FIRST STAGE PROJECT REPORT ON

SMART CANTEEN ORDERING SYSTEM

Submitted in partial fulfilment of the requirements

for the degree of Bachelor of Technology (Electronics Engineering)

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CHAPTER 1: INTRODUCTION

1.1 Background and Content

1.1.1 Traditional canteen system

A canteen installation is an auxiliary system which is provided by our college for its employees/professors/students/guests for the purpose of ordering food items. The being system is a cash and paper-based system. The client has to wait in a long queue to pay for their food order in a small amount of cash and collect a paper coupon. Further, this paper coupon generated has to be given at another counter for collecting the ordered food items, which may take varying times to be prepared. Clients with food orders that'll take a lot of time to be prepared are given waiting tokens, while others tend to heavily crowd the food collection counter with their order coupons to collect their food.

The payment and procedure tend to take some time as the client has to pay the exact amount and stay for the change. The unrest and crowding at the food collection counter, especially during lunch hours, tends to cause a lot of chaos and long waiting times for everyone since they don't know when their order will be ready

Thus for the above reasons, we propose a smart canteen ordering system for the convenience of both canteen users and owners, aiming to mitigate certain problems in the current traditional canteen system.

1.1.2 Why Is Smart Canteen Ordering System Important for Canteen Owners and Users?

A Smart Canteen Ordering System offers several benefits for both canteen owners and users, making it an important and valuable solution.

➢ **For Canteen Owners**, Smart ordering systems streamline the ordering process, reducing wait times and allowing canteen staff to serve more customers efficiently. This improved efficiency can lead to increased overall productivity. By enabling users to place orders in advance or through a mobile app, canteen owners can reduce the physical queues and crowds in their establishments. This not only improves the customer experience but also helps maintain a more organized and spacious environment. The system can generate data on customer preferences, popular menu items, peak hours, and more. Canteen owners can use this data for informed decision-making, menu optimization, and business strategy planning. Integration with digital payment systems simplifies transactions and reduces the reliance on cash. This can enhance security, reduce the risk of errors, and provide a more convenient payment experience for customers.

➢ **For Users,** they have the benefit from the convenience of placing orders through mobile apps or self-service kiosks. They can avoid long queues, save time, and have a more efficient dining experience. Users can track the status of their orders in real-time, providing transparency and assurance about when their food will be ready for pickup. Integration with digital payment methods, such as credit cards, mobile wallets, or other electronic payment systems, provides users with convenient and secure payment options.

1.1.3 Challenges in Ordering System

While Smart Canteen Ordering Systems offer numerous benefits, they may also face certain challenges.

- **Data Quality and Availability:**
  Challenge: ML models require large and high-quality datasets for training. Obtaining clean and representative data related to customer preferences, ordering patterns, and inventory levels can be challenging.
  Solution: Establish data collection processes, ensure data accuracy, and consider data augmentation techniques to gather diverse and comprehensive datasets.

- **Dynamic and Evolving Preferences:**
  Challenge: Customer preferences can change over time, and capturing the dynamics of evolving tastes and trends poses a challenge for such models that are trained on historical data.
  Solution: Implement models that can adapt to changing preferences over time. Regularly update training data to include recent patterns and trends.

- **Integration Complexity:**
  Challenge: Integrating ML algorithms in our app, TFT LCD displays with GUI, and other components into a seamless system can be complex. Ensuring compatibility and smooth communication between various hardware and software components is essential.
  Solution: Thoroughly plan and test the integration process. Use standardized communication protocols and APIs to facilitate interoperability.

- **Cost Constraints:**

Challenge: Implementing ML algorithms in our mobile app and TFT LCD displays with GUI may involve initial investment costs. We may face budget constraints when adopting new technologies.
Solution: Conduct a cost-benefit analysis, explore cost-effective solutions, and consider phased implementation to spread costs over time. Look for open-source or affordable ML frameworks.

1.1.4 Problem Statement and Scope

- **Problem Statement:**
  - Inefficient queue management during lunch hours, leading to long waiting times for orders.
  - Difficulty in estimating and reducing waiting times for orders
  - Limited availability of cash and change, hindering smooth transactions at the canteen, without online payment capabilities.
  - Continuous requirement for staff presence at the counter to manually take orders.
  - Prone to human errors in calculations and transactions due to manual handling of orders and payments.

- **Scope:**
  - Utilize TFT LCD displays to provide real-time updates on food menu items and placing orders, implementing secure digital payment options to facilitate cashless transactions, preferably using UPI and QR codes for online mobile payments, making the process convenient and efficient.
  - Design intuitive and user-friendly interfaces (GUIs) for both customers and canteen staff. Ensure that the ordering process is straightforward, and provide clear & intuitive instructions for using the system– both the app in mobile phones as well as custom designed GUI on the LCD
  - Integrating the mobile application with LCD backend so as to collect and store order data and displaying orders to the kitchen staff
  - Implement an intelligent ML-based recommendation system to personalize menu suggestions for users based on their preferences, previous orders, and popular items. This enhances the ordering experience and encourages customers to explore a variety of menu options. Also helps estimate waiting times for a given food order depending on the time of the day.

1.2 Objective

- The main objective of implementing a Smart Canteen Ordering System is to revolutionize the traditional canteen experience by leveraging advanced technologies to enhance efficiency, customer satisfaction, and operational sustainability. Streamline and optimize the entire ordering process, making it more efficient and reducing wait times & allowing crowd management for customers which enhances the overall customer experience, encourages canteen business, and minimizes operational bottlenecks.
- Use TFT LCD displays for real-time updates on order statuses, estimated wait times, and dynamic menu displays, improves transparency, reduces perceived wait times, and enhances customer engagement through visually appealing displays.
- Implement secure digital payment options through TFT LCD displays to facilitate cashless transactions, and enhances transaction security, provides a convenient payment experience for customers, and aligns with modern payment preferences.
- Design intuitive and user-friendly interfaces for both customers and canteen staff, and reduces the learning curve, enhances user satisfaction, and ensures smooth adoption of the system by canteen operators and customers.
- Utilize ML algorithms to understand customer preferences and provide personalized menu recommendations, estimate waiting times for orders based on the time of the day and increase customer engagement, satisfaction, and encourages exploration of diverse menu options, leading to a more efficient dining experience.

1.3 Overview

The Smart Canteen Ordering System project is a comprehensive initiative aimed at modernizing and improving the efficiency of canteen operations using cutting-edge technologies, specifically Machine Learning (ML) and Thin-Film Transistor Liquid Crystal Display (TFT LCD) in which we will be adding some GUI to provide an interactive and visually appealing platform for users to interact with electronic devices. This project envisions a seamless and personalized ordering experience for customers while optimizing inventory management and promoting sustainability. Our project's architecture comprises ML algorithms integrated into the backend for personalized recommendations and demand forecasting. TFT LCD displays with GUI, strategically placed within the canteen provide real-time updates and dynamic displays for Guest Customers.

The system integrates secure digital payment options, facilitated by TFT LCD displays displaying QR codes for seamless transactions. This promotes cashless payments, enhancing transaction security and efficiency. The system generates valuable data on customer behavior, preferences, and popular items. Canteen operators can leverage these insights for data-driven decision-making, menu optimization.

Intuitive and user-friendly interfaces are designed for both customers and canteen staff. This minimizes the learning curve, enhances user satisfaction, and ensures smooth adoption of the system.

ML algorithms analyze customer preferences, historical data, and popular items to provide personalized menu recommendations. This enhances the overall ordering experience and encourages customers to explore diverse menu options. Our Smart Canteen Ordering System mobile App and TFT LCD displays are employed for real-time updates on order statuses, estimated wait times, and dynamic menu displays. This reduces perceived wait times, improves transparency, and enhances customer engagement.

The successful implementation of the Smart Canteen Ordering System is anticipated to result in improved customer satisfaction, streamlined operations, and reduced costs. Our project aims to set new standards for canteen efficiency and customer experience in the real world.

CHAPTER 2: LITERATURE SURVEY

2.1 Papers (Software)

2.1.1 Smart Canteen System

The paper introduces the "Smart Canteen System," an innovative web-based application aimed at simplifying the food ordering process in canteens. This system allows users to register online, browse through the menu, and conveniently place orders, thereby reducing the need for direct interactions with waiters. The primary motivation behind developing this application was to save customers' time, especially during peak hours, by providing them with a user-friendly platform to order food seamlessly.

The methodology of the Smart Canteen System involves user registration and login processes, enabling customers to view the menu, select items, and choose from various payment methods, including cash on delivery, Paytm, or PayUmoney. Administrators have the ability to log in, manage customer details, update inventory, add or remove items, and generate bills. The overall goal is to streamline the entire ordering process, providing users with a straightforward and efficient means to order and pay for their meals.

Key takeaways from the literature survey include insights gathered from this paper on canteen management systems that utilize RFID technology and cloud computing. The discussed system in the literature relies on RFID cards for customer identification and leverages cloud hosting for scalability and load balancing using Firebase as a service. The proposed Smart Canteen System not only eliminates the need for physical interaction but also offers real-time order tracking and multiple payment options for users.

Despite the emphasis on efficiency and time-saving benefits, potential limitations are acknowledged. However, the paper lacks an in-depth discussion on issues such as security, data privacy, and system crashes during high-demand periods. Further research and testing are deemed necessary to comprehensively address these aspects and ensure the robustness of the Smart Canteen System.

2.1.2 Mobile Application for Canteen Automation System Using Android

This paper presents a novel approach to canteen management through the development and implementation of a Mobile Application for Canteen Automation System Using Android. The system aims to address challenges faced by traditional canteen management, particularly in terms of efficiency and customer satisfaction.

The methodology employed in the system involves a user-friendly process, starting with online registration and login. Users navigate through an electronic menu (E-menu), select items, and place orders seamlessly through the Android application. The integration of a barcode system ensures efficient product identification, contributing to a streamlined ordering process.

The chosen items are promptly transmitted to the chef's screen via barcodes, reducing the necessity for additional human involvement. A primary focus is placed on customization, where customers can effortlessly personalize their orders by selecting specific options, such as adding or removing ingredients. This streamlined selection process enhances their ability to tailor meals according to their preferences seamlessly.

The paper recognizes several limitations in the existing system. It highlights absence of offline access, and potential concerns regarding fake reviews as drawbacks. Furthermore, it acknowledges challenges in managing multiple IP addresses and the lack of automatic IP blocking mechanisms, suggesting potential areas for future improvements. Additionally, the absence of hardware to streamline the ordering process is present.

2.1.3 Implementation of a smart canteen system for university campus using cloud

The proposed "Canteen Automation System with Cross-Platform Application" aims to revolutionize food ordering in college canteens by leveraging Android Studio, Flutter/Dart, and Firebase. This cross-platform application facilitates user-friendly, efficient, and real-time order processing, reducing the reliance on manual systems. Users can register, view the menu, place orders, and receive notifications seamlessly. The integration of a feedback system allows users to rate food items, enabling continuous improvement.

The system is developed using Flutter for cross-platform compatibility as frontend, and Firebase for backend services. The application provides distinct interfaces for users, sellers, and pickup friends, streamlining the ordering process. Users can register, view the menu, add items to the cart, and make payments. Sellers can manage food items, track orders, and view earnings, while pickup friends can view orders and deliver items. The cloud-based approach ensures accessibility, scalability, and efficient data management.

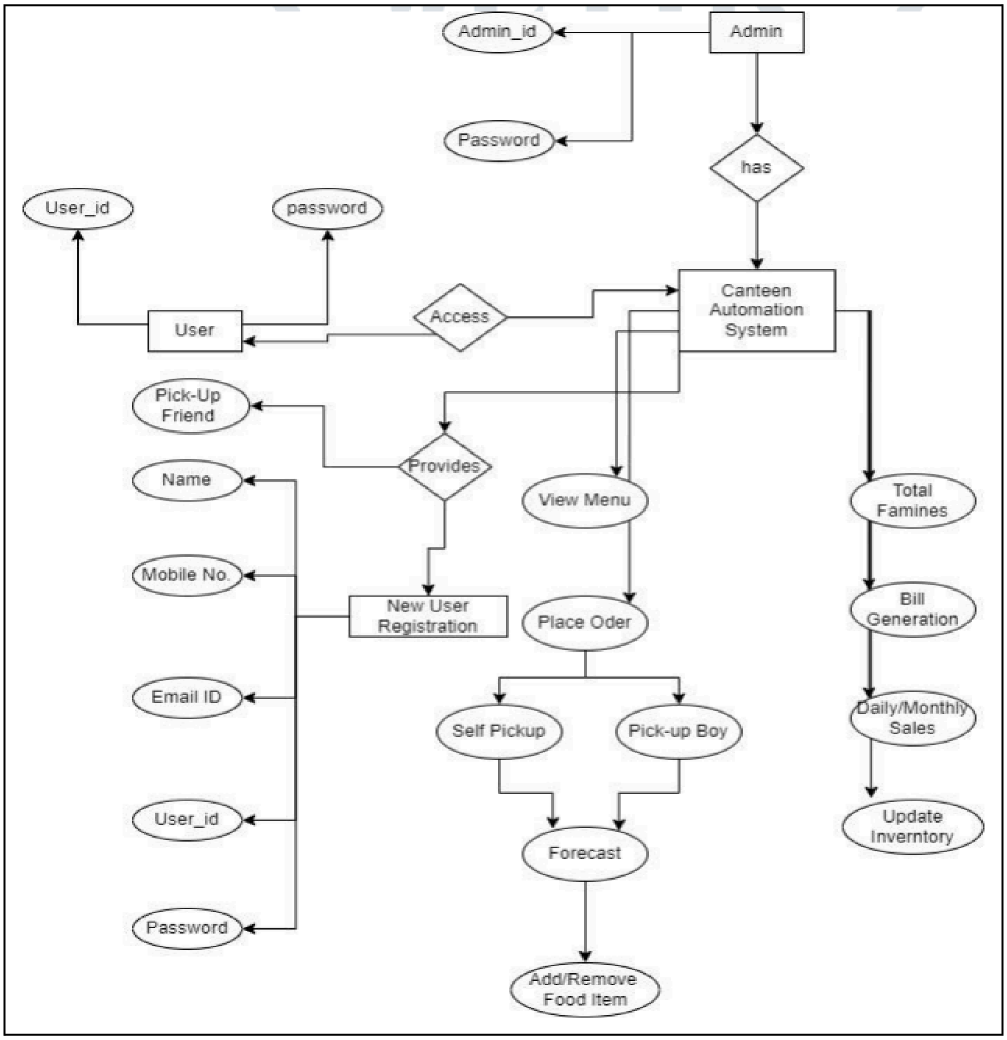


Figure: System Flowchart

The key strengths of the system lie in its user-friendly interfaces, real-time order tracking, and the ability to place orders remotely. The cloud-based architecture ensures data security, accessibility, and seamless synchronization. The application enhances the overall efficiency of canteen operations, reducing waiting times and paperwork. The feedback system fosters continuous improvement, creating a positive user experience.

Security concerns related to online payments and user data must be addressed diligently to build trust among users. Additionally, the success of the system relies on user adoption and effective communication of its benefits. Continuous updates and support will be essential for troubleshooting and adapting to evolving user needs.

2.1.4 Food Ordering Management using Recommendations

The proposed Food Ordering Management System introduces a user-friendly solution for canteens facing challenges in traditional manual operations. By allowing customers to place orders through a web application or institute's intranet, the system aims to streamline the ordering process, reduce delays, and enhance overall customer satisfaction. It incorporates an Apriori algorithm for intelligent recommendations, helping administrators update menus based on popular choices. This system not only simplifies the ordering experience for customers but also provides essential features for administrators to manage inventory, analyze sales data, and make informed decisions.

The system employs PHP, HTML, CSS, jQuery, Ajax, Bootstrap, and JavaScript for web-based implementation, while MySQL database stores datasets. Users, categorized as Admin, Staff, and Customers, each have specific functionalities. The Apriori algorithm processes six months of order details, generating recommendations that aid in menu updates and inventory management. The flow analysis divides the system into Admin, Staff, and Customer modules, ensuring a seamless process from order placement to food preparation and service.

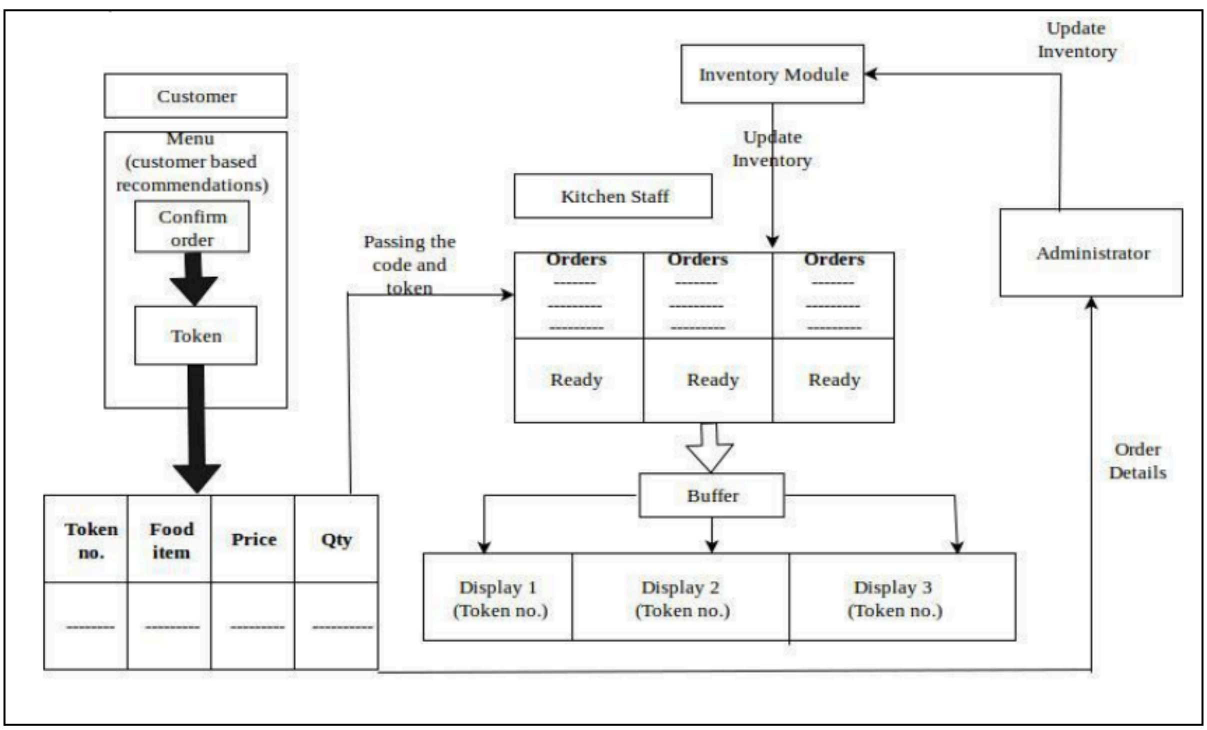


Figure: System Flow Diagram

The food ordering management system leverages the Apriori algorithm to generate recommendations derived from customer orders. These recommendations play a crucial role in informing menu updates and providing valuable insights into profitability. They serve as a pivotal tool for administrators, enabling them to optimize the menu by updating popular items, effectively managing inventory, and making informed, data-driven decisions regarding stock and pricing strategies. Features such as intelligent recommendations, sales analysis, and inventory updates empower administrators to make data-driven decisions. The elimination of calculation errors, real-time order tracking, and online ordering enhance customer satisfaction and contribute to overall system efficiency.

While the proposed system addresses many inefficiencies in traditional canteen operations, it relies on internet connectivity for order placement, which could be a limitation in areas with limited access. Additionally, implementing an online payment system could be a valuable future enhancement to further improve the overall user experience. Careful attention to data security and user privacy, especially in online transactions, is crucial for building trust among users. Continuous updates and user education will be essential for system adoption and success.

2.1.5 Restaurant ordering system using mobile application

The Restaurant Ordering System Using Mobile Application (ROSUMA) is a comprehensive computerized system designed for restaurant ordering services. It integrates four subsystems: the waiter (mobile device), cashier (system controller), kitchen department (screen display), and the web service system. With both PC and mobile device clients connected through a wireless intranet, ROSUMA enhances efficiency and communication in restaurant operations. It employs Microsoft Visual Studio 2008, Windows Mobile, and Microsoft SQL Server 2005 for development, offering distinct interfaces for cashier, kitchen, and mobile applications.

The development methodology involves using Microsoft Visual Studio 2008 for cashier and kitchen interfaces, Visual Studio Phone Emulator for mobile application design, and Windows Mobile as the operating system. Microsoft SQL Server 2005 serves as the database, storing data on staff information, orders, and inventory. A web service system acts as a connector, facilitating seamless communication between subsystems and the central database. The system is implemented with separate databases for the mobile device and cashier system, and an emphasis on real-time inventory updates.

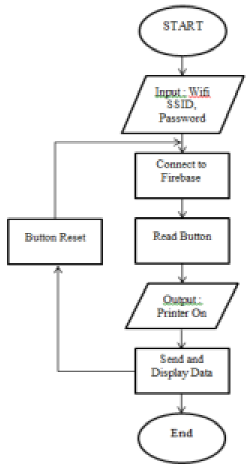
ROSUMA revolutionizes restaurant operations by offering dedicated interfaces for cashiers, kitchen staff, and mobile-based waiters. It enables waiters to take orders using mobile devices, displays orders in the kitchen, and updates inventory in real-time. Administrators can efficiently manage staff, update menus, and analyze transaction data. The step-by-step ordering transaction model minimizes errors and enhances overall service quality. ROSUMA is compatible with Windows and Windows Mobile platforms, requiring additional hardware like touch-screen PCs and mobile devices.

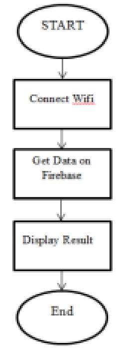
ROSUMA, while introducing efficiency to restaurant operations, faces certain limitations. Primarily designed for Windows and Windows Mobile platforms, its compatibility excludes users of alternative operating systems. The system's effectiveness relies heavily on a stable wireless intranet connection, making it susceptible to disruptions that may impede seamless operation.

2.2 Papers (Hardware)

2.2.1 Mini tickets printing machine based on IOT with mobile information using a smartphone:-

The automated substitute for custom ticket printing operates through externally controlled timed circuits, requiring an 8V DC power supply to activate a thermal printer. Notably, the ESP8266 can be powered without a laptop connection. User interaction is facilitated through a pushbutton, serving as the input to command the printer for paper ticket issuance. The initial setup involves entering a Wi-Fi SSID and password on the Arduino IDE, enabling automatic connection to Firebase or a database. Once connected, users can utilize the pushbutton to command the printer for ticket printing, initiating real-time data transfer to the smartphone through Firebase. It is imperative for this application to be pre-connected to Wi-Fi for seamless data retrieval from Firebase. This innovative system streamlines the ticketing process, offering user-friendly interaction and real-time data display on smartphones through Firebase integration. The testing phase involves connecting assembled components to an 8V power supply to ensure proper functionality. Upon pressing the pushbutton, the thermal printer automatically generates a ticket. The data is then transmitted to Firebase, which in real-time sends it back to the smartphone application. Real-time data retrieval from Firebase ensures minimal delay, contingent on the Wi-Fi connection speed. However, an unstable Wi-Fi connection may result in paper ejection without displaying data on the smartphone. After getting data on Firebase then the data will be displayed on the smartphone screen and will continue to change in accordance with the existing data on Firebase.



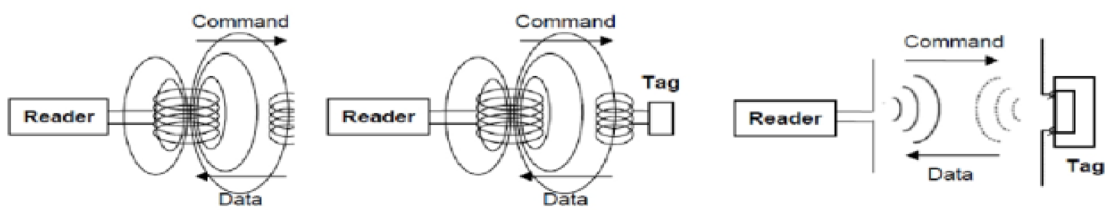


The integration of a microcontroller as a replacement for Arduino Uno in Wi-Fi data transmission, programmed using JavaScript through the Arduino IDE, signifies a notable advancement in automated ticketing systems. In parallel, Android Studio applications seamlessly connect to the internet without user logins ensure precise time and date synchronization. The portable mini ticket printing machine, operating on a minimal 8V DC power supply, adds a layer of versatility suitable for deployment in various settings. Despite these advancements, identified shortcomings, such as the Android app displaying only queue numbers, prompt ongoing research to enhance system functionality. This collaborative integration of the microcontroller and Arduino IDE not only enhances data transmission efficiency but also positions the system at the forefront of automated ticketing technology. The absence of Bluetooth connectivity poses a limitation, and a robust WiFi connection is crucial for achieving high-speed functionality. Continuous and stable power supply is imperative for the microcontroller to operate at its full capacity and in an active mode. While color-based unique variations and font variations are not always feasible, the system relies on preset data for specific instances, allowing for efficient operation during those particular times. These considerations underscore the importance of robust connectivity and consistent power supply for the optimal performance of the microcontroller-based system.

2.2.2 THE RFID TECHNOLOGY AND ITS APPLICATIONS: A REVIEW

RFID utilizes radio waves for automatic identification of people or objects from short to long distances. Falls under the Automatic Identification (Auto-ID) technology category, offering automatic object identification. Other identification technologies include Barcode, Magnetic Strip, IC card, OCR, Voice Recognition, Fingerprint, and Optical

Strip. RFID employs a tag-reader combination for object identification, storing a unique code in the RFID tag.RFID technology enhances system efficiency through automatic data capture, surpassing traditional methods like barcodes.Unlike barcodes, RFID doesn't require line of sight; the tag can be read without manual movement or alignment. RFID technology, although not new, is evolving and finding innovative applications.Offers advantages over barcodes with high reading speed, barrier tolerance, and flexibility in data carrying. Widely applied in manufacturing, agriculture, transportation, and various industries for efficient identification..The methodology for the RFID system involves several key components. Firstly, the system comprises a Tag or Transponder, which acts as an electronic label. The second component is the Antenna, serving as the medium for reading information from the tag. The third element is the Reader or Interrogator, responsible for reading information from the tag. Additionally, a Communication Infrastructure is integrated to enable seamless functioning of the reader and RFID system through IT infrastructure. Finally, the fifth component is the Application Software, which encompasses the user database, application, and interface. Notably, in the case of a Passive tag, it lacks its own power source, relying on the reader for power. The reader antenna transmits an RF signal towards the tag, and the chip in the passive tag gathers energy from this RF signal using inductive coupling for LF and HF tags and backscatter coupling for UHF tags, as depicted in Figure 4.



a) Inductive coupling b) backscattering coupling

Inductive coupling, a fundamental aspect of Radio-Frequency Identification (RFID) technology, transforms the conventional approach to data transmission. This mechanism involves a passive RFID tag equipped with a microchip and a coil antenna. The tag's functionality hinges on the electromagnetic field generated by the reader's antenna, eliminating the need for an internal power source. The reader's antenna emits a robust electromagnetic field, inducing voltage in the coil antenna of the transponder, effectively serving as the power supply for the microchip. The synergy between the primary coil in the reader and the secondary coil in the transponder establishes a transformer-type coupling, crucial for the efficient operation of the RFID system. It is worth noting that this inductive coupling mechanism proves effective within a specific distance, approximately 0.16 times the wavelength, ensuring the transponder remains within the near-field of the transmitter for optimal performance.

Advantages and Limitations of RFID System:-

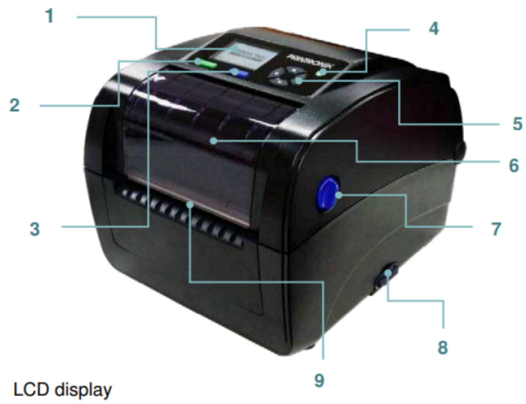
Advantage	Disadvantage
High speed	Interference
Multipurpose and many format	High cost
Reduce man-power	Some materials may create signal problem
High accuracy	Overhead reading (fail to read)
Complex duplication	
Multiple reading	

2.2.3 T600 Printer Administrator's Manual:-

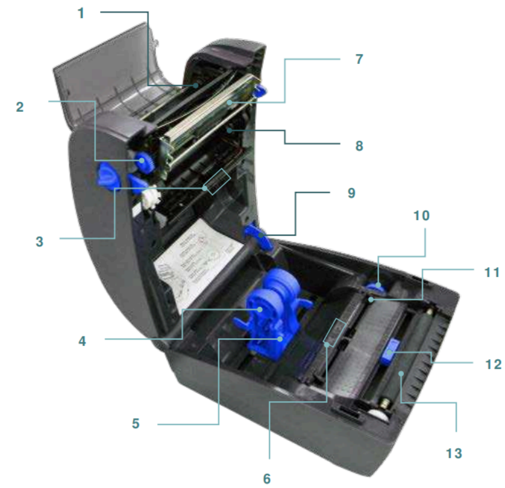
The methodology for setting up the printer involves several key steps, with a focus on LED indication, button functions, and the physical setup process. The printer is equipped with a three-color LED indicator to provide visual cues. Additionally, it features feed, menu, and navigation buttons for user interaction. The initial steps for setting up the printer include placing it on a flat and secure surface, ensuring the power switch is off, and connecting it to the computer using the provided USB cable.

To access the internal components, the printer's top cover can be opened by pulling the top cover open levers located on each side and lifting it to the maximum open angle. This step is crucial for loading both the ribbon and the media. Loading the ribbon involves following a specific path, ensuring proper alignment and functionality. Similarly, loading the media involves adhering to a predefined path for seamless printing.

Front view & Internal View :-



1. LCD display
2. Menu button
3. Feed button
4. LED indicator
5. Navigation button
6. Ribbon access cover
7. Top cover open lever
8. *SD card socket
9. Paper exit chute



1. Ribbon rewind hub
2. Ribbon rewind gear
3. Gap sensor (receiver)
4. Media holder
5. Media holder locking switch
6. Gap sensor (transmitter)
7. Print head
8. Ribbon supply hub
9. Top cover support
10. Media guide adjustment button
11. Media guides
12. Black mark sensor
13. Platen roller

This comprehensive methodology ensures a systematic and effective setup of the printer, covering both hardware and functional aspects for optimal performance.

The final testing phase of the printer involves two essential steps: adding the paper roll and initializing the printer. Adding the paper roll ensures a seamless supply of media for printing, and initializing the printer sets it up for operation. As part of the printer's functionality, there is an option called Sensor, specifically designed for calibrating the selected sensor. This meticulous calibration process contributes to the overall efficiency and performance of the printer, particularly in adapting to varying media types and maintaining optimal functionality.The automated ticketing system seamlessly integrates Thermal printers with IoT, enabling the automatic generation of tickets upon the press of a pushbutton. This streamlined process is further enhanced by IoT's wireless connectivity to Firebase, eliminating the requirement for a stable Wi-Fi connection. Real-time data updates are facilitated through Firebase, ensuring instantaneous information retrieval and display on the smartphone screen. However, the system's efficacy is contingent upon a stable Wi-Fi connection, as instability may result in paper ejection without corresponding smartphone data display. Notably, the mini ticket printing machine exhibits portability with its low 8V DC power requirement, making it versatile and adaptable for deployment in various settings. Additionally, the system's color options are limited, typically supporting monochrome or a few colors, restricting its versatility for vibrant printing needs. Furthermore, the system presents challenges in terms of maintenance, requiring regular upkeep and repairs, particularly for the print head, which can be a demanding aspect of its overall operation. These limitations underscore the importance of considering the specific requirements and constraints when opting for a thermal printer system.

2.2.4 Automatic Restaurant Food Ordering Menu Card:

The presented paper describes a restaurant automation system based on IoT, focusing on touch-based order-taking through resistive touchscreens. Three key papers are referenced, each proposing innovative solutions to enhance restaurant operations.The proposed paper emphasize the ease of using touchscreens for orders, especially during holidays or peak times. The paper suggests a device using graphical LCD for order taking, reducing the workload on waiters. Annu Lambora et al. explore wireless menu implementation through IoT, improving productivity and reducing human errors.

The proposed system in the paper integrates these ideas into a comprehensive solution. It employs a block diagram with customer table units, kitchen units, and cash counter units, powered by a PIC16F877A microcontroller. The(HMI Display) touch screen acts as a menu card, allowing customers to place orders easily. The system utilizes RF transceivers for communication between the kitchen and cashier, along with a buzzer for order notifications. Then the order from the touch screen menu list is displayed and put by the customer and the total amount is automatically determined from the contact screen list. The microcontroller PIC16F877A consists of the computer part of the transmitter. The RF transceiver that links the kitchen to the counter of the cashier.By checking the QR code and the payment message sent to the cashier's counter or manager, the client pays the bill.

The hardware components, including the PIC microcontroller, LCD display, serial converter, RF transceiver, HMI display, and buzzer, are described in detail. The software components involve MP LAB software, Embedded C language for programming, and Flash Magic for dumping the program into the controller.

Block Diagram- Customer Table Unit

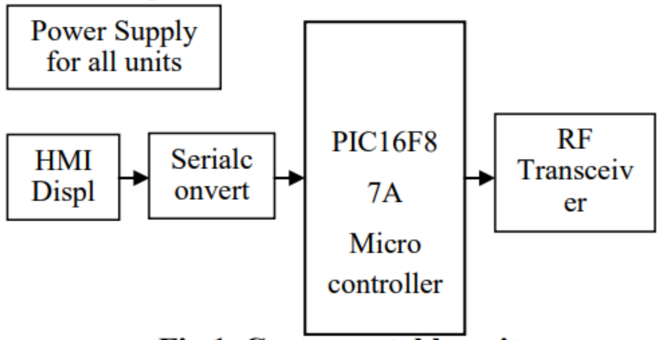


Fig.1. Customer table unit

Kitchen Unit and Cash Counter Unit:

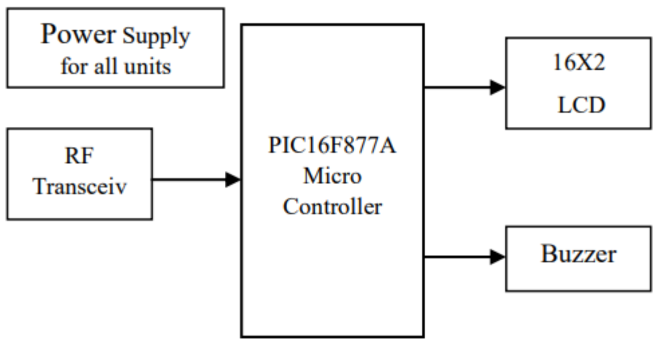
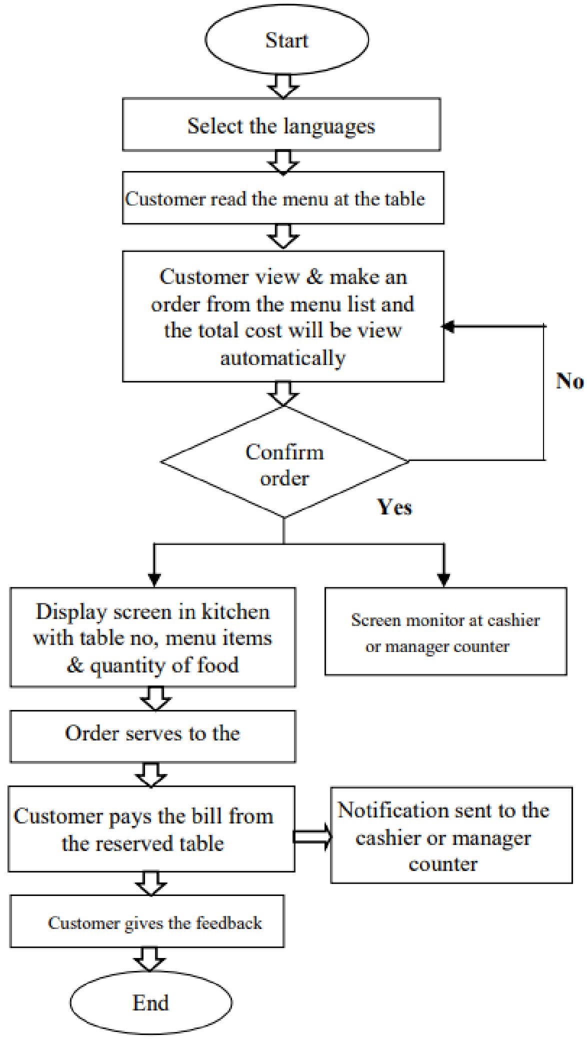


Fig.2. Kitchen unit

Flow chart



2.2.5 Smart Restaurant Menu Ordering System for using Raspberry PI 3B

This paper proposes an intelligent and smart ordering system based on Web Server technology, addressing challenges faced by restaurant entrepreneurs in organizing their establishments efficiently. The designed prototype enables users to input their menu selections, offering a solution to enhance restaurant management by optimizing human resource utilization, speeding up operations, and reducing errors and delays in food orders. The system employs Web Server communication and ARM 11 processors, featuring touch screen displays at customer tables for direct order input.

The methodology explores the use of wireless self-service ordering management information systems, emphasizing an intellectual and information-centric approach to restaurant management. Key components include a GUI interface at customer tables, functioning as a remote control and kitchen monitor, along with small modules (Raspberry Pi boards with touch screens) on each table for order placement. The block diagram illustrates the system's division into User and Kitchen areas, utilizing a 3.2-inch touch screen for customer orders. Upon order completion, data is transmitted to the Kitchen section via Web Server communication, decoded, and displayed on the kitchen monitor for streamlined processing.

In terms of software, Tkinter, a Python interface to the TK GUI toolkit, is utilized, facilitating seamless integration with the system. On the hardware side, Raspberry Pi 3 B (ARM 11) serves as the main processing unit, offering capabilities such as quad-core processing, wireless LAN, and Bluetooth. The touch screen module features a 3.5" TFT LCD with 262 colors and 480x320 resolution, making it a comprehensive solution for menu selection and order input.

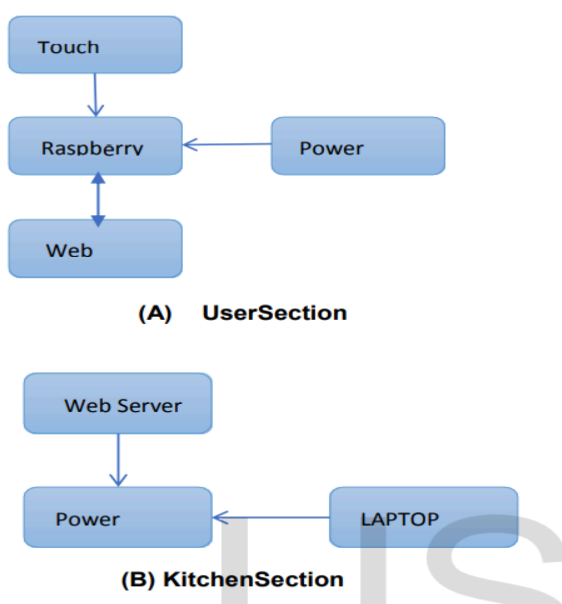


Fig .1 Block Diagram of System

2.2.6 Raspberry Pi Based Menu Ordering System for Restaurants

The paper introduces an intelligent Touch Screen Based Advanced Menu Ordering System for restaurants, utilizing Raspberry Pi and Zigbee technology. The proposed system aims to enhance service quality and management efficiency in the catering industry, addressing the limitations of traditional order-taking methods. The development is based on the ARM11 architecture of the Raspberry Pi board, providing advantages such as high performance-cost ratio, low power consumption, reliability, and a user-friendly interface.

The system comprises two main sections: the handheld device section and the main section, both equipped with Zigbee transceivers. Customers use the handheld device with a 3.2-inch resistive touch screen to select menu items, and the data is wirelessly transmitted to the main section. The main section, likely located in the kitchen, receives and decodes the data, displaying the chosen menu items on a monitor for efficient order processing. The use of Zigbee technology facilitates seamless communication between sections.

The hardware components include Raspberry Pi (ARM 11) as the main processing unit, providing capabilities like high-definition video playback and versatile computing. Additionally, the Xbee module, based on Zigbee, is employed for wireless communication with a range of up to 300 meters. The touch screen module features a 3.2-inch resistive touch screen TFT LCD, enabling customers to interact directly with the system.

The results indicate successful implementation, where customers can make selections using the touch screen, and the ordered items are efficiently processed in the kitchen. The proposed system offers benefits such as improved efficiency, reduced human resource costs, and minimized errors in food ordering. The integration of Zigbee technology and Raspberry Pi demonstrates a cost-effective and reliable solution for modernizing restaurant management.

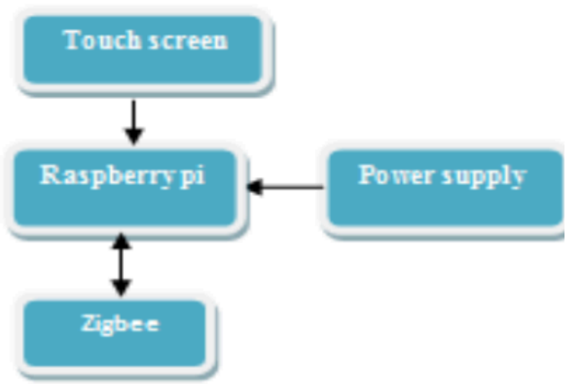


Fig.2. User Section (Table 2)

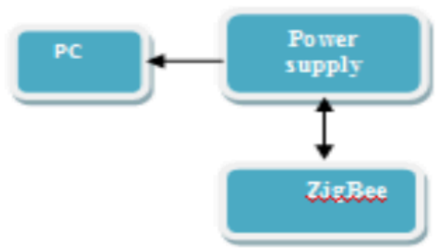


Fig.3. Kitchen Section

2.2.7 Digitalized Restaurant Menu Ordering System Aiding Contactless Dining Environment

The research paper presents a comprehensive Smart Restaurant system that aims to revolutionize traditional dining processes by leveraging advanced technologies. The introduction underscores the inefficiencies inherent in manual order-taking systems, emphasizing the susceptibility to errors and prolonged waiting times. The proposed system integrates a transmitter section, featuring an Arduino Uno microcontroller, a 2.4-inch TFT Touch Shield, and an RF Transmitter. The customer interacts with the TFT display, selecting dishes and placing orders. The RF Transmitter facilitates wireless communication between the customer interface and the kitchen, promoting a seamless and efficient ordering process.

In the existing system analysis, the paper discusses the limitations of traditional approaches, including manual order taking and self-service models. The need for an innovative solution is evident, and the proposed Smart Restaurant system addresses this by incorporating a receiver section in the kitchen. This section includes an Arduino

Uno, a 16x2 LCD Module, an RF Receiver, and a buzzer. The Arduino Uno in the kitchen processes the incoming data from the RF Receiver, displaying order details on the LCD module and activating a buzzer for immediate kitchen staff notification. This hardware configuration ensures real-time order tracking and minimizes the chances of errors associated with manual order processing.

The hardware components are discussed in detail, providing technical insights into their functionalities. The Arduino Uno microcontroller serves as the central processing unit in both the transmitter and receiver sections, orchestrating data flow and control. The 2.4-inch TFT Touch Shield acts as the customer interface, presenting a user-friendly menu and allowing for touch-based order placement. The RF Transmitter and Receiver modules facilitate wireless communication, ensuring data transmission reliability between the customer interface and the kitchen. The 16x2 LCD Module in the kitchen displays order details, while the buzzer serves as a real-time notification mechanism for incoming orders.

The proposed system's technical architecture combines the strengths of Arduino-based microcontrollers, TFT displays, and RF communication to create an automated and efficient Smart Restaurant model. The integration of these components not only streamlines the ordering process but also enhances overall customer satisfaction by minimizing waiting times and reducing the likelihood of errors in order fulfillment.

TRANSMITTER SECTION

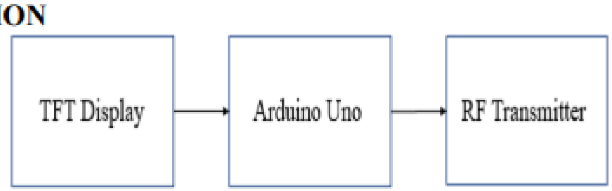
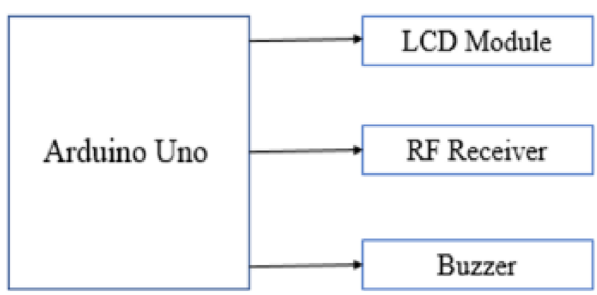


Figure 8: Block Diagram of Transmitter Section

RECEIVER SECTION



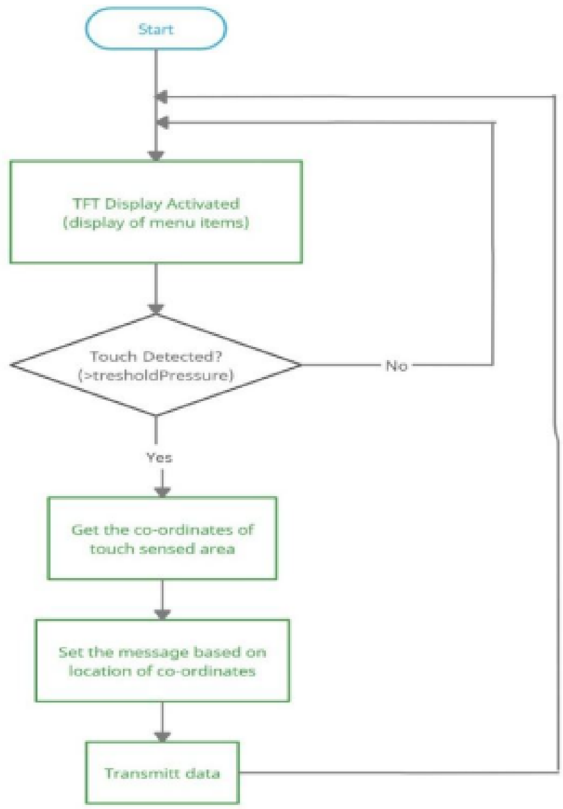
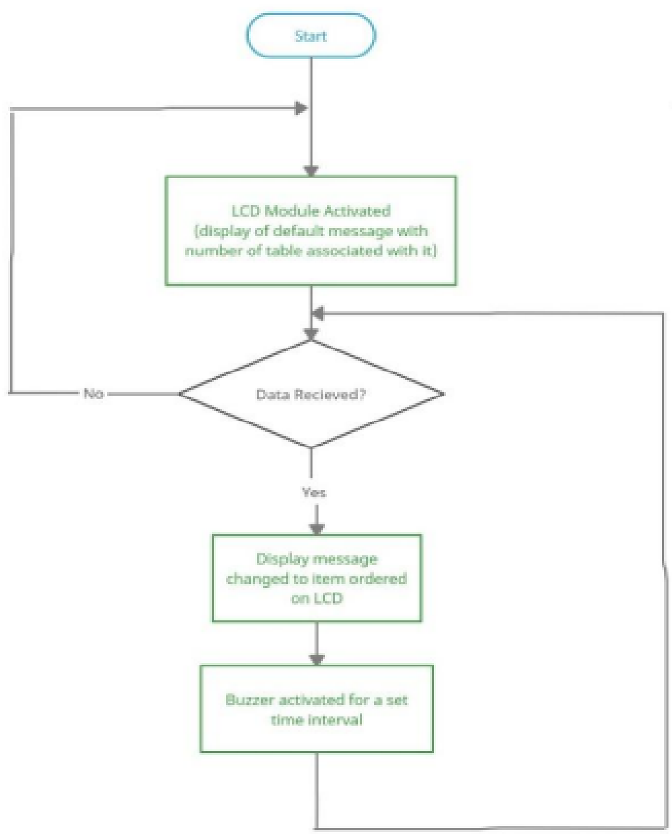


Figure 9: Flow of working of the transmitter section

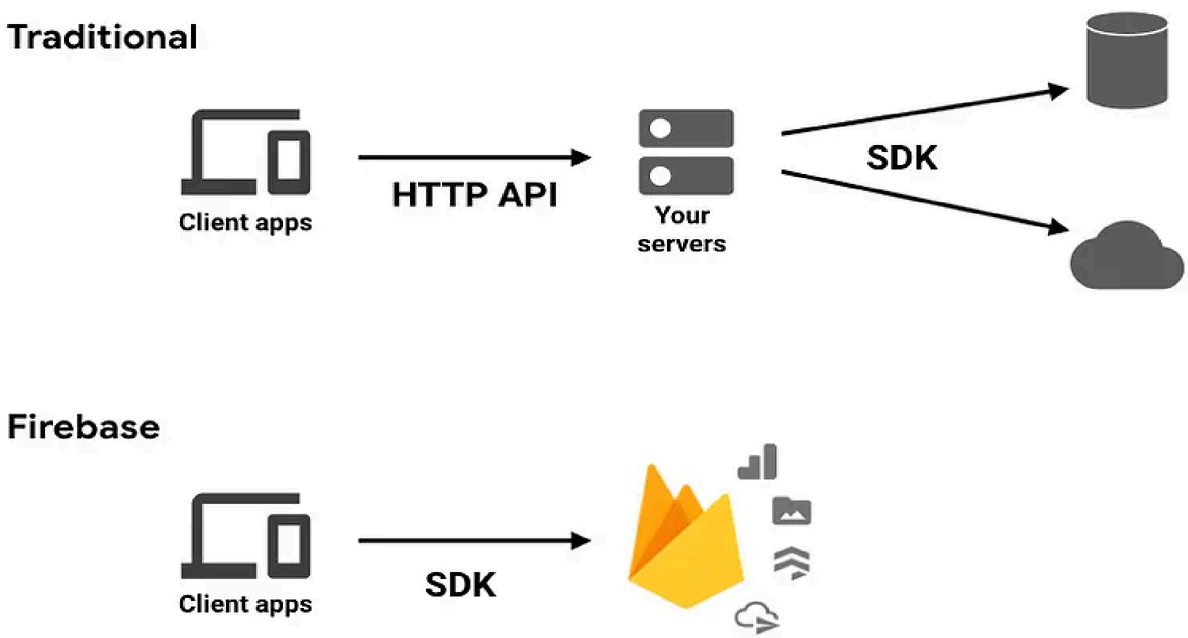


2.3 Observation

2.3.1 Based on the papers and the websites which we have gone through, we have two prominent options for the database and that are: Firebase and MongoDB

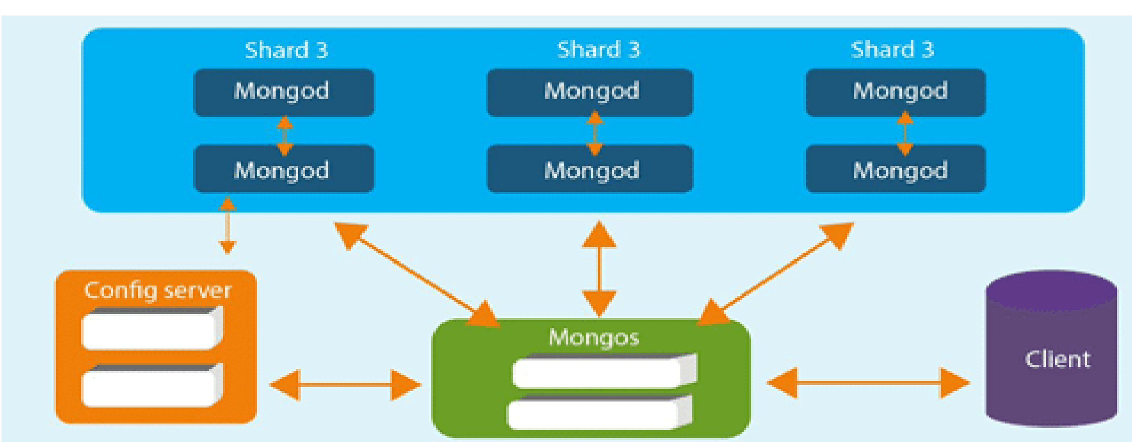
Firebase

Firebase is a comprehensive mobile and web development platform by Google, offering real-time database services, authentication, hosting, and more. It utilizes a NoSQL database for flexible and scalable data storage, enabling developers to build dynamic, realtime anDresponsive applications with ease.



MongoDB

MongoDB is a popular NoSQL database system, known for its flexibility and scalability in handling unstructured data. It stores data in a JSON-like format called BSON, making it suitable for various applications.



Firebase Vs MongoDB [2] [12]

Features	Firebase	MongoDB
Real-time Capabilities	Built-in real-time database (Firestore) that supports real-time data synchronization.	Limited real-time capabilities often require additional setup for real-time functionality.
Hardware Consideration	Abstracts hardware concerns, offering a fully managed cloud-based solution with automatic scaling.	Requires careful consideration of hardware and scaling strategies for optimal performance.
Flutter Integration	Firebase provides official Flutter plugins, simplifying integration for various Firebase services, including Firestore, authentication, and more.	MongoDB can be integrated with Flutter using third-party packages like 'mongo_dart' for Dart language support.

Therefore, due to the limitations posed by the MongoDB and how firebase provides a good alternative to overcome those limitations, and also its ease to integrate with the Hardware, we are opting to choose the Firebase for the backend of the application.

Flutter:

Flutter is chosen for the front end of the application due to its versatility, efficiency, and streamlined development process. As a cross-platform framework, Flutter allows developers to create a single codebase for both iOS and Android, reducing development time and maintenance efforts. Its rich set of pre-designed widgets facilitates a visually appealing and consistent user interface across platforms. Moreover, Flutter supports hot reload, enabling real-time code changes and faster iteration during development. The integration of Flutter with Firebase provides a seamless end-to-end solution, leveraging Firebase's backend services for features like real-time data synchronization, authentication, and hosting, ensuring a robust and scalable application architecture.

2.3.2

When deciding between Arduino and Raspberry Pi for a smart canteen system that incorporates a 10-inch TFT LCD display, several factors need consideration. Both platforms have their strengths and are suitable for different applications. Here's a comparison focusing on key aspects relevant to your project:

Arduino :

Microcontroller:

- Arduino boards are microcontrollers, optimized for real-time control and low-level hardware interactions.
- Suited for tasks requiring precise timing and control, making them ideal for interfacing with sensors, actuators, and other peripherals.

Real-time Processing:

- Arduino excels in real-time processing, ensuring immediate response to external events.
- Suitable for applications where timing and responsiveness are critical, such as controlling motors or handling sensor data in real-time.

Power Consumption:

- Arduino boards typically have lower power consumption compared to Raspberry Pi.
- Well-suited for battery-operated or low-power applications.

Simplicity:

- Arduino is simpler to use and is often preferred for projects that require straightforward programming and minimal setup.

Raspberry Pi:

Microcomputer:

- Raspberry Pi is a full-fledged microcomputer with a more powerful processor compared to Arduino.
- Ideal for applications that require multitasking, running complex algorithms, or handling multiple processes simultaneously.

Operating System:

- Raspberry Pi can run a full operating system (like Raspbian, a Debian-based OS), allowing for easier software development and management.
- Suitable for projects requiring networking, databases, or web-based interfaces.

Multimedia Capabilities:

- Raspberry Pi has better multimedia capabilities, making it suitable for applications involving high-quality graphics, video playback, or web-based interfaces.

Connectivity:

- Raspberry Pi comes with built-in Ethernet and USB ports, simplifying connectivity options.
- Ideal for projects requiring network communication or peripheral devices.

Choosing the right microcontroller:

Our system requires a full operating system, multitasking capabilities, advanced graphics, connectivity options, and complex applications involving networking, databases and multimedia capabilities, for which Raspberry Pi would be more suitable.

CHAPTER 3: DESIGN AND ARCHITECTURE OF THE SYSTEM

3.1 Methodology

3.1.1 Software

Key components in software methodology

a. Project Planning:
    - Defining the project scope, objectives, and requirements.
    - Identifying key features and functionalities.
    - Creating a project timeline and milestones.
b. Setup and Configuration:
    - Installing and configuring Flutter and Dart.
    - Creating a new Flutter project.
    - Setting up a Firebase project and configuring Firebase services (Authentication, Firestore, etc.).
c. User Interface Design:
    - Designing the user interface using Designing tools and Flutter widgets.
    - Planning and implementing navigation between screens.
    - Ensuring a responsive and user-friendly design.
d. Database Designing
    - Designing the database schema for storing menu items, orders, users etc.
e. App Logic:
    - Implementing business logic for menu browsing, item details, cart management, and order placement.
    - Handling real-time updates using Firestore listeners.
f. Testing:
    - Writing unit tests for critical functions.
    - Performing integration tests for UI and backend interactions.
    - Setting up automated testing using CI/CD tools.
g. Documentation:
    - Document code, API endpoints, and configuration details.
    - Provide setup instructions for developers.
    - Create user documentation for end-users.

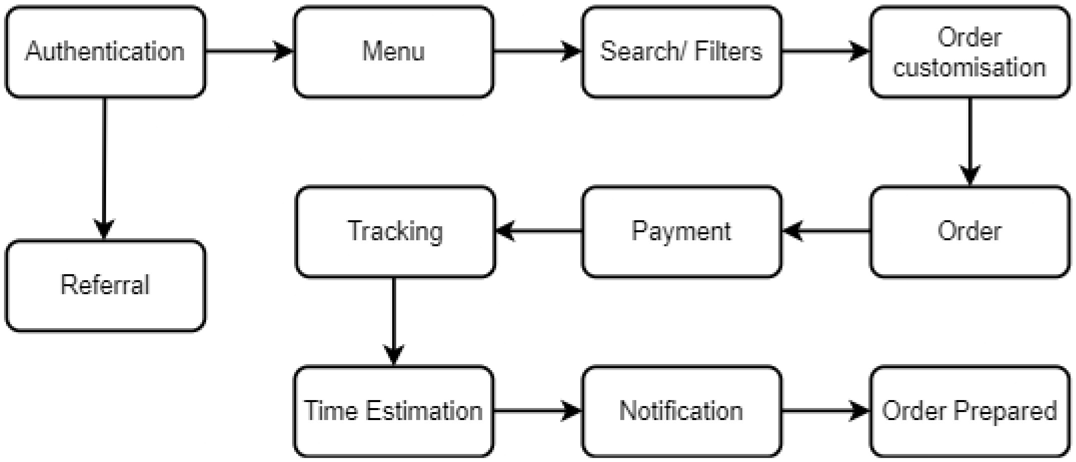


Figure: Flow of software

The above system flow diagram shows the proposed flow of the application. Starting with the Authentication, once authenticated, the user will be redirected to the Menu page. The user will be able to use the search among the available food items or filter based on the different categories and later customize the food according to the requirements of the user. Once done with the customization, the user can place order and proceed for the payment. Later the user will be able to track the order, know the estimated time for the preparation of the order, get notification for all the updates regarding the order including getting a final notification for the order has been prepared and ready to serve.

3.3.2 Hardware :-

The proposed methodology for the integrated food ordering system in the canteen, catering to guests, teachers, and students, involves a multifaceted approach, encompassing both app-based and on-site functionalities.

1. User Segmentation:
   - Segment the user base into three categories: guests, teachers, and students, each with unique features and access levels within the app.

2. App-based Ordering for Teachers and Students:
   - Implement a secure login system for teachers and students, requiring a password for access to the food ordering app.
   - Allow users to browse the menu, select food items, and compile orders within the app interface.

3. Cashless Payment Integration:
   - Enable online payment options for orders placed through the app, promoting cashless transactions for convenience.

4. On-site Ordering with LCD Screens:
   - Integrate LCD screens within the canteen area, both inside and outside, for on-site ordering by students.
   - Provide a separate queue for online orders, streamlining the process for those present in the canteen.

5. IOT Thermal Printer Integration:
   - Implement an IOT thermal printer to generate e-tickets for online orders, ensuring efficient communication between the app and the canteen staff.

6. Order Notification System:
   - Integrate a notification system, including buzzers and LED screens, to alert users when their orders are ready for collection.

7. Special Features for Teachers:
   - Design special features for teachers, such as bulk orders and on-table delivery, enhancing their user experience.
   - Offer exclusive discounts and timely updates on the latest menu items through the app.

8. Canteen Staff Interface:
   - Develop a user interface for canteen staff, displaying details of app-based orders, including order time, payment mode, and item quantities.
   - Include a cancellation log and daily order summary for efficient canteen management.

9. Guest Ordering:
   - Implement a simplified ordering process for guests, without requiring a login or password.
   - Ensure anonymity in data storage for guests, limiting personalized features.

10. Raspberry Pi Integration:
   - Connect LCD screens to Raspberry Pi devices, utilizing the GUI interface to merge data from both on-site and app-based orders.Various GUI Libraries are available for use like Tkinter, PyQT, Kivy, PyGame, etc.
   - Integrate Firebase to consolidate and synchronize data, ensuring a seamless and unified food ordering experience.

11. Feedback Mechanism:
  - Incorporate a feedback mechanism for users to provide comments and ratings, aiding in service improvement.
  - Analyze data to derive insights for enhancing the overall system efficiency.

12. Future Scope:
  - Plan for future enhancements, such as order feedback mechanisms for canteen staff, to continually improve service.
  - Explore additional features like personalized recommendations and order history for an enhanced user experience.

This comprehensive methodology integrates both app-based and on-site functionalities, creating a dynamic and user-friendly food ordering system tailored for different user categories in the canteen environment.

3.2 Proposed System

3.2.1 Software

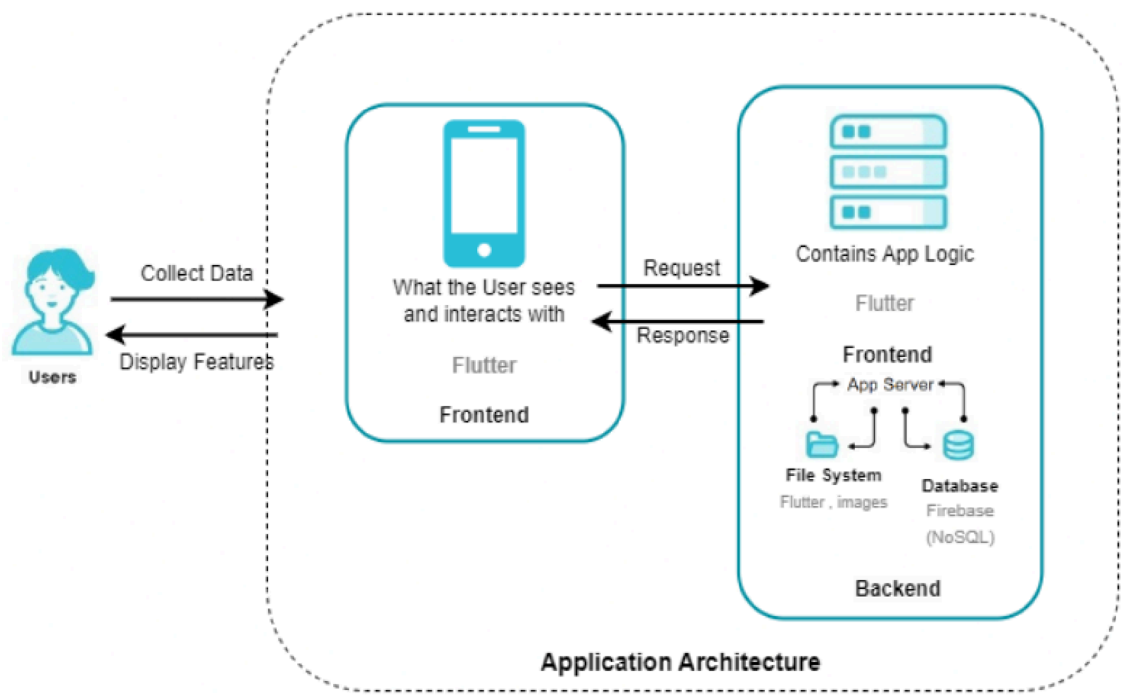


Figure: Software Architecture

The software system depicted in the above diagram represents a comprehensive mobile application architecture built on the Flutter framework. The primary focus revolves around seamless user interaction and data processing. The system employs a client-server model, with the Flutter framework serving as the frontend client responsible for user interfaces, requests, and responses.

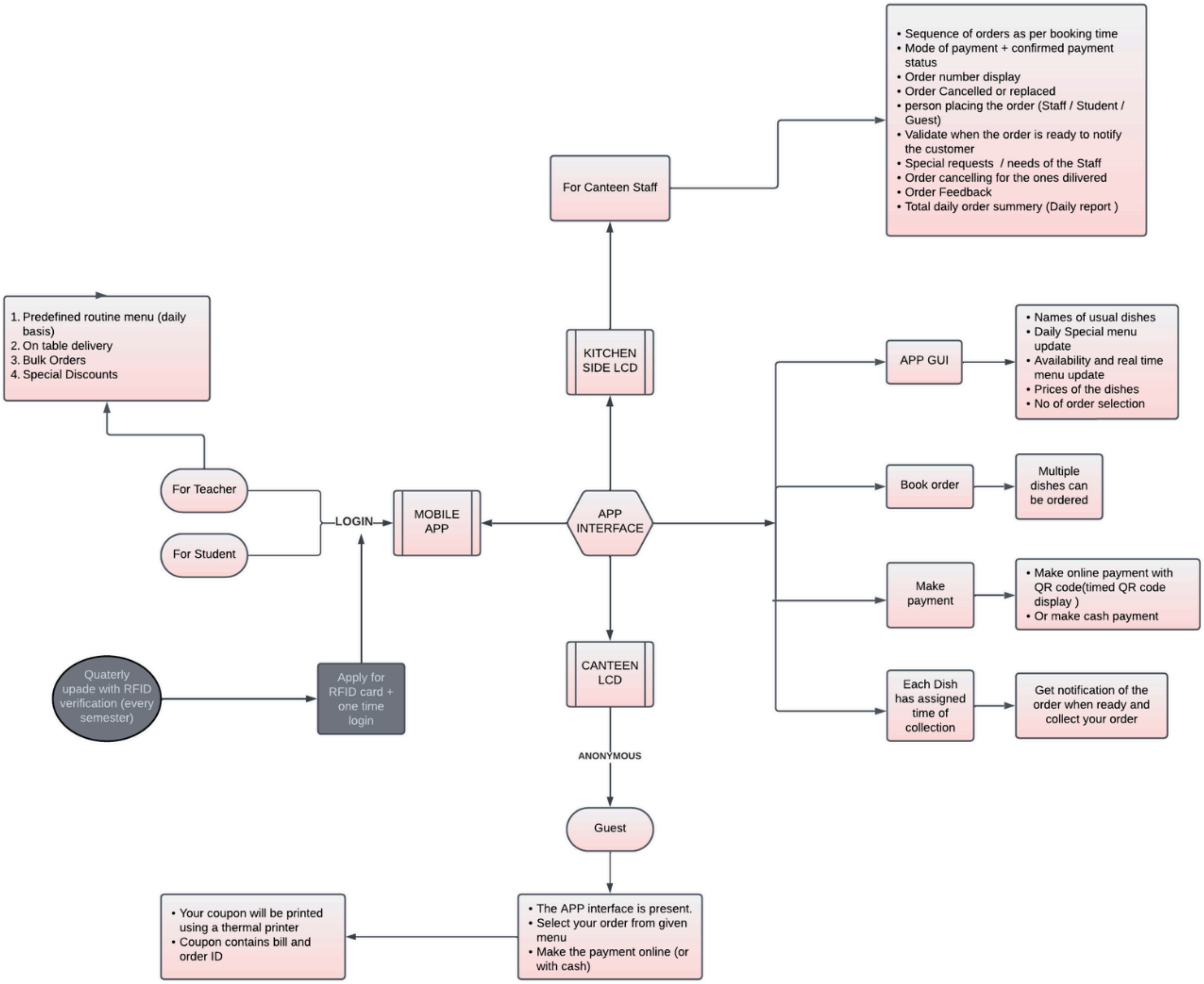
The frontend, implemented in Flutter, intricately manages user experiences, displaying features that users interact with. Flutter's cross-platform capabilities ensure a visually appealing and responsive interface. The app logic, governing user input and application behavior, is encapsulated within the Flutter frontend.

On the backend, an application server is employed to handle requests originating from the frontend. This server, in conjunction with the file system, manages Flutter images, allowing for efficient storage and retrieval. The database functionality is integrated using Firebase, indicating the utilization of a NoSQL database for effective data management.

Some of the key features:

1. User Authentication (Student/Teacher): Ensures secure access to the app, allowing only authorized students and teachers to use the smart canteen ordering system.
2. Digital Menu: Presents a comprehensive and interactive digital menu showcasing the available food items with details and images.
3. Order Placement: Enables users to select desired items from the digital menu and place their food orders seamlessly.
4. Online Payment/Cash/Card: Provides multiple payment options, including online payment, cash, and card, for convenient and flexible transaction processing.
5. Order Tracking: Allows users to monitor the status and location of their food orders in real-time through an integrated tracking feature.
6. Estimated Time of Ordering: Provides users with an estimated time for order preparation and delivery, enhancing transparency and managing expectations.
7. Customization: Allows users to customize their food orders based on individual preferences or dietary restrictions.
8. Referral Among Students: Facilitates a referral system where students can recommend the app to peers, encouraging wider adoption and engagement.
9. Notification: Sends timely alerts and notifications to users regarding order confirmation, status updates, and promotional offers.
10. Search and Filter: Enables users to efficiently search for specific food items and apply filters for categories or dietary preferences, enhancing the overall user experience.

3.2.2.Hardware :-



Here the section is being divided into three parts: the guests, the teachers and the students. So when the student and the teachers want to order the food they can do it via the app which only the teachers and the student only have the login access thus they have to have the password and then they can do it from their phone from any corner without having the need to be present in the canteen. Thus when they select their order and make the final list of orders they can pay the bill online itself with cashless payment being possible but in case you are in the canteen then there is a situation where there is lot of rush in the canteen thus the two standing queues one for the normal line and the other one is when there is an LCD screen being placed for student to book order online and then generate their e-ticket printed by the IOT thermal printer and thus they can go and give that directly to the counter when their order is being ready now when the order is ready on the counter there will be a buzzer and also an LED screen on which there will be display of the order number of that person who had placed the order thus that person can come and collect the order.

So now in this case there are 2 LCD screens placed one in the canteen area for the canteen people and another one also in the canteen area outside for the students to access . Now for the teachers, there are special features like bulk orders and the on-table delivery of food for them and the special discounts for them thus all of these are being displayed on the app as well and the most latest order which is famous and the menu update will be notified to them first. Then talking about the screen on the canteen staff side there the bookings which are done by the app will be displayed and and what time was the order made and the sequence of the order with respect to time and what mode of payment was done also how much of one food item has that person ordered then who is placing the order is that a student or a staff or a guest and then the validation which is confirmed with the buzzer and LED display of the order number. The orders that get canceled are also displayed for them. Then the total daily order summary and the future scope where the Order feedback will also be received by them so that they can improve their service.

Now for the guests the LCD screen was present that had basic entry without login as no password is needed but yes for the canteen side the password is required. So moving here for the guests the same features are available as the students and the teachers just that the data is anonymously saved and they will not get recommendations or they will not be able to save the previous data to review again .

The LCD screen both of them are being connected to the Raspberry Pi and they are using the Raspberry Pi GUI interface thus the data collected from both are being merged together and combined with the app data via the Firebase this entire process will make the food ordering process more comfortable and easy .

CHAPTER 4: PROJECT SCHEDULE

Stage 1: Research

In the initial Research stage, we kickstarted the project by delving into the domain of Internet of Things (IoT) to identify specific challenges. Our focus was on conducting an extensive literature review, aiming to understand existing solutions and the broader research landscape within IoT. This phase equipped us with valuable insights, helping us define the project's scope, objectives, and research questions. The knowledge gained from this research lays a solid foundation for making informed decisions as we progress through the subsequent stages.

Stage 2: Problem Identification

In defining the scope and objectives of our IoT and software project, we collectively identified gaps and opportunities within the chosen domain. This collaborative effort involved a comprehensive analysis to clearly delineate what our project aims to achieve and the specific challenges it seeks to address. It's a pivotal step towards establishing a shared vision and purpose for our work in the field of internet of things and software development. Subsequently, we embarked on the task of identifying problems around us that seamlessly align with our project objectives. This helped us in finding the problem in our college canteen itself and we chose this topic for our final year project.

Stage 3: App Designing

In stage 3 of the timeline, the project delved into app design, employing the versatile tool Figma. Basic pages essential for seamless user interaction were crafted, encompassing authentication, order processing, account settings, and payment interfaces. Figma's collaborative features facilitated a streamlined design process, enabling real-time feedback and iteration. This stage was pivotal in laying the visual groundwork for the application, ensuring a user-centric and aesthetically pleasing design.

Stage 4: App Development

In this stage of the timeline, app development focuses on creating a responsive and visually appealing user interface using Flutter widgets. Firebase integration is paramount, incorporating Firebase Authentication for secure user access and the cloud_firestore package to seamlessly interact with the Firestore database. Business logic implementation covers essential features like menu browsing, cart management, and order placement, ensuring correct interactions with Firebase services. Testing becomes crucial at this stage, encompassing unit tests for critical functions, integration tests for component interactions, and UI tests to validate user interface behavior.

Stage 5: Hardware Requirements

In this stage, the focus is on defining and acquiring the necessary hardware requirements for the project. This includes identifying and procuring components such as Raspberry Pi boards, LCD screens, IoT printers, buzzers, LEDs, and other essential hardware. Detailed specifications, compatibility checks, and ensuring adequate power supply are integral parts of this step. Additionally, considerations for the physical setup and connections between the hardware components are outlined to facilitate smooth integration during the development phase.

Stage 6: Interfacing and Coding Hardware

In this phase of the project, the primary focus is on developing the graphical user interface (GUI) for the LCD screen and seamlessly integrating it with the Raspberry Pi along with all associated components. The LCD screen will be interfaced with the Raspberry Pi's GPIO pins, utilizing Python and Tkinter for GUI development. Dynamic information, menus, and prompts will be displayed on the LCD, ensuring an interactive user interface. Subsequently, attention will shift to Week 6, where the interfacing and coding will extend to the IoT Printer, Buzzer, and LED components. The IoT Printer will be connected to the Pi, employing suitable libraries to enable data printing from the app. For the Buzzer and LED, GPIO pins will be used, and Python code will be written to trigger them based on specific events, such as order placement or system alerts, ensuring a synchronized and responsive hardware system.

Stage 7: Integration

In the upcoming phase of the project, the primary focus is on developing the graphical user interface (GUI) for the LCD screen and seamlessly integrating it with the Raspberry Pi along with all associated components. The LCD screen will be interfaced with the Raspberry Pi's GPIO pins, utilizing Python and Tkinter for GUI development. Dynamic information, menus, and prompts will be displayed on the LCD, ensuring an interactive user interface. Subsequently, attention will shift to Week 6, where the interfacing and coding will extend to the IoT Printer, Buzzer, and LED components. The IoT Printer will be connected to the Pi, employing suitable libraries to enable data printing from the app. For the Buzzer and LED, GPIO pins will be used, and Python code will be written to trigger them based on specific events, such as order placement or system alerts, ensuring a synchronized and responsive hardware system. Regular testing and refinement will be conducted to guarantee the reliability and functionality of the integrated components.

Stage 8: Testing

In this testing stage, a meticulous approach will be applied, subjecting each app component to rigorous unit testing to guarantee seamless functionality. The focus extends to comprehensive end-to-end testing, evaluating the overall system's performance and pinpointing areas for enhancement. Systematic debugging will collectively identify and resolve any emerging issues or bugs, fostering a robust app and database. Code optimization for efficiency and scalability aims to elevate system performance, testing the integrated flow of the project involving the app, hardware, and the common real-time updated database. Iterative testing and fine-tuning cycles will ensure any last-minute issues are addressed, ultimately securing the project's successful alignment with defined objectives.

Each individual hardware component will undergo thorough testing to ensure its seamless integration with the Raspberry Pi boards. The subsequent steps involve the integration testing of two Raspberry Pi boards, designated for the canteen and student use. Detailed checks will be performed to guarantee the proper channeling of data from the two LCD displays, with a focus on ensuring a successful merge with the app's data through Firebase.

Stage 9: Documentation

Throughout the project, we will continue documenting our steps, ensuring a comprehensive and well-documented record of every phase. In the Documentation stage, we will capture intricate details of the entire project, including the codebase, methodologies, and configurations. This ongoing documentation effort serves as a valuable resource, facilitating knowledge transfer among team members and providing a robust foundation for future maintenance and enhancements.
We will collaboratively prepare a detailed report that will meticulously outline the project's methodology, results, and challenges, creating a reference point for understanding the project's evolution. Additionally, we collectively generate user guides and documentation, anticipating the need for clear instructions to aid in the effective utilization of the developed system.

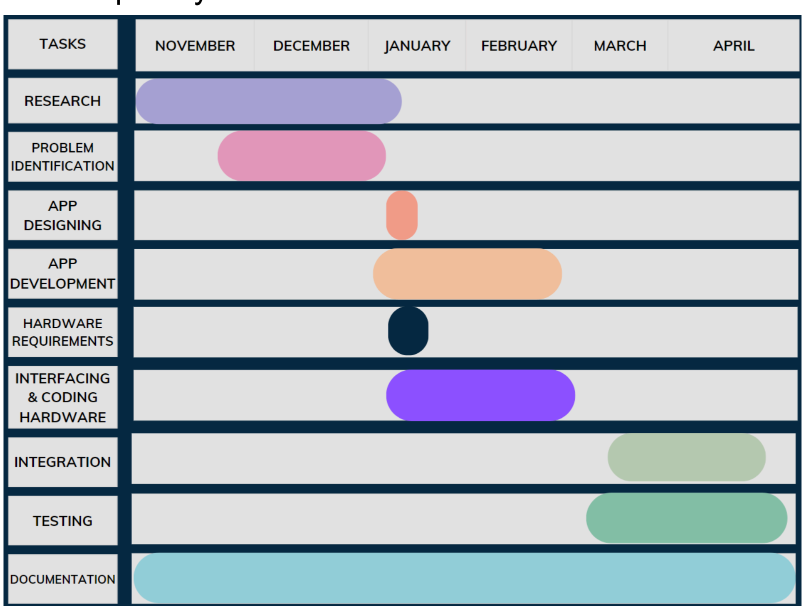


Figure: Gantt chart for the project schedule

CHAPTER 5: CONCLUSION AND FUTURE WORKS

CONCLUSION

In conclusion, Smart Canteen Ordering System represents a small yet impactful project that modernizes canteen operations, providing a glimpse into the potential improvements that emerging technologies can bring to the dining experience. Our project serves as a foundation for future enhancements and innovations in the realm of smart ordering systems. The integration of various technologies in this project, combined with modern features and user-friendly interfaces, contributes to a more streamlined and user-centric dining environment. It also provides a modern and interactive interface for users. Our Mobile App with ML Algorithms and visual appeal of TFT LCD displays, coupled with a Graphical User Interface (GUI), significantly enhances the overall ordering experience. The project optimizes the ordering process, reduces wait times, and minimizes queues through real-time updates on TFT LCD displays as well as in our app. This results in a more efficient and organized canteen operation. It provides real-time updates on order statuses and estimated wait times, improving transparency and reducing perceived wait times. Queue management is more effective, leading to a smoother flow of customers. The integration of secure digital payment options through TFT LCD displays supports cashless transactions, enhancing payment convenience, and improving overall transaction security.

FUTURE WORKS

The proposed system aims to elevate efficiency and user experience in the canteen environment through interconnected features. A dynamic order suggestion system utilizes recent order data to suggest popular items, aiding quicker decision-making for canteen staff.

A user-friendly web platform empowers staff with insights into order history, analytics, and crowd-based reports. Sales trends, popular items, and customer preferences are highlighted for detailed performance analysis.

Real-time updates on order status are facilitated through an integrated LED Dot Matrix display, improving communication between the kitchen and serving area. This enhances operational efficiency.

The addition of a cash payment system, seamlessly integrated into the ordering platform, accommodates a broader customer base. An optional biometric scan system adds security and convenience during cash transactions, ensuring compliance with privacy and security regulations.

REFERENCES

[1] Ketan Bhekare, Chinmay Karandikar, Ganesh Kamble, Varsha Wangikar: *'SMART CANTEEN SYSTEM'.* April 2019
https://www.jetir.org/papers/JETIR1904776.pdf

[2] Mrs.A.Gowthami, Ms.T.Banupriya, Ms.E.Vadivukkarasi: *"MOBILE APPLICATION FOR CANTEEN AUTOMATION SYSTEM USING ANDROID",* March 2020
https://www.academia.edu/42899665/MOBILE_APPLICATION_FOR_CANTEEN_AUTOMATION_SYSTEM_USING_ANDROID

[3] Adwiet Holkar, Aditya Gohil, Chaitanya Soni, Dr. Amit Gadekar: *"IMPLEMENTATION OF A SMART CANTEEN SYSTEM FOR UNIVERSITY CAMPUS USING CLOUD",* June 2023.
https://www.jetir.org/papers/JETIR2306263.pdf

[4] Alfiya M. Shaikh, Aditya C. Shetgaonkar, Sandesh S. Dalvi, Shubham S. Sawant, Kruti V. Singh, Prof. Sagar K. Naik, Prof. Rajesh K. Gauns: *"Food Ordering Management using Recommendations",* June 2019
https://www.academia.edu/39635568/Food_Ordering_Management_using_Recommendations

[5] NUR HANIS BINTI IHSAN: *"RESTAURANT ORDERING SYSTEM USING MOBILE APPLICATION",*
http://umpir.ump.edu.my/id/eprint/4297/1/NUR_HANIS_BINTI_IHSAN.PDF

[6] Lestari, S & Elvyanti, Siscka. (2020). *Mini tickets printing machine based on IOT with mobile information using a smartphone. IOP Conference Series: Materials Science and Engineering.* 850. 012022. 10.1088/1757-899X/850/1/012022.
https://www.researchgate.net/publication/341599482_Mini_tickets_printing_machine_based_on_IOT_with_mobile_information_using_a_smartphone

[7] Chechi, Davinder & Kundu, Twinkle & Kaur, Preet. (2012). THE RFID TECHNOLOGY AND ITS APPLICATIONS: A REVIEW. International Journal of Electronics, Communication & Instrumentation Engineering Research and Development (IJECIERD). 2. 109-120.
https://www.researchgate.net/publication/232575248_THE_RFID_TECHNOLOGY_AND_ITS_APPLICATIONS_A_REVIEW

[8] T600 Printer Administrator's Manual: t600-admin-manual-p180043-001--rev-a.pdf

https://fs.tscprinters.com/system/files/RS-9/t600-admin-manual-p180043-001--rev-a.pdf

[9] M., Kousalya & E., Lakshi & R.K., Mukesh & G., Pravin & T., Prabhu. (2021). Automatic Restaurant Food Ordering Menu Card. International Research Journal on Advanced Science Hub. 3. 7-12. 10.47392/irjash.2021.052.
https://rspsciencehub.com/article_9829_451794f43ff869082d7aa892b70dd092.pdf

[10] Raspberry Pi Based Menu Ordering System for Restaurants M.VISHWANATH
https://ijsetr.com/uploads/436152IJSETR13095-1686.pdf

[11] G. Siva Sankar Varma, et. al. “Digitalized Restaurant Menu Ordering System Aiding Contactless Dining Environment.” IOSR Journal of Engineering (IOSRJEN), 11(06), 2021, pp. 39-45.
https://iosrjen.org/Papers/vol11_issue6/E1106013945.pdf

[12] Firebase versus MongoDB
https://www.excellentwebworld.com/mongodb-vs-firebase/