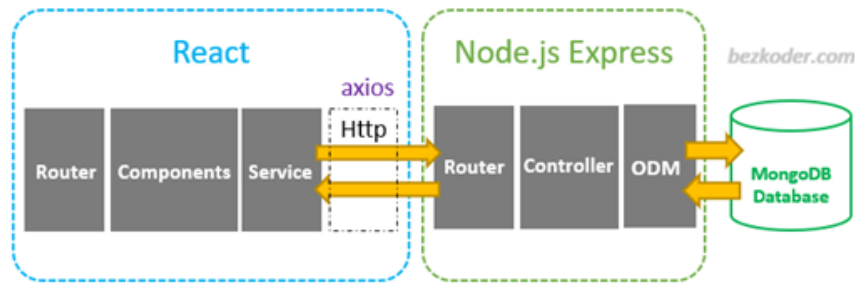| S/N	Administrator		
	Requirements	**Description**	**Priority**
1	Verify Student Documents	This system will verify students documents and other additional details in order to get tickets.	High
2	Login	This system will allow authorized admin access to Administrator capabilities.	High
3	Dashboard	This system will provide the admin with a dashboard consisting of all the students and other functions like view, adding or editing students.	High
4	Generate report	This system will provide daily, weekly, or monthly reports on the tracking of the digital tickets.	High
5	Help Students	This system will receive concerns from students concerning the app and the cafeteria.	High
6	Inform Students	This system will inform students on changes or announcements from the cafeteria.	Mid

TABLE II FUNCTIONAL REQUIREMENTS OF THE ATTENDANT

S/N	Attendant		
	Requirements	Description	Priority
1	Login	This system will allow authorized attendant access to Administrator capabilities.	High
2	Scan Digital Ticket	This system will allow attendants to scan and validate students digital meal tickets (QR Code).	High
3	Setup meal for the time	This system will allow attendants set up the meal for the day and time in order to process digital tickets of students.	High
4	Inform Students	This system will allow attendants to update information about the meals being served or the cafeteria.	Mid

TABLE III FUNCTIONAL REQUIREMENTS OF THE STUDENT

S/N	Student		
	Requirements	Description	Priority
1	Registration	This system will let students register for a digital ticket.	High
2	Login	This system will grant registered students access to the website and other features in it.	High
3	Generate Ticket	This system will create the QR code (digital ticket) needed for collecting meals	High
4	User Profile	This system will show students their details that were submitted during registration.	Mid
5	Dashboard	Shows the student details from the analysis obtained from tracking their digital tickets.	Mid
6	Help Center	To ask for help concerning any issue.	High
7	Info/News Feed	Relays information from the administrator concerning the cafeteria.	Mid
8	Submit Documents	This system will accept documents and other information for verification and provision of digital tickets of students	High
9	View Menu	This system will show the food for that day.	Low

B. System Architecture

The developed ticket management system for Babcock University Cafeteria consists of several components and follows a specific system architecture. The system architecture for the ticket management system can be explained as followsFig. 2 shows the System Architecture and its various key features and functionalities.

1)   ***Frontend Interface:*** The frontend interface is responsible for providing a user-friendly interface for the different system actors: Administrator, Attendant, and Students. React, a popular JavaScript library for building reusable user interfaces, was implemented in developing the progressive web capabilities of the system's interface. The frontend interface allows students to submit their receipts and passports, generate digital tickets, view cafeteria activities, and receive messages related to the cafeteria. The interface for the administrator includes a dashboard with analytical reports and inference generation capabilities, as well as a help center to address student issues and provide updates.

2)   ***Backend Server:***   The backend server handles the logic and processing of the system. It is built using Node.js and Express, which are widely used for server-side development due to its short development time. The backend server manages the communication between the frontend interface and the database, handling requests and responses. It includes the necessary APIs and endpoints for functionalities such as student verification, ticket generation, and data management.

3)   ***Database Management System:*** The system utilizes MongoDB, a popular NoSQL database, for data management. MongoDB provides a secure and real-time updating cloud database solution. It stores and manages student data, including information such as receipts, passport details, digital tickets, and cafeteria transaction records. The database allows for efficient storage, retrieval, and manipulation of data related to the ticket management system.

4)   ***Secure QR Code System:*** The system incorporates a secure QR code (SQRC) system to provide digital tickets for students. The SQRC system is implemented using the RSA cryptographic algorithm (NodeRSA), ensuring the security and integrity of the generated QR codes. Each student is assigned a unique QR code that is regularly updated to minimize security risks associated with static codes. The QR codes are scanned and validated by attendants using a QR code scanner device, camera connected to a computer or their mobile phones.
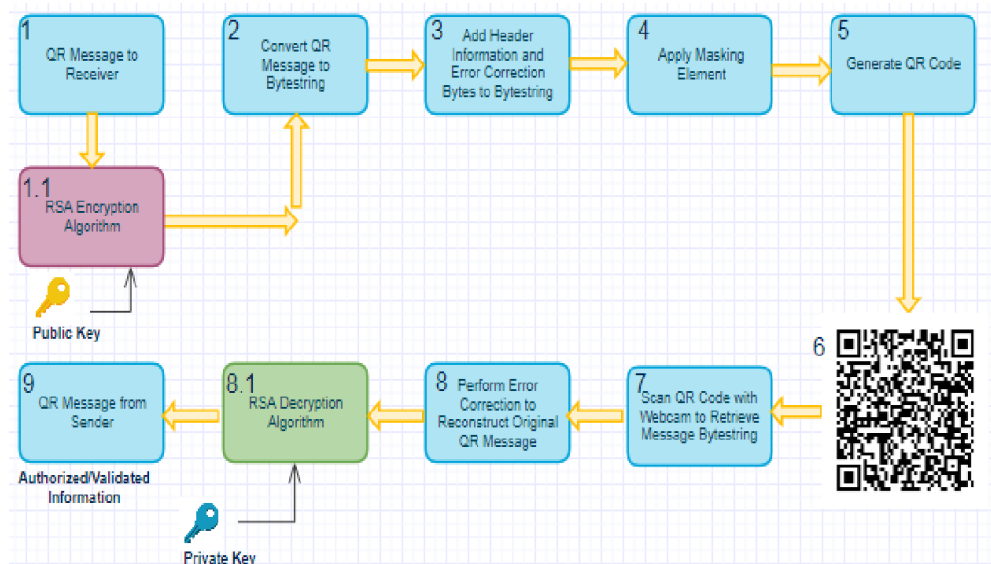

Fig. 3 Secure QR Code model showing QR code generation process with proposed security feature of validation.

5)   ***System Components Interaction:*** Fig. 2 demonstrates the interaction of the system components. The frontend interface interacts with the backend server through http API calls, sending and receiving data for various functionalities. The backend server communicates with the database through mongoose (Object Data Manager) to store and retrieve student information, manage digital tickets, and generate analytical reports. Attendants use the QR code scanner device or camera to scan and validate students' digital tickets, with the backend server verifying the authenticity of the tickets. The administrator utilizes the frontend interface and the backend server to manage student data, generate reports, and handle communication with students.

C.   User Roles

This system has three actors: The Administrator, Student, and Attendant.

1)   *Administrator:*   Granted access to the database, with privileges to verify, add, or delete student details. Included a dashboard for generating analytical reports and inferences from the database.

2)   *Attendant:* Granted access to validate registered student QR codes by scanning them and receiving backend responses for authentication. Also displays transaction records for the period of time of meal served.

3)   *Student:* Accessed a user interface to submit receipts and passports for verification, register for digital tickets, generate digital tickets for collecting meals, view cafeteria activities, and receive cafeteria-related messages.

V. RESULTS AND DISCUSSIONS

The implementation of the digitalized ticket management system at Babcock University Cafeteria has yielded significant improvements and positive outcomes. In this section, we will discuss the results obtained from the system and provide insights into the implications and benefits of the implemented solution.

A. *Improved Efficiency and Time-Saving*

The digitalized ticket management system has successfully addressed the issues associated with the previous manual process. One of the key outcomes is the significant improvement in efficiency and time-saving. With the transition from paper tickets to digital tickets using QR code technology, the process of ticket validation has become faster and more streamlined. The attendants equipped with QR code scanners can quickly validate students' digital tickets, reducing waiting times and eliminating the need for manual ticket issuance. This will result in smoother operations and a more efficient cafeteria experience for both students and staff.

B. *Enhanced Security and Reduced Risks*

The adoption of QR code technology has introduced enhanced security measures to the ticket management system. The regular updating of QR codes for each student significantly reduces security risks associated with static codes. The dynamic nature of QR codes ensures that unauthorized access or replication of tickets is minimized, protecting the integrity of the system. This will mitigate the risks of ticket loss, theft, or damage, providing a more secure environment for ticket distribution and validation.

C. *Cost Reduction and Environmental Sustainability*

By transitioning from paper tickets to digital tickets, the system will successfully eliminate the expenses associated with paper ticket production. The labor-intensive processes involved in creating, printing, and distributing paper tickets have been eliminated, resulting in cost savings for the cafeteria. Furthermore, the digitalized system aligns with environmental sustainability goals by reducing paper usage and promoting a more eco-friendly approach to ticket management.

D. *Streamlined Data Management and Reporting*

The implementation of a real-time updating and secure cloud database using MongoDB will facilitate streamlined data management. All student information, transactions, and cafeteria activities are efficiently stored and managed within the system. The administrators have access to a comprehensive dashboard that generates analytical reports and insights from the database. This empowers the administration to make informed decisions, track student transactions, and identify trends or patterns related to cafeteria activities. The availability of accurate and up-to-date data will enhance the overall management and decision-making process.

E. *User-Friendly Interface and Student Engagement*

The user interface developed using the Progressive Web App environment and the ReactJS framework will provide a user-friendly experience for both students and staff. The system offers a simple and intuitive interface for students to submit receipts, upload documents, and generate digital tickets. Additionally, the system allows students to receive messages and updates related to the cafeteria, fostering engagement and improving communication between the cafeteria administration and the students.

In essence, the implementation of the digitalized ticket management system has the prospect of addressing the drawbacks of the current manual process. The system will improve efficiency, enhance security, reduce costs, streamline data management, and provide a user-friendly experience. The positive outcomes of this project will not only benefit the cafeteria operations but also contribute to a more convenient and reliable ticket management system for the students at Babcock University.

Below are a few user-friendly pages that meet the system's specifications;
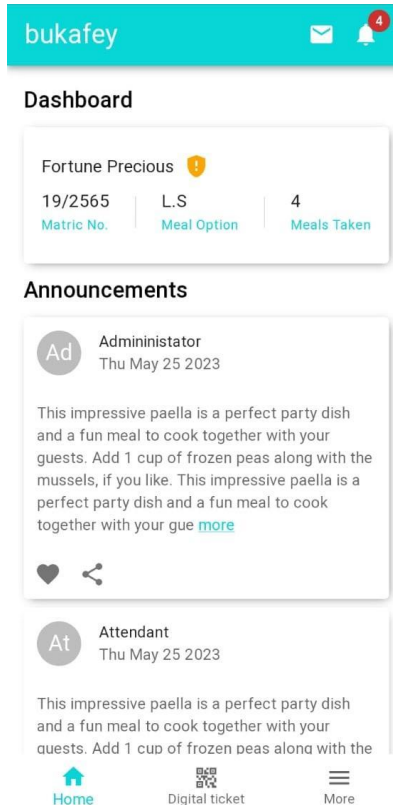
Fig. 4 Login Page for Students, Attendants and Admins

Fig. 5 Student Home Page with Simple Dashboard and other functions
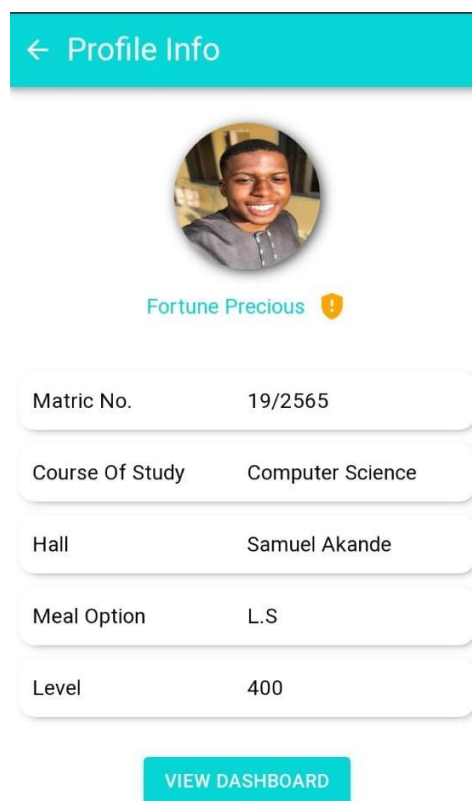
Fig. 6 Attendant Meal Setup Page

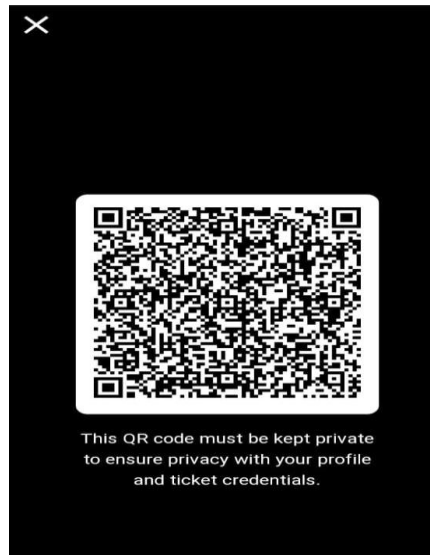Fig. 7 Student Profile Info Page

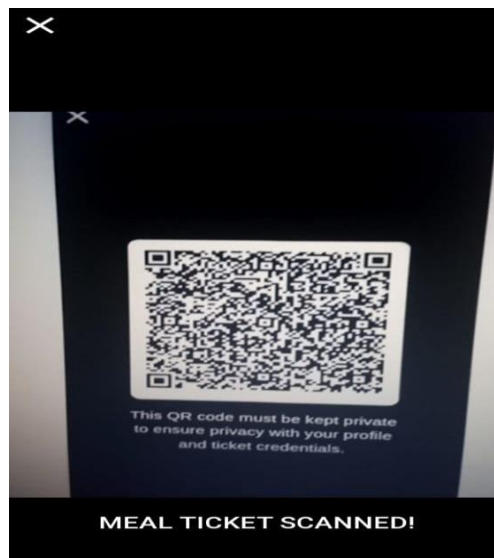Fig. 8 Student Digital Meal Ticket

Fig. 9 Attendant successfully scanning Student Meal Ticket
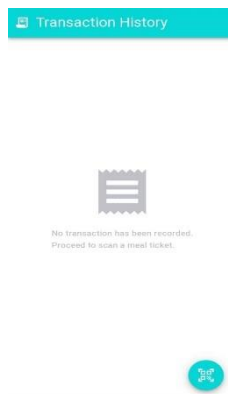

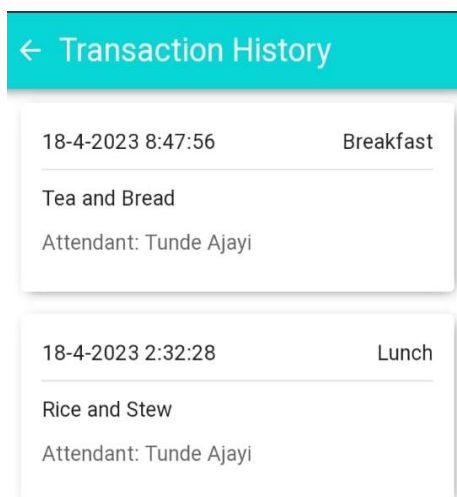Fig. 10 Attendant Transaction History showing empty records

Fig. 11 Transaction History with two recorded meal transactions

VI. CONCLUSIONS

After completing this project, I successfully designed and developed software capable of efficiently managing the Babcock University online cafeteria ticket system, including ticket validation, student registration, meal transaction recording, and an admin system. To accomplish this, I obtained valuable firsthand information on the university's traditional management system. Furthermore, this project serves as a starting point for further research in this area.

There are several advantages of the implemented system, including:

- The system offers the ability to generate reports and conduct analyses based on meal transaction data on a daily, weekly, monthly, or semester basis.

- The cloud storage used for the operational data can also be utilized for other forms of organization data.

- The installed software facilitates meal ticket verification and validation. Furthermore, the structured approach adopted during each phase of the software development provides a helpful guide for future research in this field.

A. Future Scope

The future enhancement would;

- Incorporate artificial intelligence into the software to verify student profile pictures and receipts.

- Enable a communication channel for students to send feedback and complaints to the cafeteria admin and vice versa.

- Add a calendar feature to preview the meals available each day of the week.

- Connect the student bursary system directly to the cafeteria registration process to reduce instances of fraud.

ACKNOWLEDGMENT

REFERENCES

[1] Akash Sharma. (2020). Online Cafeteria Management System BACHELORS IN COMPUTER APPLICATION. https://www.coursehero.com/file/119462687/project1reviewreport3-Akash-Sharmapdf/

[2]　Avram, M. G. (2014). Advantages and Challenges of Adopting Cloud Computing from an Enterprise Perspective. Procedia Technology, 12, 529–534.

[3]　Definition of Digitalization—IT Glossary | Gartner. (n.d.). Retrieved March 19, 2023, from https://www.gartner.com/en/information-technology/glossary/digitalization

[4]　F N Hasanah, F Renaldi, & F R Umbara. (2021). Implementing Cloud Computing Technology on Restaurant's Expenses Monitoring System—IOPscience. https://iopscience.iop.org/article/10.1088/1757-899X/1115/1/012039/meta

[5]　*Fauzi, A. F. M., Mohamed, N. N., Hashim, H., & Saleh, M. A. (2020). Development of Web-Based Smart Security Door Using QR Code System. 2020 IEEE International Conference on Automatic Control and Intelligent Systems (I2CACIS), 13–17.*

[6]　*Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification*, IEEE Std. 802.11, 1997.

[7]　*Fortunato, D., & Bernardino, J. (2018). Progressive web apps: An alternative to the native mobile Apps. 2018 13th Iberian Conference on Information Systems and Technologies (CISTI), 1–6.*

[8]　*Golightly, L., Chang, V., Xu, Q. A., Gao, X., & Liu, B. S. (2022). Adoption of cloud computing as innovation in the organization. International Journal of Engineering Business Management, 14, 18479790221093990.*

[9]　*Intal, G. L., Payas, J. D., Fernandez, L. M., & Domingo, B. M. (2020). 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), 1054–1059.*

[10]　*Jose, B., & Abraham, S. (2020). Performance analysis of NoSQL and relational databases with MongoDB and MySQL. Materials Today: Proceedings, 24, 2036–2043.*

[11]　*Lin, P.-Y. (2016). Distributed Secret Sharing Approach With Cheater Prevention Based on QR Code. IEEE Transactions on Industrial Informatics, 12(1), 384–392.*

[12]　*Mendhe, A., Gupta, D. K., & Sharma, K. P. (2018). Secure QR-Code Based Message Sharing System Using Cryptography and Steganography. 2018 First International Conference on Secure Cyber Computing and Communication (ICSCC), 188–191.*

[13]　*Moerkerke, D. (2022). What PWA Can Do Today. https://whatpwacando.today/*

[14]　*Nuhi, A., Memeti, A., Imeri, F., & Cico, B. (2020). Smart Attendance System using QR Code. 2020 9th Mediterranean Conference on Embedded Computing (MECO), 1–4.*

[15]　*Paul, P. K., & Ghose, M. K. (2012). Cloud Computing: Possibilities, Challenges and Opportunities with Special Reference to its Emerging Need in the Academic and Working Area of Information Science. Procedia Engineering, 38, 2222–2227.*

[16]　*Qadami, S. F. H. A. (2018). Research and Development of Shared Restaurant Platform Based on Cloud Computing. American Journal of Industrial and Business Management, 8(12), Article 12.*

[17]　*Sharma, S., & Sejwar, V. (2016). Implementation of QR Code Based Secure System for Information Sharing Using Matlab. 2016 8th International Conference on Computational Intelligence and Communication Networks (CICN), 294–297.*

[18]　*https://doi.org/10.1109/CICN.2016.64*

[19]　*Sheppard, D. (2017). Beginning Progressive Web App Development: Creating a Native App Experience on the Web | SpringerLink. https://link.springer.com/book/10.1007/978-1-4842-3090-9*

[20]　*Supriyono, H., Fitriyan, M. R., & Munaroh. (2018). Developing a QR Code-based Library Management System with Case Study of Private School in Surakarta City Indonesia. 2018 Third International Conference on Informatics and Computing (ICICI), 1–6.*

[21]　*Taghipour, D., Mowloodi, E., Mahboobi, M., & Abdi, J. (2020). Application of Cloud Computing in System Management in Order to Control the Process. 3, 34–55.*

[22]　*The History of Management Information Systems. (n.d.). Biz Fluent. Retrieved March 19, 2023, from https://bizfluent.com/about-5444925-history-management-information-systems.html*

[23]　*Thomas Steiner. (2018). What is in a Web View | Companion Proceedings of The Web Conference 2018. https://dl.acm.org/doi/abs/10.1145/3184558.3188742*

[24]　*Ting Si Xue, C., & Xin, F. (2016). Benefits and Challenges of the Adoption of Cloud Computing in Business. International Journal on Cloud Computing: Services and Architecture (IJCCSA), 6, 1–15.*

[25]　*Tiwari, S. (2016). An Introduction to QR Code Technology. 2016 International Conference on Information Technology (ICIT), 39–44.*

[26] *Tretinjak, M. F. (2015). The implementation of QR codes in the educational process. 2015 38th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 833–835.*

[27] *What is a cloud database? | IBM. (n.d.). Retrieved March 19, 2023, from https://www.ibm.com/cloud/learn/what-is-cloud-database*

[28] *What is a PWA? Progressive Web Apps for Beginners. (2021, April 6). FreeCodeCamp.Org. https://www.freecodecamp.org/news/what-are-progressive-web-apps/*