Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th February 2026. Vol. 5. No. 2; e-ISSN: 2808-4519

IoT Application in Cashier Systems to Help People with Disabilities (Deaf)

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Abstract

The rapid development of the *Internet of Things* (IoT) has brought significant impact across various aspects of human life, including information systems and public services. One of its important applications lies in supporting inclusivity for people with disabilities. This research focuses on the implementation of IoT in a cashier system specifically designed to assist individuals with hearing impairments in conducting payment transactions more easily, independently, and equally. In conventional cashier systems, most transaction information is delivered through audio signals, which creates a barrier for hearing-impaired users in fully understanding the payment process. To address this issue, this study develops and implements a prototype of an IoT-based cashier system that utilizes visual notifications and digital indicators as the main medium for delivering transaction information.The results of testing indicate that the IoT-based cashier system functions effectively in delivering transaction information, reducing communication errors, and improving the independence of hearing-impaired users during the payment process. Therefore, this research contributes not only to the development of modern cashier systems but also to the advancement of inclusive and accessible technology that supports equal opportunities for all members of society.

Keywords: *Internet of Things, Cashier System, Disabilities*

1. Introduction

The Internet of Things (IoT) has revolutionized the way we interact with the digital world, enabling the integration of physical devices with the internet to improve efficiency and quality of life. The Internet of Things (IoT) is a concept that aims to expand the benefits of continuous internet connectivity. The Internet of Things (IoT) can be used in buildings to control electronic equipment such as room lights, which can be operated remotely through a computer network(Efendi 2018). The Internet of Things (IoT) has become a new paradigm in the world of technology that changes the way we interact with our surroundings through internet connections. The concept of IoT involves a network of connected physical devices, enabling automated and intelligent data exchange and control. History, How it Works and Benefits of IoT. The method in this research is using the Systematic Literature Review method. The results of the research are the early history of IoT in 2009 by Kevin Ashton by conducting research on communication between Machine to Machine (M2M). The basic idea of IoT is to connect several devices and exchange data with other devices in one network. Currently, the development of how IoT works is experiencing rapid development such as the addition of Security and Blockchain features. IoT has a very good impact on government institutions, industry, education and health(Wilianto and Kurniawan 2018).

A cash register is one tool that utilizes the principles of this information system. It is an electronic device used to calculate financial transactions. A typical cash register has a keyboard for data entry, a scanner, a drawer for cash storage, and a receipt printing device. With advances in technology, cash registers can perform a variety of additional functions, including credit card processing, personal check verification, and inventory tracking(Trianasari 2022). Optimizing operational efficiency and enhancing customer experience
A deaf person is someone whose hearing loss hinders the processing of linguistic information through hearing, whether or not they use hearing aids, provided their hearing is sufficient to enable successful processing of linguistic information through hearing(Rahmah 2018). According to Goffman, people with disabilities are limited in their ability to communicate with others. Their environment assumes they can't do anything, which causes problems. Because of these limitations and the negative stigma attached to them by others, they strive and believe in themselves so they don't become dependent on others(Dwi Ningsih 2020).

2. Theoritical Basic

2.1. Computer Network

A computer network (network) is a telecommunications network that allows computers to communicate with each other by exchanging data. The purpose of a computer network is to achieve its goals, each part of the computer network can request and provide services. The party requesting/receiving services is called a client and the party providing/sending services is called a server. These connected computers must also have at least one network card each which is then connected via cable or wireless as a data transmission medium and there is network operating system software that will form a simple computer network(Astuti 2018).

2.2. Network Topology

Network topology is a collection of nodes, devices, and network connections that are interconnected in a logical and orderly manner(Dwi Setiawan, Ridwansyah 2023). Network topology is a concept that describes the physical and logical layout of a computer network, namely how devices such as computers, servers, printers, and other devices are connected to each other. In network topology, there are several types of device arrangement methods, each with its own characteristics, advantages, and disadvantages. Determining the network topology is very important because it affects network performance, ease of maintenance, and cost efficiency. In general, topology can be divided into two aspects: physical topology, which describes how cables or other communication media are connected, and logical topology, which describes the flow of data between these devices. Some types of network topologies commonly used include bus, star, ring, mesh, tree, and hybrid topologies, each of which is implemented according to specific needs and the desired network scale. Selecting the right topology is crucial to ensure network reliability, scalability, and operational efficiency.

2.3. Cashier System

A cashier system is a computer system used to manage sales transactions electronically in a business or store. This system aims to simplify the transaction process, minimize human error, increase efficiency, and provide accurate and detailed information about sales and inventory. Cashiers are a form of service provided by producers both to users of the goods produced and the services offered. The most important thing in a business is the quality of service provided. Consumers will be satisfied if the service provided is excellent(Muthohari, Bunyamin, and Rahayu 2016). A cashier system, often referred to as a Point of Sale (POS) system, is a technology designed to help businesses manage and process sales transactions efficiently. This system is a combination of hardware and software that work together to handle various operational functions, such as payment processing, sales recording, inventory management, and customer data management. Essentially, a cashier system serves as the primary point of interaction between customers and businesses during transactions, where every purchase is accurately recorded and payments are accepted through various methods, including cash, credit cards, debit cards, and digital payments.

2.4. IoT (Internet of Things)

The Internet of Things, or often called IoT, is an idea where all objects in the real world can communicate with each other as part of a unified integrated system using the internet network as a connection(Efendi 2018). With IoT, these devices can communicate with each other or with a central system that manages and analyzes the collected data. For example, in a smart home, a smart thermostat can automatically adjust the room temperature based on the habits of the occupants, while smart lights can be set to turn on or off via a smartphone app, even when the user is away from home. In the industrial world, IoT is used for machine condition monitoring, logistics management, and production process automation, all of which contribute to increased operational efficiency and cost reduction. One of the most exciting aspects of IoT is its ability to create more responsive and proactive systems. For example, IoT-connected vehicles can send real-time data on traffic conditions, allowing drivers to avoid congestion or even alerting them to potential mechanical problems before they occur. IoT also enables the development of smart cities, where various urban infrastructure such as streetlights, transportation systems, and public utilities can be monitored and controlled to improve energy efficiency, reduce congestion, and enhance the quality of life for residents.

2.5. IoT Architecture

Internet of Things (IoT) architecture is a framework that governs how various components within an IoT ecosystem interact and function together to create a connected and integrated system. This architecture encompasses interconnected layers, from physical devices and sensors that collect data from the environment, to applications and services that use that data to generate useful insights and actions.

2.6. IoT Applications

The Internet of Things (IoT) has revolutionized various industrial sectors and everyday life by connecting physical devices to the internet and enabling them to communicate, exchange data, and operate automatically. IoT applications now span everything from smart homes to smart cities, from healthcare to agriculture, and from manufacturing to transportation. With IoT, various processes become more efficient, automated, and can be monitored in real time, generating significant benefits for society and businesses.

2.7. Visual Basic

Visual Basic is a language that supports object-oriented programming. Therefore, users can easily utilize the features in the form designer. Simply by observing the features in the form designer, users can easily use them to design a program(Isroqmi 2022). Visual Basic (VB) is

a programming language developed by Microsoft and used to create Windows-based applications. VB is known for its ease of use in creating intuitive and interactive graphical user interfaces (GUIs). Visual Basic is a version of the BASIC (Beginner's All-purpose Symbolic Instruction Code) programming language that is enhanced with object-oriented programming capabilities and focuses on developing efficient applications with less code.

2.8. Object-Oriented Programming

Object-Oriented Programming (OOP) is a programming method that is oriented towards objects. The purpose of OOP is to simplify program development by following existing models in everyday life(Muhamad Saepuloh and Ginting 2022). Object-Oriented Object Modeling (OOB) is based on several core concepts that provide advantages in software development. Encapsulation is one key concept, where data and its associated methods are combined into a single unit, the object. This not only simplifies data management but also improves data security and integrity by restricting direct access to object attributes and allowing interaction only through predefined methods. Inheritance is another concept that allows a new class, or subclass, to inherit attributes and methods from an existing class, called the superclass. With inheritance, developers can reduce code duplication and improve the hierarchical structure of a program, thus facilitating code reuse.

2.9. Databases

A database is a systematic collection of information stored on a computer so that it can be accessed through a computer program to obtain information from the database. A database is a collection of data formed from related files. In a computer, databases are stored in storage hardware and manipulated for specific purposes. Data management in a library database. A database is a software system that allows users to define, create, maintain, and provide access to a database. There are many technologies used, such as MySQL, SQL, and others(Chairane et al. 2023)

2.10. Disability

A person with a disability is any individual who faces long-term physical, intellectual, mental, and sensory limitations who, in interacting with their surroundings, still experiences obstacles and difficulties in fully and actively participating in society. Intellectual disability is a person's limitations, both intellectually and behaviorally, in adapting to their surroundings(Waspiah et al. 2022). People with disabilities require special attention from the government and all elements of society. Therefore, a legal basis for protecting them is Law Number 8 of 2016 concerning Persons with Disabilities. Subsequently, the Central Java Provincial Government issued Regional Regulation Number 11 of 2014 concerning the Fulfillment of the Rights of Persons with Disabilities as a step to clarify and emphasize equal rights for people with disabilities(Waspiah et al. 2022).

2.11. Deaf

Deafness is a condition or state in which a person experiences a lack or loss of hearing, making it impossible to perceive stimuli in the form of sounds, voices, or other stimuli through hearing. The impact of this hearing impairment can significantly impact other developmental milestones, such as speech and language skills, resulting in delays and difficulties in communication. This condition can affect an individual's communication skills, impacting social interactions, education, and daily life. Many deaf individuals communicate using sign languages, such as Indonesian Sign Language (BISINDO), which is a visual language that uses hand gestures, facial expressions, and body movements

3. System Analysis and Design

3.1. Problem Analysis

The current system still has limitations in providing access to food ordering for people with disabilities, particularly the deaf. The manual ordering process requires verbal communication, which is difficult for individuals with hearing impairments. Furthermore, calling queue numbers is also not optimal for this group of people with disabilities. Therefore, a system is needed that can facilitate people with hearing impairments in ordering and purchasing at quick-service restaurants.The system aims to address these issues by providing a digital menu ordering interface. This interface displays a menu list accompanied by video guides in sign language, making it easier for people with hearing impairments to understand the ordering process. Furthermore, the system also accommodates the needs of the queue calling process. Specifically for people with hearing impairments, an ESP32-based calling system is provided, designed to provide vibrations as a notification when an order is ready to be picked up. Thus, this system is expected to increase the comfort and independence of people with disabilities in ordering at quick-service restaurants.

3.2. Analysis System

The current system in place at quick-service restaurants uses a direct-order system. Customers are required to make payment at the beginning of their order to obtain a queue number. After receiving their queue number, customers wait until their food is ready. The cashier then calls customers according to the queue number they were given.

3.3. Needs Analysis

The requirements analysis is divided into functional requirements analysis and non-functional requirements analysis. Functional requirements analysis discusses the functions the system can perform, while non-functional requirements analysis discusses the devices needed to build a cashier system that can assist the deaf. The functional requirements for the system being developed are as follows:

1. The system built can perform menu ordering functions via a digital interface.
2. The system built has a cashier interface that has the function of confirming and sending orders to the kitchen interface.
3. The kitchen interface has a function to send a signal to the calling system when the order is ready to be served.
4. The calling system that is built can provide notifications in the form of vibrations as a sign that the ordered menu is ready to be picked up.

3.4. Cashier System Topology Design

The cashier system topology consists of three PCs: a customer PC, a cashier PC, and a kitchen PC. The system also has a Wi-Fi hotspot/access point as a communication medium between the three PCs. Furthermore, the system also features a calling system built using an ESP32 device. The complete system topology can be seen in Figure 3.1 below.

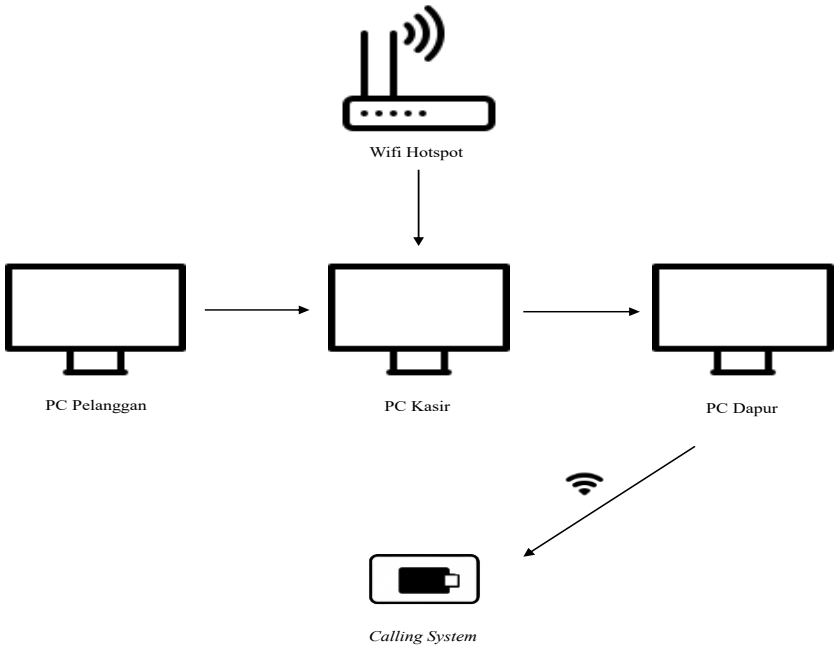

Fig. 1: Cashier System Topology

The customer's computer will display a menu interface from which customers can select and order. Once the order is complete, the order data will be sent to the cashier's computer via Wi-Fi. The cashier will receive the order information and then forward it to the kitchen computer. The kitchen computer will receive the order details from the cashier's computer for further processing.
Once the menu is prepared, the kitchen staff will confirm the order via the kitchen computer with the customer calling system. The customer calling system will provide a vibration notification to indicate that the order is ready for pickup. All communication between system components is connected via Wi-Fi. The cashier's computer acts as the main control center, processing orders and storing data in the database.

3.5. Cashier System Activity Diagram

An activity diagram is a diagram used to depict the flow of activities or processes within a system, from start to finish. The activity diagram for the system to be developed can be seen in Figure 3.2 below.

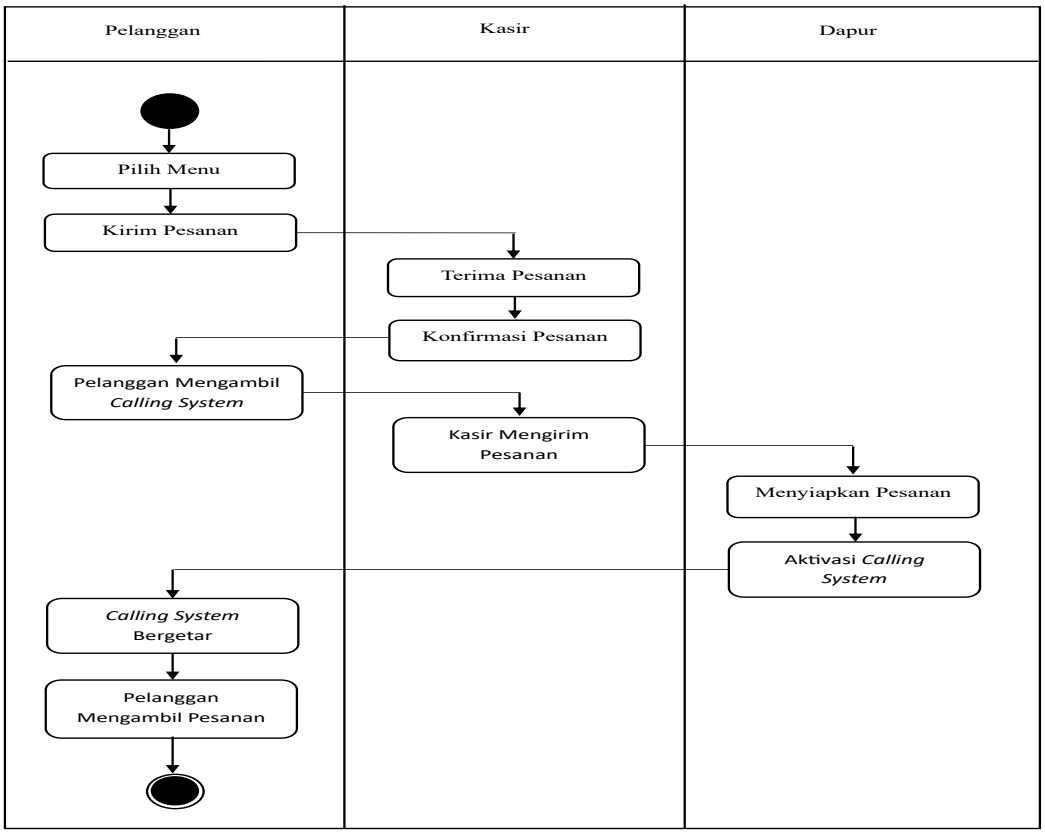

Fig. 2: Activity Diagram of Cashier System

3.6. Entity Relationship Diagram of Cashier System

The Entity Relationship Diagram (ERD) in the cashier system consists of four entities, namely user, message, menu, and info. The user entity has an id_user attribute as the primary key, username, password, and role attributes for database management. Meanwhile, the menu entity has an id_menu attribute as the primary key, menu_name, menu_price, and category attributes to accommodate menu types such as food or drinks. The message entity has an id_message attribute as the primary key, id_menu attribute as a foreign key, status attribute, and quantity attribute, this entity is used to accommodate customer order data. The last entity is the info entity used to accommodate informational videos with sign language. This entity has an id_info attribute as the primary key, file_name attribute, and file-path for the video storage location. The cardinality of each entity to other entities is 1 to many. The complete Entity Relationship Diagram schema of the cashier system can be seen in Figure 3.3 below.

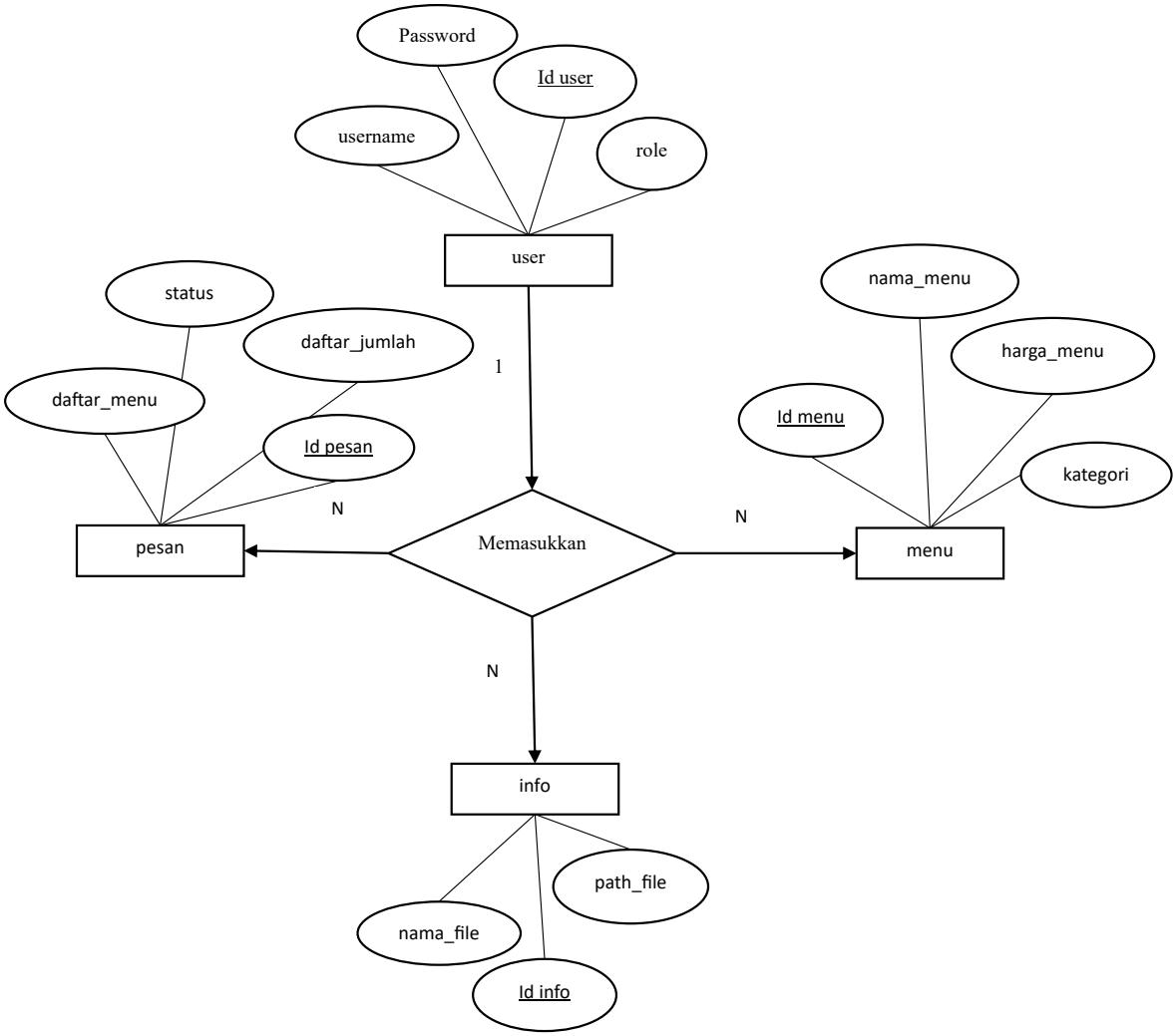

Fig. 3: Entity Relationship Diagram of Cashier System

3.7. Block Diagram of Calling System

A block diagram is a graphical representation of a system that shows the relationships between components. A block diagram of a calling system can be seen in Figure 3.4 below.

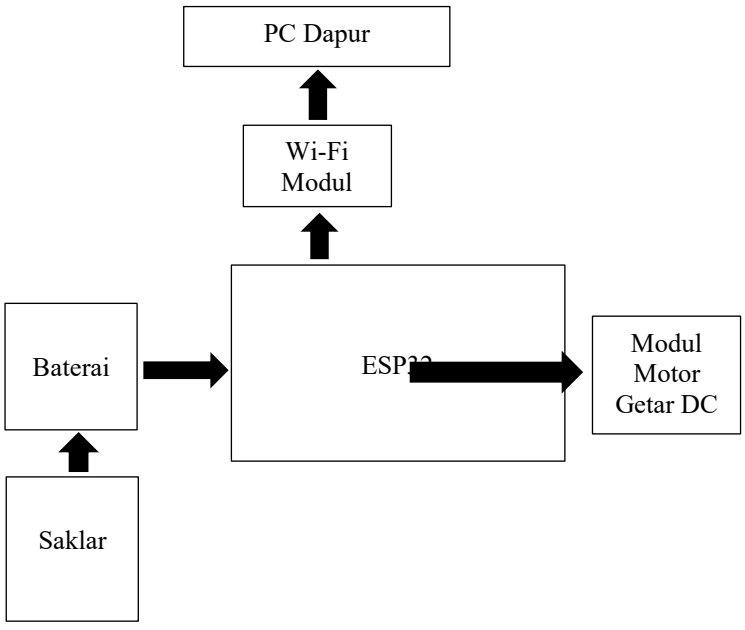

Fig. 4: Calling System Block Diagram

3.8. Calling System Circuit Design

This circuit consists of several modules that are connected to each other, such as ESP32, DC vibration motor module, 18650 lithium battery and switch.

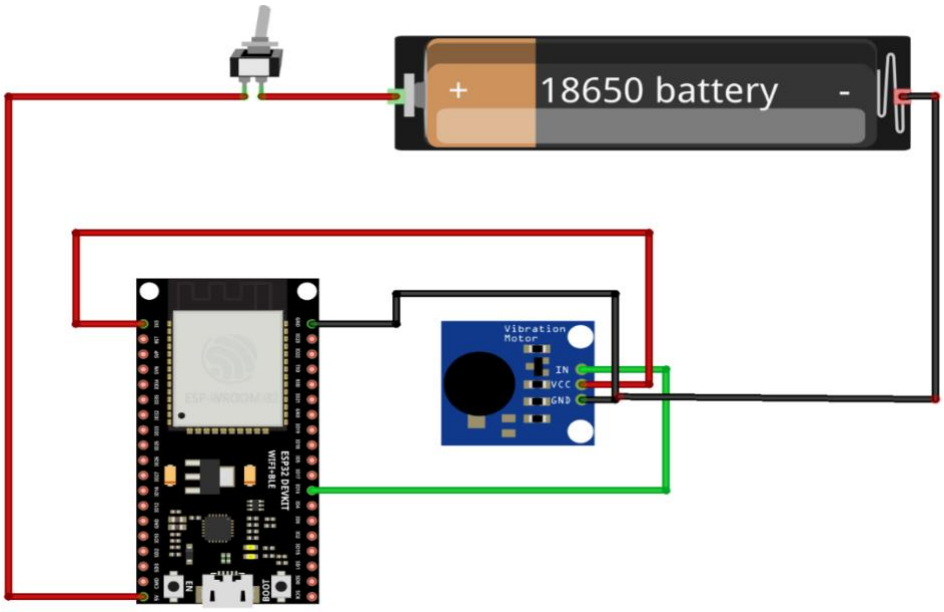

Fig. 5: Complete Series of Calling Systems

4. Results and Discussion

4.1. System Implementation

The system is implemented on three computers with distinct functions. The first computer functions as an ordering device and provides ordering guidance information to customers. The second computer is used by the admin or cashier to modify user data, order data, and menu data. Meanwhile, the third computer functions in the kitchen area, receiving order information from the cashier and also controlling the calling system device for notification of completed orders.

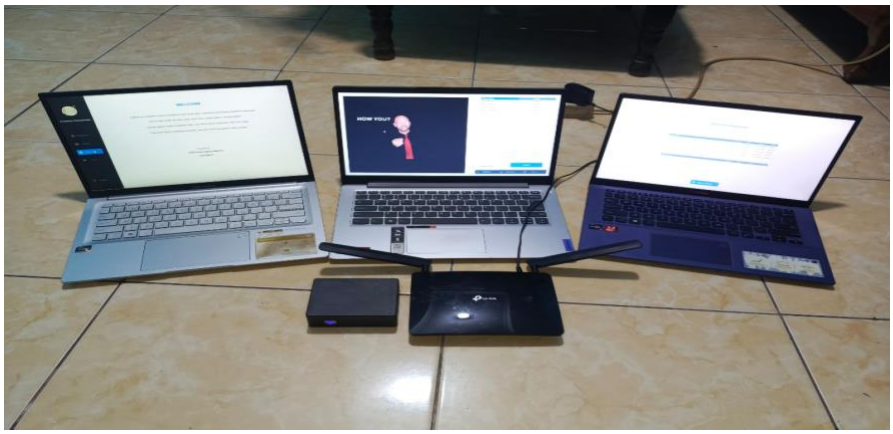

Fig. 6: Topology View

4.2. Interface Implementation

The developed application has seven main forms: a login form, a user management form, a menu management form, an order management form, an info management form, a customer form, and a kitchen form. The login form serves to verify user authentication and restrict access rights to the application.

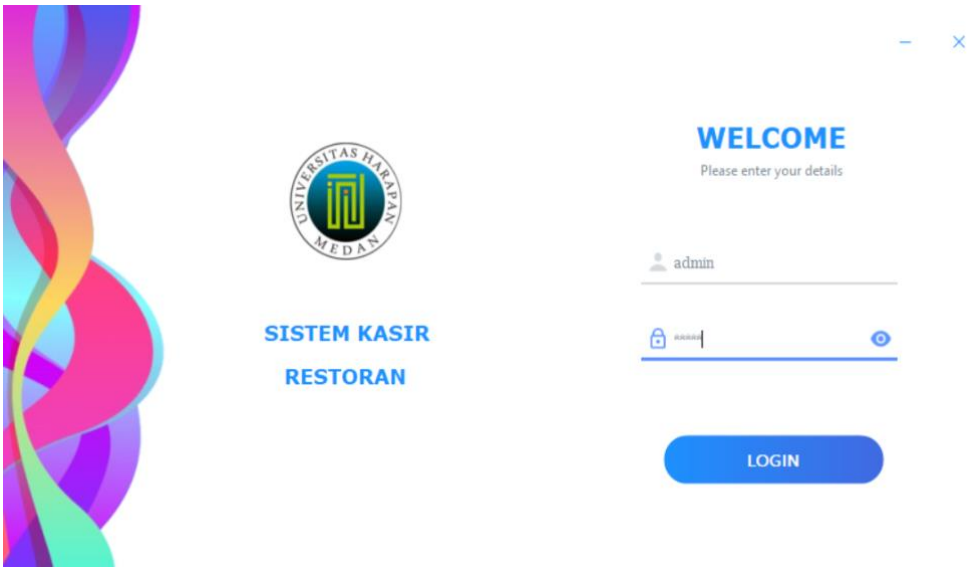

Fig. 7: Login Form Display

After the user successfully logs in and is properly authenticated, the system will display the home page as the first screen. This page serves as an initial information interface that provides general application usage guidance and includes the identity of the application's creator.

Fig. 8: Home Page Display

Customers place orders through their computers, guided by video instructions displayed on the system interface. To order food, customers first select the Food tab, then select the desired menu, determine the order quantity, and press the Order button to send the items to the Total tab. The same procedure is also carried out when customers want to order drinks through the Drinks tab. All selected items, both food and drinks, will automatically be displayed on the Total tab, which serves to summarize the entire order along with the quantity and total price to be paid by the customer. The customer form display can be seen in the following image.

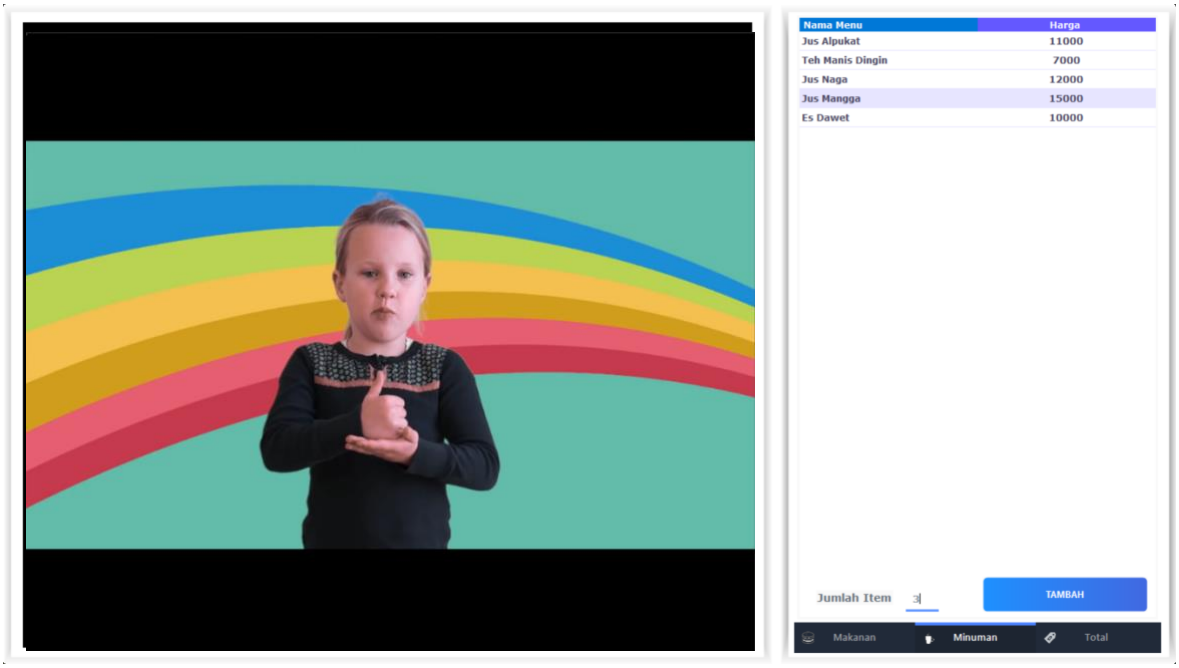

Fig. 9: Customer Form Display

After an order is submitted from the customer's computer, the first table on the order form on the cashier's computer will automatically update with the quantity and details of the incoming order. This table serves as a temporary storage area to make it easier for the cashier to verify, accept, or reject each order received from the customer.

Fig. 10: Incoming Order View

Once the order is approved by the cashier, the order data is automatically forwarded to the kitchen computer for further processing. The kitchen form contains two main tables. The first table displays a list of orders with a pending status, complete with a "finish" button used by kitchen staff to indicate that the order has been prepared. Meanwhile, the second table displays a list of orders that have been processed, complete with a "delete" button for deleting individual data. Additionally, at the bottom of the form, there is a "delete all" button that removes all completed order data from the table.

Fig. 11: Kitchen Form View

When the kitchen staff member presses the "finish" button, the calling system will automatically activate and vibrate to notify the customer that the order is ready to be picked up. Additionally, the order data will be transferred from the waiting table to the finished table.

Fig. 12: Calling System

The indicator light on the device indicates that the calling system is active. This device uses an ESP32 microcontroller as the main processing unit, which is powered by a power supply of up to 4.2 volts from an 18650 lithium battery. The vibration source comes from a DC vibration motor module that will be activated when the system receives a signal. Initial activation of the device is done manually by pressing the push button switch located on the device.

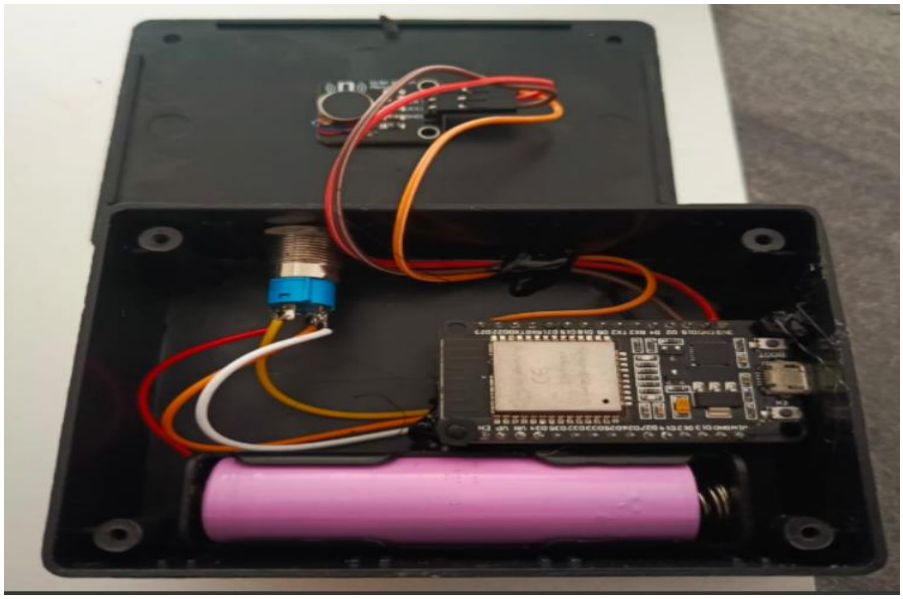

Fig. 13: Calling System Circuit Display

5. Conclusion

Based on the results of the discussion and research that has been carried out, the following conclusions can be drawn:

1. The system built can speed up and simplify the ordering process, thereby reducing customer waiting time.
2. The simple system interface and accompanying video instructions make it easy for customers, especially customers with hearing disabilities, to place orders independently.
3. Integration between the cashier system and the kitchen system increases the effectiveness of communication between the cashier and kitchen staff, so that the order processing process becomes more coordinated.
4. The calling system feature makes it easier for customers to know that their order is ready to be picked up.
5. Displaying orders in the kitchen helps staff process orders quickly and in an organized manner.

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