

Snack Vending Machine Using QR Code as Payment Method

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ABSTRACT

Vending machines can be used as a solution to overcome losses for selling and make the payment system easier. This study aims to design a snack vending machine with a payment system using an Android-based QR Code scan application in which there is a balance as electronic money. In the payment application, there is also an admin account to top up balances and view sales history, making it easier for sellers to monitor sales results. This snack vending machine uses ESP32 to store data as well as transmit data from every activity that occurs. There are 4 types of snacks in this vending machine. Selection of the type of snack using the Keypad and to regulate the release of the snack using a servo motor connected to a spiral wire. 16x2 LCD to display data and an Infrared Avoid Obstacle sensor to stop the servo from rotating when it detects food falling in front of it. Testing on a snack vending machine using a QR Code was carried out by trying to purchase 4 types of snacks, with each trial 10 times. The whole test is successful, the tool can issue snacks and transactions on the payment application run properly.

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1. INTRODUCTION

A vending machine is a machine that can automatically sell various products based on user requests. A vending machine is an automatic device that uses digital and mechanical energy or a mechanism to automatically dispense products such as medicines, groceries, tickets, or licenses to users without paying for human labor in vending machines [1, 2]. Several different drink machines user operated by inserting coins to purchase drinks [3]. Today's vending machines generally still use coins, paper money, and cards to make payments at vending machines [4]. The problem when using banknotes or coins is that they are less effective when making payments because not all buyers carry the specified amount [5].

Vending machines can now be applied to honesty canteens. Honesty canteens are a method used in schools and offices to sell something without a salesperson on duty [6]. The honesty canteen has a similar principle to a vending machine [1,7]. Buyers can make payment transactions independently without a seller, by entering money in the box provided as a place of payment at the honesty canteen [8]. However, the problem that often occurs for sellers is that the amount of sales proceeds do not match, resulting in losses [9, 10]. A vending machine can be interpreted as a tool or machine used to sell goods automatically. What is meant by automatic here is that it does not require workers to sell goods that can be purchased according to what the buyer wants [11, 12].

In its use, smartphones can read QR Codes, one of which is to provide information on data [13]. QR Code is a two-dimensional image that represents data, especially data in the form of text. QR Code has the ability to store data [14].

In this study, there are several similar studies that are used as a reference in the implementation of this research. The research and observations used as a reference are described as follows. The first research discusses an automatic food-drink vending machine with a payment system using a coin acceptor to read coins [15]. In this study, the hardware design uses ATmega8 as a microcontroller, DC motor driver, DC gearbox motor, coin selector, Bluetooth module, and buzzer. The second study discusses the design of a vending machine with a payment system entering banknotes by reading the value of the color of the banknote using a color sensor. In this study, the manufacturer of the tool uses Arduino Uno as a microcontroller and uses a 16x2 LCD, Push button, and Servo Motor [16]. The third research discusses Vending money changer machines made to help kiosks, mini markets, or banks to exchange money and make the process of converting paper money into coins easier. This device is based on the Arduino Uno microcontroller to control the equipment [17]. This tool uses a TCS3200 color sensor to detect the color of the IDR 5,000 note, a DC motor to pull out banknotes, and a servo motor to issue IDR 1,000 coins. In this device, the LCD is used to display the manual for using the vending machine and the number of coins issued. In this research, the manufacturer of the tool uses Arduino Uno as a microcontroller and uses a 16x2 LCD, TCS3200 color sensor, and a DC motor. The fourth research discusses automatic beverage vending machines that can make sales using non-cash payments by utilizing RFID as a medium for storing balances and different IDs. In this study, the manufacturer of the tool uses Arduino Uno R3 as a microcontroller and uses a 16x2 LCD, Keypad, and Servo Motor [18, 19]. The fifth study discusses the manufacture of vending machines with RFID containing balances used as a tool to make payments at the vending machine [20]. In this study, the manufacturer of the tool uses Arduino Uno as a microcontroller, Button, RFID Module, 16x2 LCD, and Motor.

This research will complement the shortcomings of previous research. The vending machine payment system this time will be done by scanning the QR Code via the camera installed on the smartphone so that buyers don't need to prepare banknotes, coins, and cards. To make payments via QR Code, smartphone users must first download the application that has been made to make payments. On the vending machine, a QR Code will be affixed which will provide information in the form of data from the snacks on the machine [21]. The QR Code scanning process is carried out through an android-based application. In the application, there are two accounts, namely the admin account user account. User accounts are used to make payment transactions which contain data in the form of user accounts and balances. The admin account is used to top-up user account balances and view snack sales history. The communication used between the vending machine and the application is through the real-time database feature on firebase. Through this application, snacks in the vending machine can be purchased. With this research, it is hoped that it can help in terms of convenience and security in transacting on snack vending machines.

2. RESEARCH METHOD

The snack vending machine made in this study consists of components that are used both software and hardware such as:

2.1. Design Block Diagram

It is one part of the design of making this tool because from this block diagram we can know the working principle of the whole circuit. Simplify the design process for making tools so that a system that is in accordance with the previous design will be formed. The following block diagram of the system can be seen in Figure 1.

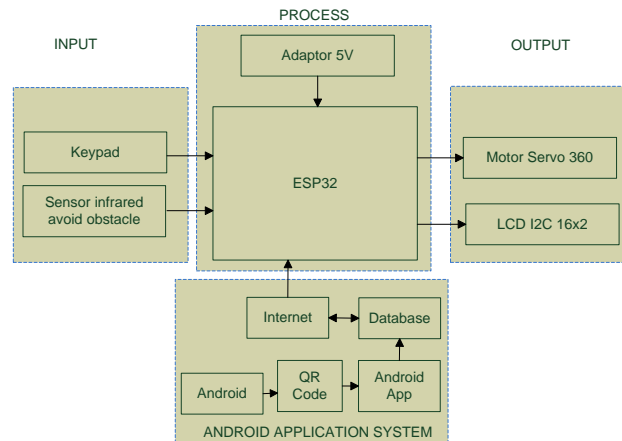


Figure 1. Design Block Diagram

The Block diagram of the system in Figure 1 can be explained as the system on a snack vending machine using ESP32 as one of those microcontrollers. ESP32 has several advantages over other microcontrollers. The main thing is the built-in WiFi module and Bluetooth which makes it easy for the ESP32 to connect to the internet. Internet connection is needed in an IoT project. ESP32 is also equipped with a GPIO Pin that can be used for various needs. There are also I2C and SPI pins which make it easy to communicate [22]. In this study, using ESP32 was the main microcontroller or data processing center used to control snack vending machines. The keypad is a series of switch buttons that have been arranged to form a row and column named in the form of numbers and letters, which serves to signal a circuit, by connecting certain lines [23]. In this study, the Keypad is used as a button to select the type of snacks available on the snack vending machine. The Infrared Obstacle Avoid Sensor is a module consisting of infrared and a photodiode that functions as a detector of obstacles or objects in front of it [24, 25]. In this study, the Infrared Obstacle Avoid sensor is used to detect food falling in front of it as a continuous servo motor rotation controller. A Servo motor is a DC motor with a closed feedback system where the position of the motor will be informed back to the control circuit in the servo motor. This motor consists of a DC motor, a series of gears, a potentiometer, and a control circuit [24]. In this study, using a continuous servo motor connected to a spiral to push snacks. As communication between the vending machine and the Android application, the real-time database feature on the firebase console is used as a database for data storage so that the vending machine and the Android application can be connected to run the work system of the snack vending machine.

2.2. Account List Flowchart

Figure 2 is a system flowchart from account registration in order to make purchases on the vending machine application. On account registration, user data after registration will be stored in the database. The data that must be filled in is the Account Name and Password. The system can also find out from the account data whether it has been used or not, if it has been used a warning will appear that the account has been registered.

2.3. Account Login Flowchart

In the design of Figure 3, namely the Account Login flowchart, the method of filling in the Account Name and Password is used, if the Account Name and Password are incorrect, the system will automatically warn that the account entry failed because the account name or password is wrong. If true then Login is successful.

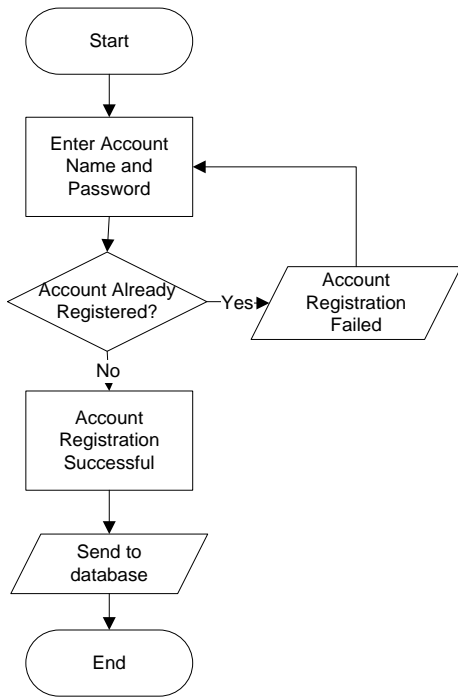


Figure 2. Account List Flowchart

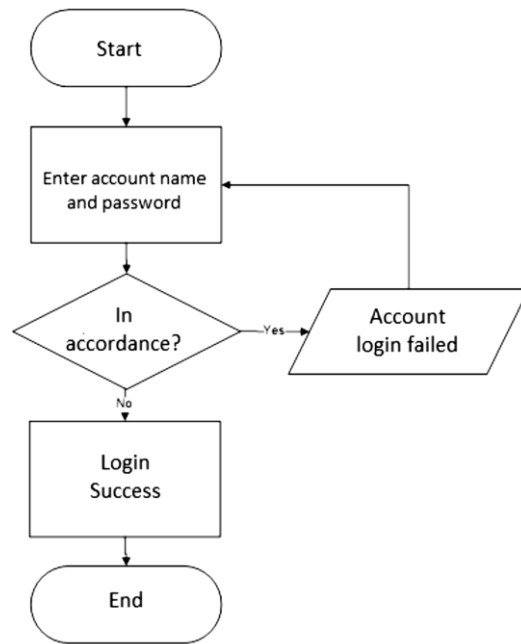


Figure 3. Account Login Flowchart

2.4. Admin Account Flowchart

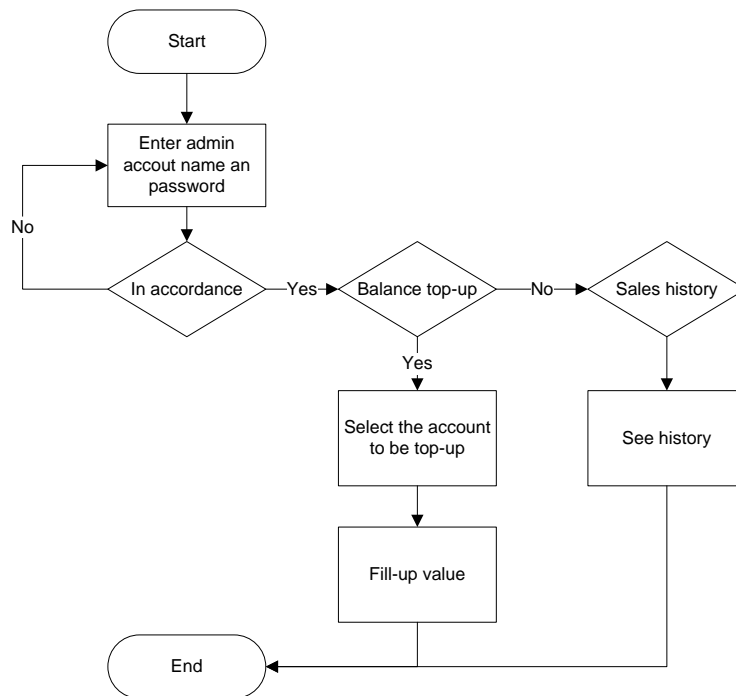


Figure 4. Admin Account Flowchart

In the design Figure 4, is a flowchart of the admin account to top-up balances and view the sales history of the vending machine. Accounts that can be top-up balances are user accounts that have been registered.

2.5. Work System Flowchart

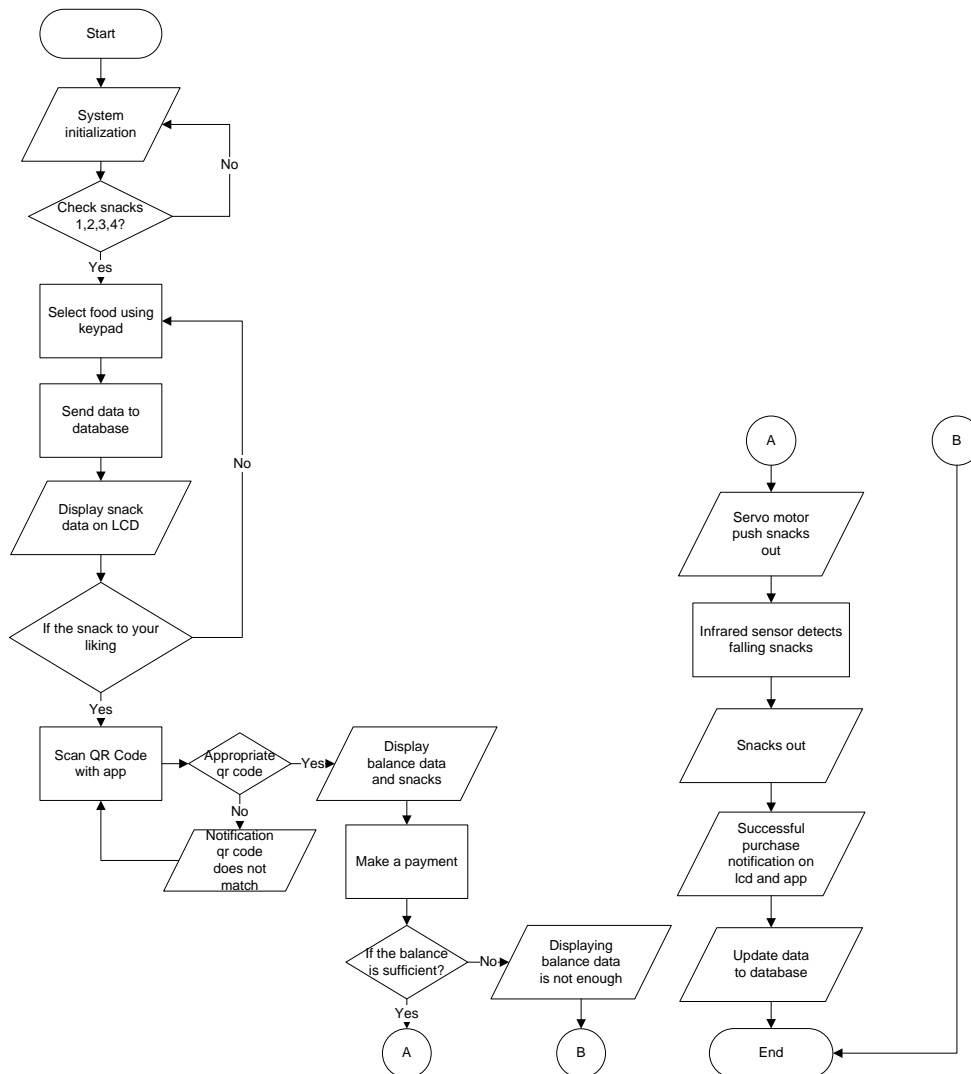


Figure 5. Work System Flowchart

From the flowchart in Figure 5, it can be explained the process of running a snack vending machine using a QR code. First, it starts with system initiation including ESP32, keypad, LCD, infrared sensor, and servo motor. The way it works starts with checking the food stock with an infrared sensor and then selecting the type of snack using the keypad. After that, the keypad input sends the food type selection data to the database which will be sent to the QR code scan payment application after scanning. After that, enter the payment application and make payments by scanning the QR code using Android. The QR code scan process is successful when the scanned QR code matches the vending machine. This QR code contains data on the price and type of snacks. Then check the balance, when the balance is sufficient then you can make purchases and when the balance is less then you can't make transactions. After the purchase transaction is successful, the latest balance data will be updated in the database. Then after the purchase is successful, the servo will push the food out. The falling food will be detected by the infrared sensor to stop the rotation of the servo motor. The buyer picks up the selected food.

2.6. Snack Vending Machine Hardware

The snack vending machine using created QR Code in Figure 6 has been tested. This is done with the aim of knowing whether the tools made are working as expected.



Figure 6. Snack Vending Machine Hardware

3. RESULTS AND DISCUSSION

This section contains the design results from testing each hardware and software used as a whole that makes up the system on the snack vending machine.

3.1. Android Application Design Results

1. Account Login Page

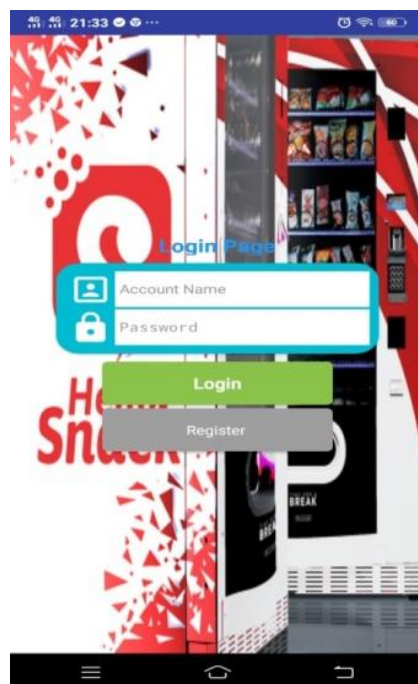


Figure 7. Account Login Page

This display in Figure 7 has two menus, namely, the first is the Login menu for an account that has been registered, then you can enter or log into the application to make transactions on the vending machine. Second, the menu for Registering a New Account, if you don't have an account, for a newly registered account, you will get an initial balance of zero rupiahs.

2. Admin Page



Figure 8. Admin Page

On the admin page view in Figure 8, there are three menus that can be accessed, namely the Top-up Balance Menu which functions to top-up balances on member accounts or registered users so that they can make food purchases, the Snack Sales History Menu functions to view transaction history on the vending machine. Snacks that have been sold.

3. Payment Transaction Page



Figure 9. (a) QR Code for snack and (b) Payment Transaction Page

On the payment transaction page in Figure 9 (b), there is an account name, balance, and a menu to scan the QR code in Figure 9 (a). After the user selects the type of snack on the machine. After that, the user scans the QR Code on the machine. When it has been scanned, the application will direct the user

or user to the menu to make payments for the snacks that have been selected. In the menu for making payments, there is price information for the selected snacks and a menu for clicking Pay Now to remove the food and the balance in the account will decrease. In addition, there is also a menu to cancel if you want other types of snacks.

2.2. System Testing Discussion

In this section is the result of a discussion of system testing carried out on snack vending machines that have been made according to the purpose or not.

1. Keypad Test and QR Code Scan

This test is carried out to determine the results of the accuracy of selecting the type of food by using the Keypad as input and scanning the QR Code according to the selected results or not. Selecting the type of food using the Keypad will be displayed on the LCD while the results of the QR Code Scan will be displayed on the Application. Keypad keys in Figure 10 used for selection are:

1. Button No. 1 in Keypad for Momogi snacks
2. Button No. 2 in Keypad for Saltcheese snacks
3. Button No. 3 in Keypad for Regal snacks
4. Button No. 4 in Keypad for Better snacks
5. Button A for Cancel

The result of the keypad test and QR code scan result is shown in Table 1.



Figure 10. Keypad Test and QR Code Scan

Table 1. Keypad Test and QR Code Scan Result

Data to-	Selection of types of snacks on the keypad	Display on LCD	QR Code scan display on the application	Description
1	Momogi	In accordance	In accordance	succeed
2	Saltcheese	In accordance	In accordance	succeed
3	Regal	In accordance	In accordance	succeed
4	Better	In accordance	In accordance	succeed

2. Infrared Obstacle Avoid Sensor Testing

This test is carried out to detect any obstacles or objects from falling snacks. Falling objects can be detected by the sensor because it has an IR Emitter that functions to reflect infrared to the object and then it is reflected and will be received by the IR Receiver. When the object in front is detected by the infrared sensor, the LED will light up. The result is in Table 2.

Table 2. Infrared Obstacle Avoid Sensor Testing

Object distance	LED condition/Sensor digital value	Status on LCD
1-4 cm	ON/0	Please take a snack
5-8 cm	ON/0	Please take a snack
9-12 cm	OFF/1	-

3. Snack Payment Test with Order

This test is done by selecting the type of food in sequence and doing the experiment repeatedly. In this test, it is expected that the tool can remove snacks on the machine according to the choice. And the balance on the account is expected to be updated after making a snack purchase at the vending machine. If the payment is successful, the display will show Figure 11 (b). This test is carried out using 4 different accounts and balances.

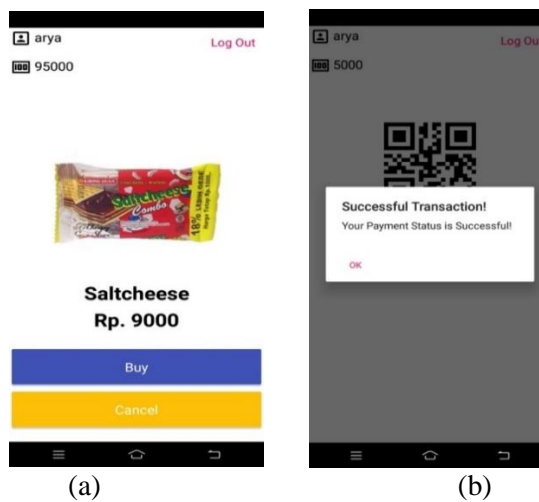


Figure 11. (a) Buy a snack and (b) payment snack

4. Less Balance Payment Test

This test is carried out to prove when making a payment at a snack vending machine that when the balance on the account is not sufficient, it cannot process transactions and also does not issue snacks. The display will show Figure 12.

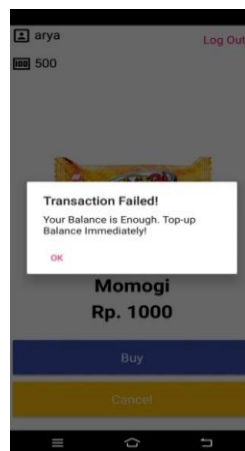


Figure 12. Less Balance Payment Test

4. CONCLUSION

Based on the results of the design, manufacture, testing, and analysis that have been carried out from the implementation of this research it can be concluded, as follows:

1. Snack vending machines using a scan QR code can work well marked by snacks that manage to come out of the vending machine after making a purchase transaction using a scanned QR code application.
2. Purchase of snacks using an android-based QR code scan application which includes the user's account and balance so that it is safer and makes it easier for users to make payment transactions.
3. The payment application uses an admin account to top-up balances and views the history of successful sales based on testing and analysis.

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