International Journal of Scientific Research and Engineering Development-– Volume 7 Issue 2, Mar- Apr 2024
Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Development of An Electronic Meal Ticketing System Using Radio Frequency Identification (RFID)

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Abstract
This project focuses on designing and implementing an innovative Electronic Meal Ticket System (EMTS) using Radio-Frequency Identification (RFID) technology. The system aims to revolutionize meal management at Babcock University by automating the already set up meal ticketing system and improving operational efficiency. RFID-enabled smart cards are used to ease a seamless and secure ticketing system. This paper delineates the architecture, workflow, and technical aspects of the EMTS, emphasizing system components, RFID integration, databasemanagement, and user interfaces. The experimental results highlight the system's enhanced performance, accuracy, and convenience, proving its potential for widespread adoption within Babcock University. In response to the growing demand for modernized meal management solutions, this project presents the development and practical application of an Electronic Meal Ticket System (EMTS) using Radio-Frequency Identification (RFID) technology. The EMTS streamlines the meal ticketing systems by introducing RFID-enabled smart cards, supplying an efficient and contactless means for users to access their meals. This abstract outline the project's aim: system design, RFID cardissuance, meal tracking, and user experience. By enhancing the accuracy and speed of meal processing, the EMTS optimizes operations for establishments while enhancing the overall dining experience for end-users. The successful implementation and validation of the system proves its potential to revolutionize meal management in a variety of settings.

Keywords: RFID (Radio Frequency Identification), EMTS (Electronic Meal Ticketing System), Smart Cards, Scanner, Cafeteria, Babcock University

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1.0 INTRODUCTION

In today's fast-paced world, efficient and streamlined meal management systems are imperative for various establishments such as universities, corporate cafeterias, hospitals, and other organizations with dining facilities. Traditional meal ticket systems often rely on paper-based tickets or manual processes, resulting in inefficiencies, long queues, and potential errors. To address these challenges, the integration of Radio-Frequency Identification (RFID) technology offers an innovative and automated solution.

RFID is a wireless technology that uses electromagnetic fields to find and track tags attached to objects. RFID systems consist of RFID tags, RFID readers, and a database. Each RFID tag has a unique identifier and can store relevant information about the associated object. When an RFID reader scans the tag, it captures the data and processes it accordingly.

In the realm of meal management, integrating RFID technology with meal ticketing systems offers countless advantages. RFID-enabled smart cards can serve as personalized meal tickets, allowing for a seamless, contactless ticketing system. Users can register their RFID cards and easily access meals by simply tapping the card on a reader. This not only hastens the meal ticketing process but also enhances accuracy and reduces the chances of fraudulent activities.

Moreover, the implementation of an Electronic Meal Ticket System (EMTS) using RFID technology will allow for efficient tracking of meal consumption patterns, aiding in better forecasting and planning of food services. Analyzing the data collected through RFID can supply valuable insights into dietary preferences, peak mealtimes, and overall meal consumption trends, enabling optimized meal planning and resource allocation.

This project aims to design and implement an EMTS utilizing RFID technology, exploring the technical architecture, system components, database management, and user interfaces. By enhancing meal management efficiency and improving the overall dining experience, the integration of RFID technology holds the promise of revolutionizing meal ticketing systems and setting new standards for operational excellence at Babcock University.

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3.0 SYSTEM ANALYSIS & DESIGN

This chapter will detail the machine to be built in conjunction with evidence of the chosen system version for designing and implementing the electronic meal ticketing system. Additionally, it'll embody diverse techniques to correctly manage the undertaking, outline the layout and improvement tools to be employed, and specify the selected methods for facts and statistics accumulating and undertaking design.

3.1 SYSTEM DESIGN

This section describes the software development process in general. The SDLC model used for this project's development was the extreme programming software process model. Multiple versions of the system were developed and tested by the device's intended users and other key stakeholders before a stable version was developed.

3.1.1 FLOW CHART DIAGRAM

The following Flow Chart diagram in Fig 1. illustrates how the proposed system will be used and some of its capabilities.

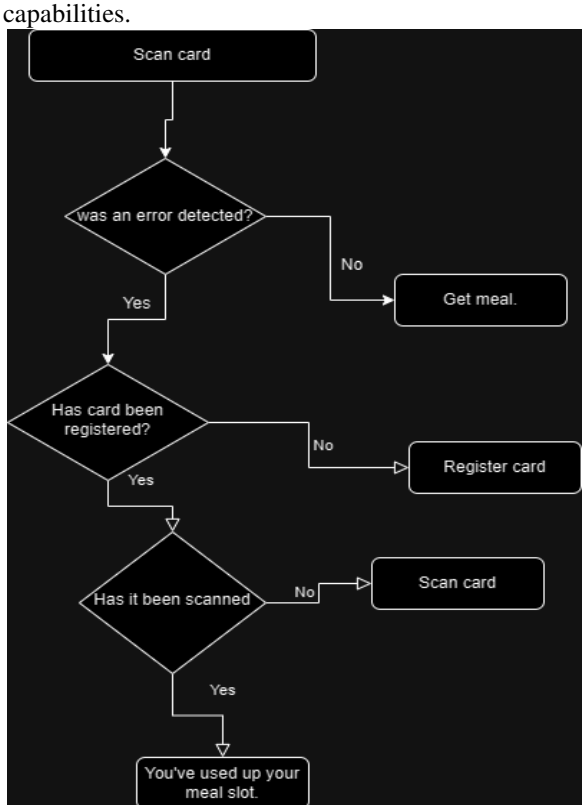

Figure 3.1: Flow Chart Diagram of an Electronic Meal Ticketing System

The Electronic Meal Ticketing System consists of Users, and a Smart card. A user can scan the card. A user can get meal. A user can register the card. A user can increase meal slot.

3.1.2 SEQUENCE DIAGRAM

The following Sequence Diagram in Fig 2. illustrates the Characteristics of the proposed system. It is showing the interaction of the user with the system.

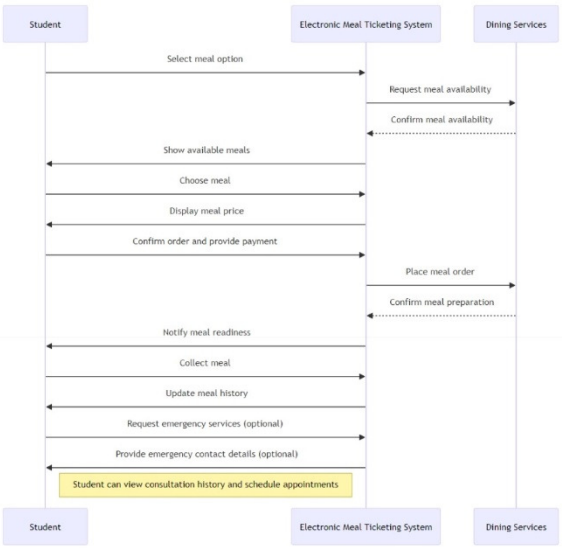

Figure 3.2: Sequence Diagram of the Medical Appointment Booking System

The Sequence diagram shows the features available to each user in the system.

1. Student: Students have access to qualified and competent meals no matter their current location. This diagram shows that select meal option, choose meals, pay for meals with their cards, collect meal, request emergency services, view consultation history and schedule appointment.
2. System: The system can request meal availability, display meal availability, display meal prices, place meal order, notify meal readiness, update meal history, provide emergency contact details. This saves time and lessens burdens, the system can access the meal history of the students,write reports on the students based on meal order.
3. Dining Services: The dining can confirm meal availability and confirm meal preparations.

3.1.3 ENTITY RELATIONSHIP DIAGRAM

The entity-relationship diagram, which portrays the structure of the existing system database, is shown in Fig. 3. It shows how entities, like a patient, Specialist (doctor), department and appointment scheduling are connected.

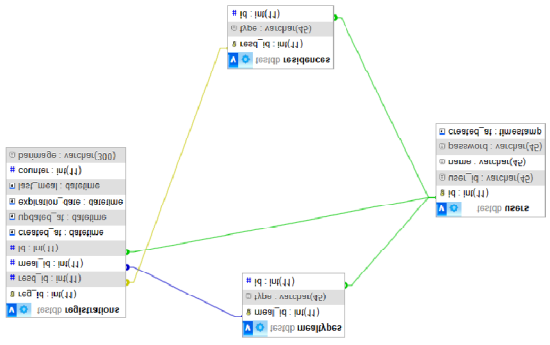

Figure 3.4: ER Diagram of the Medical Appointment Booking System

Explanation of some of the above illustrated data items.

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ID: On Registration each individual user is issued a unique ID which in our system we refer to as the 'id'.
Name: The name provided by the patient on registration.
User_id: When a registration is carried out by the student, the student is issued a unique serial number which the system recognizes as user_id.

3.1.4 SYSTEM ARCHITECTURE

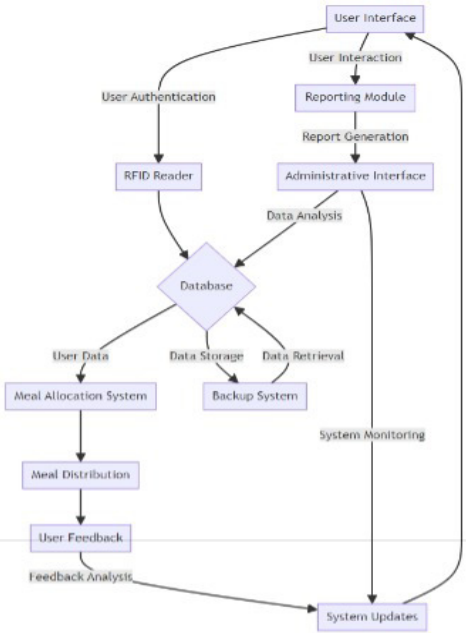

Figure 3.5 System Architecture of the Electronic Meal Ticketing System

3.2 REQUIREMENT SPECIFICATION & ANALYSIS

The requirement analysis phase is an integral part in the development of the application. This stage analyses the various functionalities that are used to achieve the project goals and objectives. The system requirements are split into functional and non-functional requirements.

3.2.1 USER REQUIREMENTS

This section provides a summary of the crucial duties that the system ought to complete in a good way to meet the needs of those who will use it. It describes in extensive strokes what student and dining services can assume from the machine without moving into an excessive amount of technical jargon.
Students Requirements:
1. User-pleasant Interface: Student require a simple and intuitive interface that permits them to, without difficulty, navigate the system.
2. Access to Meal Information: Students need get right of entry to applicable facts about available meals, along with their nutritional values, content of the meals to prevent an allergic reaction, and meal evaluations, to make informed selections whilst choosing a meal.
3. Secure and Private Data Handling: Students expect their non-public and personal data to be treated securely and with strict privacy measures in location. The machine must comply with information safety regulations and make certain the confidentiality of user's records.
4. Integration with University database: Integration with University database allows users information to keep users data and history to their meal choices and personal data.
Dining Requirements:
1. Availability Management: Dining services should have the ability to set their mealand time availability, which includes every day running hours, when meals would be ready, what meal would be available. The gadget must allow them to effortlessly control their timetable and adjust as desired.
2. Analytics and Reporting: Dining services might also benefit from getting admission to analytics and reporting functions that offer insights into meal volume, student attendance, and other metrics. This enables them to optimize their practice and improve student care.

3.2.2 SYSTEM REQUIREMENTS

This section presents a complete summary of the elicited desires of the proposed gadget's senior stakeholders and builders. Any machine's gadget wishes are normally described in terms of functional and non-functional requirements.
Functional Requirements:
1. User Registration and Authentication: Intuitive registration process for students and staff. Issuance of RFID-enabled meal tickets and authenticate their identities to get entry to the machine.
2. Meal Collection: Secure and contactless authentication using RFID technology. Swift processing of meal collection at dining facilities.
3. Real-time Monitoring**:**Monitoring capabilities for administrators and real-time tracking of system performance and transaction security.
4. Reporting and Analytics: Robust reporting functionalities for administrators.Insights into user behavior, popular meal choices, and peak dining times.
5. Database Integration: Integration with university databases for exact user data management.
6. Security and Privacy: The gadget should put into effect appropriate safety features to defend patient records, together with encryption, get entry to controls, and compliance with records protection guidelines.
Non-functional requirements:
1. Performance: Swift RFID authentication for efficient meal collection and minimal system downtime for uninterrupted service.
2. Usability: The tool needs to be person-best and smooth to navigate, with clean instructions and intuitive interfaces that allow customers (each student, and administration) to interact with the machine without confusion or hassle. Inclusivity features to accommodate users with diverse needs and accessibility standards compliance for user interfaces.

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3. Security: Robust data encryption to protect user information and access control measures to prevent unauthorized system access.
4. Scalability: Ability to scale seamlessly to accommodate an increasing number of users and adaptable to the evolving needs of the university community.
5. Regulatory Compliance: Adherence to data protection and privacy regulations and compliance with university policies and guidelines.
6. Compatibility: The gadget wishes to be compatible with unique devices and structures, allowing customers to get entry to and use it from several gadgets together with laptop structures, laptops, capsules, and smartphones.
7. Integration: The device must have the functionality to combine with different structures, management software programmes, to change applicable affected person data and streamline administrative tactics.
8. Data Backup and Recovery: The device needs to have mechanisms in place to regularly backup facts and make certain that they may be recovered in the event of machine disasters or record loss.
9. Maintainability: Ease of system updates and maintenance and documentation for administrators to troubleshoot and manage the system.
10. Performance Monitoring and Reporting: Regular monitoring and auditing of system performance and alerts for potential security breaches or system irregularities.

3.3 DESIGN AND DEVELOPMENT TOOLS

The medical appointment system will be implemented via a platform based on web applications. To ensure the proper design, programming language and development of the software, the following tools and applicationwill be employed

HYPERTEXT MARKUP LANGUAGE (HTML)
HTML is the standard markup language for documents meant to be displayed in a web browser. It is used to organize the content of a webpage or defines the structure of the webpage and organizes its content. It was developed by Tim Berner-lee in the year 1991. This will be used in our project to organize the webpage structure.
CASCADING STYLE SHEET(CSS)
Cascading style sheet is a style sheet used to style in the elements in a markup language e.g., HTML or XML. It is used to describe the presentation of the document written in markup language. It is the style sheet that gives html elements their exterior appearance, making the web look pleasant. It was first proposed by Hakon lie in the year 1994. This will be used in our project to beautify the webpage.
JAVASCRIPT
JavaScript is one of the popular and widely accepted programming language used to create interactive client and server web page. It was developed in the year 1995 by Brendan Eich. Since the development of JavaScript, a lot of JavaScript engines has been developed to aid the process of creating web pages and make the page more interactive. Some JavaScript engines are React.js, Angular.js, vue.js, Chrome V8 JavaScript*, svelte.js, three.js, jQuery. React.js and node.js will be utilized, accordingly, for the front-end and back-end of this project.
VISUAL STUDIO CODE
VS Code, short for Visual Studio Code, is a source code editor created by Microsoft. It is available for Windows, Linux, and macOS operating systems. The text mentions several features of the software, such as debugging support, embedded Git control, syntax highlighting, intelligent code completion, snippets, and code refactoring. The software is designed to be highly customizable, so users can easily install extensions to add extra features and functionality. Developers have been drawn to VS Code because of its lightweight design and powerful features, which make it a top choice for web development projects.
PHP
PHP is an important part of making websites today because it is a coding language for the server. As a hacker with roots in both Denmark and Canada, Rasmus Lerdorf made PHP in 1994. This tool has changed a lot since then, and now coders can use it to make live, interactive web pages.
PHP and HTML get along great, which is one of its best features. This means that coders can add PHP code directly to HTML pages. This integration lets you make dynamic web pages, where most of the content is made in response to requests to a database or input from the user. There are also different content management systems (CMS), web frameworks, and internet template styles that can be used with PHP. In turn, this makes it easier to use and better for making websites.
There are a lot of reasons for this since PHP is used by so many people. To begin, coders of all levels can use it because it is easy to understand. They can quickly pick up the basics and start making useful web apps. PHP is also very adaptable, which means that programmers can change how things are done to suit different jobs. PHP gives developers the tools they need to make a lot of different features, like ones that verify users' identities, handle form entries, and talk to databases.

4.2 TESTING OF THE APPLICATION

Testing is an important part of making software, and this software includes a tool giving easy access to meals. In this way, it makes sure that the tool works as planned and meets users' wants and expectations in a wide range of situations.
1. Unit Testing:
Individual units or parts of the machine are checked on their own to make sure they are accurate. This is called unit testing. Unit exams could test different parts of the meal ticketing system, like how it handles notifications, how it registers users, among other things. Any possible flaws can be found and fixed during the early stages of development by using independent testing and paying close attention to every detail. This makes sure that the whole system is stable and strong.
2. Integration Testing:

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Checking for integration means looking at how different parts or sections of the tool work together to make sure they work well together and. In your meal ticketing system, integration testing might include checking out the interactions among frontend components (e.g., user interface) and backend components (e.g., database, server-aspect good judgement). This type of checking out helps uncover any inconsistencies or compatibility troubles that may arise when different parts of the gadget are combined, allowing you to cope with them before deployment.

3. User Acceptance Testing (UAT):

User Acceptance Testing includes trying out the gadget from the perspective of give-up -users to make sure that it meets their expectations and fulfils the intended business requirements. In the case of your scientific meal ticketing system, UAT would contain actual Users (e.g., students, administration) interacting with the software to carry out not unusual tasks such as registering, updating private information, and receiving notifications. By soliciting feedback from real users, you could discover usability troubles, accumulate insights for development, and validate that the system aligns with people's needs and options.

4.3 SYSTEM REQUIREMENTS

Hardware Requirements:

1. Server:

- A server capable of website hosting the meal ticketing software. This server must have sufficient processing energy, reminiscence, and storage potential to address user requests, database operations, and different gadget obligations efficaciously.
- Recommended specs: Quad-center processor (or better), 8GB RAM (or extra), SSD storage for faster statistics get entry to.

2. Networking Equipment:

- Reliable net connection to make certain non-stop get entry to the device from numerous gadgets and places.
- Network switches, routers, and cables to facilitate communication between clients and the server.

3. Client Devices:

- Desktop computers, laptops, pills, smart card, or smartphones for getting access to the electronic ticketing system.
- These gadgets must meet minimum requirements for web browsing and strolling contemporary internet programs.

4. Dining Device:

- A Scanner for giving access to the dining facility and for getting access to meals

Software Requirements:

1. Operating System:

- Server: Linux (e.g., Ubuntu Server, CentOS) or Windows Server working system.
- Clients: Any present-day working gadget like-minded with trendy web browsers (e.g., Windows, macOS, Linux, iOS, Android).

2. Web Server:

- Apache, Nginx, or Microsoft Internet Information Services (IIS) to host the clinical appointment booking device software on the server.

3. Database Management System (DBMS):

- MySQL, PhpMyAdmin, or SQLite for storing and dealing with user details, and device configurations.

4. Web Browser:

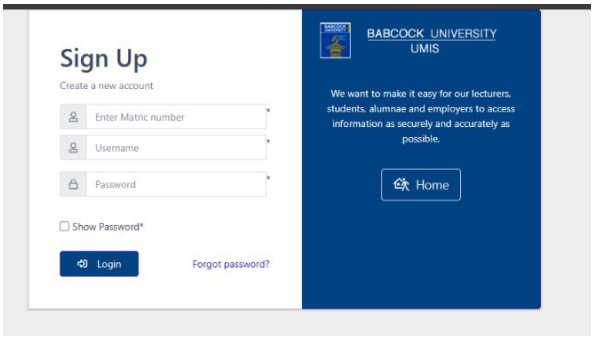
- Any present-day net browser together with Google Chrome, Mozilla Firefox, Safari, or Microsoft Edge for getting access to the medical appointment reserving system from consumer devices.

4.4 SYSTEM SECURITY

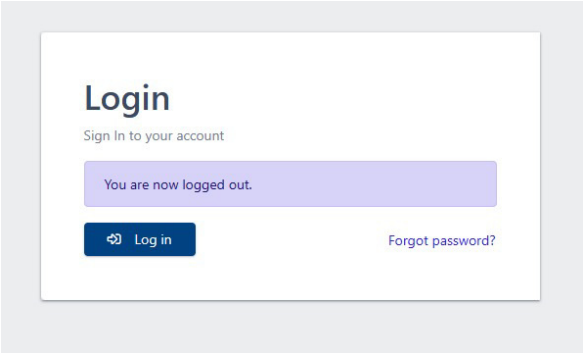
Ensuring the safety of your smart card and user details is critical to shield sensitive user information and access to meals. Implement robust encryption protocols to protect data throughout transmission and storage and use steady authentication techniques like electronic mail and password verification to authenticate users. Validate and sanitize user input to prevent commonplace attacks like SQL injection and cross-site scripting. Manage user sessions securely to prevent unauthorized access and hold specified logs of device sports for auditing purposes. Regularly check the system's protection posture through testing and tracking, addressing any vulnerabilities directly to establish a sturdy safety framework for your electronic meal ticketing system.

4.5 SNAPSHOTS

LOG IN:



THE LOG OUT



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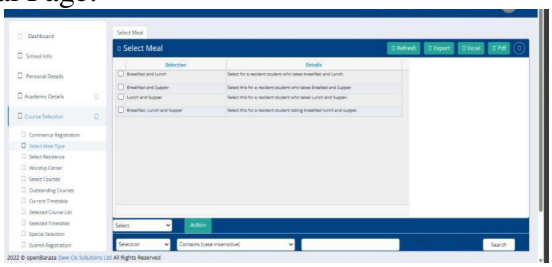
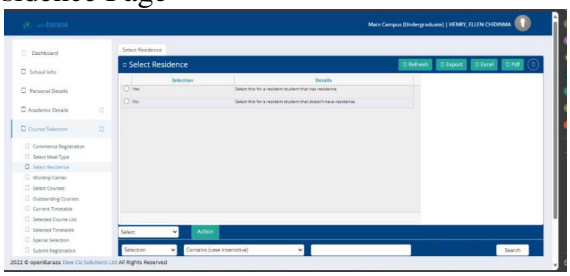
Meal Page:



Residence Page



5.1 CONCLUSION

The Electronic Meal Ticketing System (EMTS) has been developed to be able to curb the issues that have risen from the paper-based manual system, these problems have been highlighted in earlier chapters. After carefully designing and implementing the Electronic Meal Ticketing System using RFID technology which is one of the best modern technologies used in access control, it can confidently be said that this system works perfectly well and proves to be a better solution to meal access than the paper-based system.

5.2 RECOMMENDATIONS

Based on recent findings, the use of this system is strongly advisable to corporations, industries, and institutions, as it will help them overcome many of their challenges in meal access. The use of RFID is also recommended not only for meal access but also to ease access control procedures in various firms and industries. Proper security measures are also recommended because a system like this will need physical security to be able to ensure order in accessing meals.

5.3 LIMITATIONS OF THE STUDY

After testing the system which has been designed, some limitations have been brought to limelight and some of them include.

Human Error: Some users might get into the dining facility and remember that they do not have their meal pack with them and because the system is a read once system, they will not be able to leave and return after getting their packs.

Queues: Institutions with many users will have to deal with the issue of queuing mainly because of the waiting time when the cards are being scanned at the entry points.

There are other limitations which might arise, but these are the ones which are of immediate concern.

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