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Bottle Refill Water Payment Using E-Card

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ABSTRACT

Keywords:
Payment
ESP32
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Reading Distance
Drinking Water

The high demand for drinking water makes drinking water sold in many stores, it makes buyers have to enter the store first and queue to pay for it. Even though there are people who cannot wait too long. This makes people want fast and easy payment for drinking water. So a fast and easy payment tool is needed. This paper describes the payment of refillable water bottles using ESP32-based E-Card. Testing is done in three stages: (1) E-Card reading distance testing, (2) payment testing in successful conditions, and (3) payment testing in failed conditions. The first test found that the E-Card reading distance is 3.5 cm but when given an aluminum plate barrier, the E-Card cannot work. From the results of the second test the payment was as expected. And the third test states that the tool works well even in conditions of inappropriate payment. The weakness of this tool is that it cannot pay with coins.

1. Introduction

At this time there are two necessities that are very important and cannot be separated from humans, which are the need for electricity and water [1]. Water is an important component in life and cannot be separated from it, without water life would not be able to take place as it is now, especially drinking water [2]–[4]. The needs of water are very important in life and cannot be separated from it. Humans really need water because water is a very important substance for the human body to regulate body temperature, solvents, catalysts, lubricants and also providers of minerals and electrolytes [5].

Nowadays, there are lots of drinking water sold in stores, making buyers have to enter the store first and queue to pay for it. Even though there are people who cannot wait too long. This makes people want fast and easy payment for drinking water [6]. With the development of technology, problems can be easily resolved [7]. Now the business of selling refill drinking water is one that is needed by the community, because of the high need for cheap and healthy drinking water [8].

Today's society is facilitated by everything modern, this is because nowadays it needs everything that is easy to use and fast to work on so that humans are required to complete tasks quickly and efficiently [9]. The development in terms of technology is very rapid, which makes humans compete in terms of making tools that can facilitate human activities [10]. One of the current technological developments is in the payment system [11]. Therefore, the author makes a payment tool that uses non-cash payments, which is expected to make it easier for the community by having a registered E-Card [12]. Each E-Card has a unique code, so each card will not be the same [13]. It is hoped that by using this non-cash payment, the payment will be fast and easy. In addition, some people choose to use non-cash payments to avoid direct contact with cash during pandemic times and also now many people are utilizing cashless payments [14][15]. If this artificial intelligence is implemented into the control system, it will be something good [16]. Therefore, a non-cash payment machine is needed. In this study, a refillable drinking water payment design using E-Card was made [17]. Where the microcontroller uses ESP32 [18]. In this case, the use of an ESP32-based E-Card is very useful for non-cash payments. If this artificial intelligence is implemented into the control system, it will be something good.

E-Card is a technology that transmits information between the terminal and the object to be identified using electromagnetic waves [19]. By using this E-Card technology, payment is very easy to do, just by attaching the E-Card to the reader, payment using this E-Card has a short time in payment [20]. The benefits of this research are expected to provide convenience in payment and no longer need to carry cash, just carry an E-Card [21]. And so that the distribution of clean water is more widespread to the general public which is definitely cheaper because it does not require the cost of packaging water in bottles or gallons [22][23]. This research uses an ESP32 microcontroller instead of Arduino UNO. This research also uses payments using E-Cards, it is hoped that with this use the community will be easier to make payments, because it becomes faster and no longer depends on cash.

2. Method

2.1. System Block Diagram

The block diagram of the bottle refill water payment system using E-Card will be explained in Figure 1. This system consists of several components, namely: Keypad, ESP32 and also LCD. Where each block has its own function. The E-Card system block diagram can be seen in Figure 1.

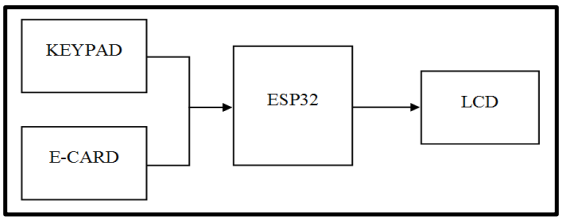


Fig.1. System Block Diagram

From Figure 1. It can be seen that the entire system is connected to the ESP32 microcontroller, ESP32 functions as a processing system. In the input section using a keypad to select the payment menu, E-Card is used to make payments. Data commands that have been entered via keypad and E-Card are then processed by the ESP32 microcontroller and the results will be displayed on the LCD.

2.2. Flowchart System

In Figure 2. Is a flowchart that explains the workflow system of the tool. In this tool there are 2 inputs used, namely keypad and E-Card. For processing using ESP32, then the results will be displayed on the LCD. In the initial menu displayed on the LCD there are 4 options, the first is the option to check the balance and the other 3 options are the options for how many liters of water you want to pay. Checking the balance and paying for water is both done by attaching the E-Card to the E-Card reader and the results will come out on the LCD.

2.3. Wiring Diagram

In Figure 3 (a). Wiring Diagram above, the components, namely Keypad, E-Card, are connected to the input pins of the ESP32 microcontroller and the LCD is connected to the SDA SCL output pin of the ESP32 microcontroller.

2.4. Hardware Design

This tool is made of a black plastic box measuring 18 cm x 6 cm x 11 cm (PxLxT). On the front there are components such as, 20x4 LCD, 4x4 Keypad. On the right side there is an E-Card reader where to make the payment process. And at the back there is a hole for the power source cable. The tool design can be seen in Figure 3 (b).

2.5. Software Design

The software used to create this payment tool program is done through the Arduino IDE (Integrated Development Environment) application, as shown in Figure 4. Arduino IDE software in the design of this payment tool is used to program ESP32. The program sketch includes an E-Card sensor that functions as a scan to check the balance and also scan as a non-cash payment, there is also a 4x4 keypad used for payment input, then everything is displayed on a 20x4 LCD. If the

program and sketch are finished, then compile to make sure the program is arranged correctly, after uploading the program to the ESP32 microcontroller. Here is an example of a partial program sketch image.

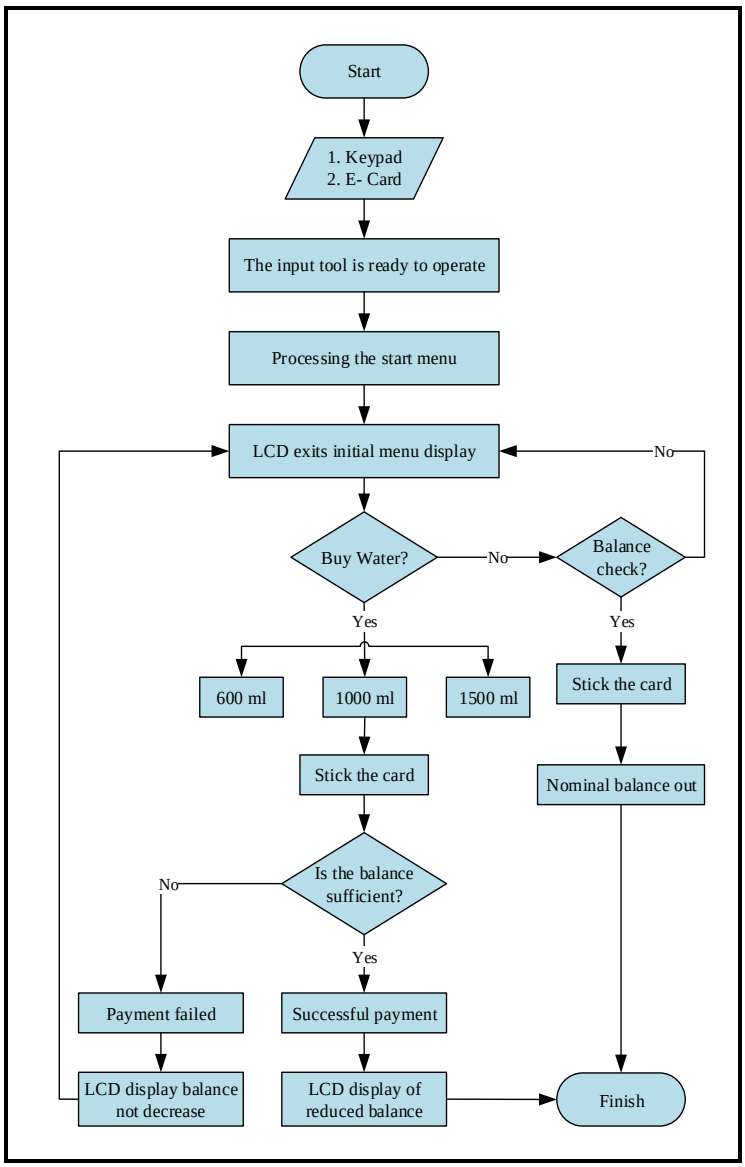
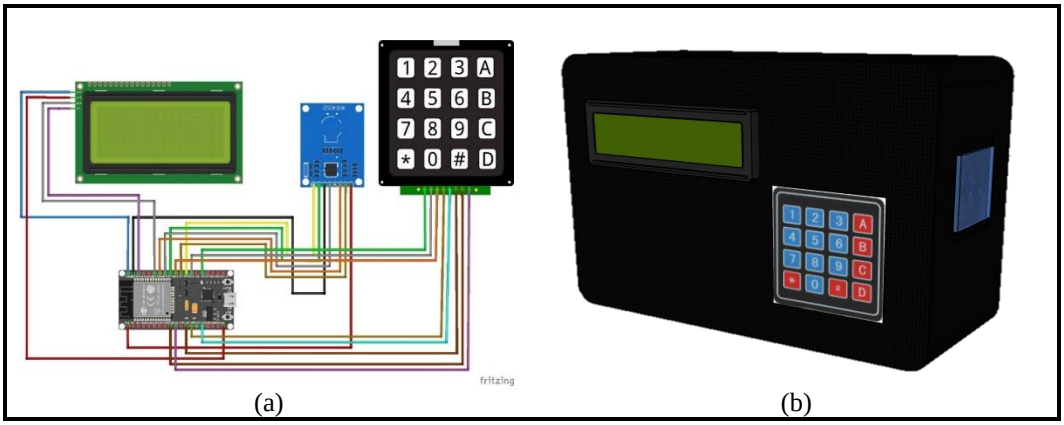


Fig.2. Flowchart System



(a) (b)

Fig.3. (a) Wiring Diagram; (b) Hardware Design

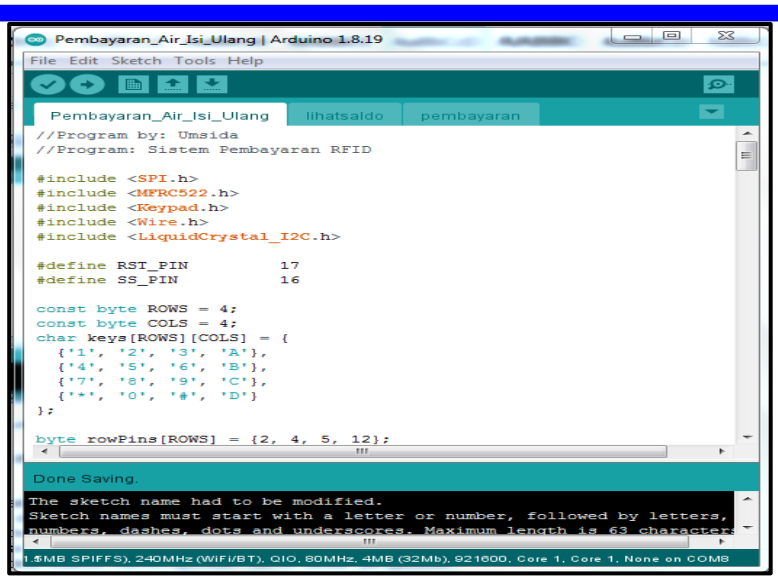


Fig.4. Software Design

3. Result and Discussion

3.1 Card Reading Distance Testing

This test is conducted to determine the maximum reading distance that can be read by the E-Card reader. This reading distance measurement is done by slowly attaching the E-Card to the reader at a certain distance with a parallel position while being measured using a ruler. Testing the E-Card reading distance is very important to do and know the maximum distance, because if the time of attaching the E-Card is outside the range of the recommended reading distance then the tool cannot work. Testing is done with 5 cards with each card tested 5 times to get maximum results. The test results are shown in Table 1. This reading distance test is also carried out with a barrier to find out how much influence if the card is given a wrapper. Testing is done several times to get maximum results. The test results are shown in Table 2.

Table.1. E-Card Reading Distance Testing

Card / Code	Distance (cm)	Legible / Unlegible
Card 1 / 1548a2ac	0,5	Legible
	1	Legible
	2	Legible
	3	Legible
	3,5	Legible
	4	Unlegible
Card 2 / 83258f8	0,5	Legible
	1	Legible
	2	Legible
	3	Legible
	3,5	Legible
	4	Unlegible
Card 3 / e3f58d8	0,5	Legible
	1	Legible
	2	Legible
	3	Legible
	3,5	Legible
	4	Unlegible
Card 4 / 636ec58	0,5	Legible
	1	Legible
	2	Legible

Card / Code	Distance (cm)	Legible / Unlegible
	3	Legible
	3,5	Legible
	4	Unlegible
Card 5 / 59eac37e	0,5	Legible
	1	Legible
	2	Legible
	3	Legible
	3,5	Legible
	4	Unlegible

In the test in table 1, it can be seen that the maximum distance that the E-Card reader can read is 3.5 cm, if it exceeds that distance the E-Card cannot be read.

Table.2. E-Card Testing

No	Barrier Type	Distance (cm)	Trial To-					Legible / Unlegible
			1	2	3	4	5	
1	Without Barrier	0,5	1	1	1	1	1	Legible
		1	1	1	1	1	1	Legible
		2	1	1	1	1	1	Legible
		3	1	1	1	1	1	Legible
		3,5	1	1	1	1	1	Legible
		4	0	0	0	0	0	Unlegible
2	Paper	0,5	1	1	1	1	1	Legible
		1	1	1	1	1	1	Legible
		2	1	1	1	1	1	Legible
		3	1	1	1	1	1	Legible
		3,5	1	1	1	1	1	Legible
		4	0	0	0	0	0	Unlegible
3	Plastic	0,5	1	1	1	1	1	Legible
		1	1	1	1	1	1	Legible
		2	1	1	1	1	1	Legible
		3	1	1	1	1	1	Legible
		3,5	1	1	1	1	1	Legible
		4	0	0	0	0	0	Unlegible
4	Alumunium Plate	0,5	0	0	0	0	0	Unlegible
		1	0	0	0	0	0	Unlegible
		2	0	0	0	0	0	Unlegible
		3	0	0	0	0	0	Unlegible
		3,5	0	0	0	0	0	Unlegible
		4	0	0	0	0	0	Unlegible

As in Table 2 above, the test was conducted 5 times each at a distance of 0.5 cm to 4 cm. From the tests conducted, it is known that the distance that can be read whether it is not given a barrier, given a paper barrier, or given a plastic barrier is 0.5 cm to 3.5 cm, but if when attaching the E-Card at a distance of 4 cm then the E-Card cannot be read at all.

It is different if the E-Card is given an aluminum plate barrier, the reader cannot read the E-Card at any distance at all. This is due to the lack of flux from the magnetic field, which results in the E-Card not being able to work because the electromagnetic waves emitted by the E-Card reader are disturbed by the aluminum plate barrier.

3.2 Payment Testing in Successful Condition

This test is carried out with water payments on successful conditions. This test starts by choosing how many liters of water you want to pay for on the menu options on the LCD. Choose

how many ml on the LCD (picture a). Next there is a "sure" option to make sure it is appropriate, if so then press "*" (star) on the keypad. Next, attach the E-Card to the E-Card reader (picture b), wait for the payment process for 3 seconds (picture c) and the payment process is successful (picture d) indicated by the reduced balance (picture e) The tool testing image can be seen in Figure 6.

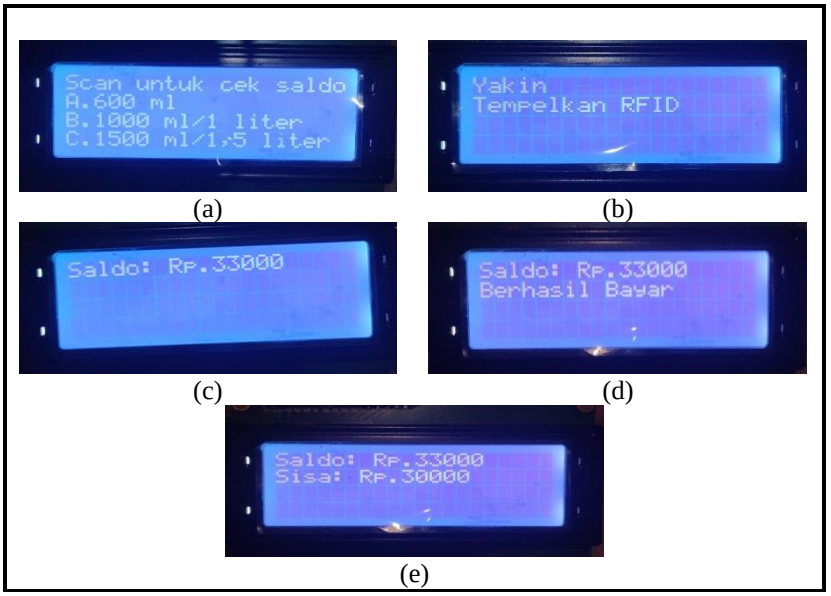


Fig.5. Payment Testing, (a) Initial Menu Display; (b) Paste Card;(c) Initial Balance Display; (d) Successful Payment; (e) Final Balance.

In Figure 5 shows a successful water payment test, said to be successful because the balance has been reduced according to the selling price[24].

Table.3. 600 ml Payment Testing.

Trial To-	Payment	Price	Beginning Balance	Ending Balance	Suitability
1	600 ml	Rp. 3000	Rp. 33.000	Rp. 30.000	✓
2	600 ml	Rp. 3000	Rp. 30.000	Rp. 27.000	✓
3	600 ml	Rp. 3000	Rp. 27.000	Rp. 24.000	✓
4	600 ml	Rp. 3000	Rp. 24.000	Rp. 21.000	✓
5	600 ml	Rp. 3000	Rp. 21.000	Rp. 18.000	✓

In Table 3. It can be seen that in 5 trials of paying for 600 ml water using a price of Rp 3000, the results obtained for the initial and final balances have the appropriate difference in change.

Table.4. 1000 ml Payment Testing.

Trial To-	Payment	Price	Beginning Balance	Ending Balance	Suitability
1	1000 ml	Rp. 5000	Rp. 30.000	Rp. 25.000	✓
2	1000 ml	Rp. 5000	Rp. 25.000	Rp. 20.000	✓
3	1000 ml	Rp. 5000	Rp. 20.000	Rp. 15.000	✓
4	1000 ml	Rp. 5000	Rp. 15.000	Rp. 10.000	✓
5	1000 ml	Rp. 5000	Rp. 10.000	Rp. 5.000	✓

In Table 4. It can be seen in 5 trials of 1000 ml water payment using a price of Rp 5000, the results obtained for the initial and final balances have the appropriate change difference.

Table.5. 1500 ml payment testing.

Trial To-	Payment	Price	Beginning Balance	Ending Balance	Suitability
1	1500 ml	Rp. 7000	Rp. 39.000	Rp. 32.000	✓
2	1500 ml	Rp. 7000	Rp. 32.000	Rp. 25.000	✓
3	1500 ml	Rp. 7000	Rp. 25.000	Rp. 18.000	✓
4	1500 ml	Rp. 7000	Rp. 18.000	Rp. 11.000	✓

5	1500 ml	Rp. 7000	Rp. 11.000	Rp. 4.000	✓

In Table 5. it can be seen in 5 trials of 1500 ml water payments using a price of Rp. 7000, the results obtained for the initial and final balances have the appropriate change difference.

3.3 Payment Testing in Failed Conditions

Fig.6. Failed Payment

Figure 6 shows the failure of payment, this is due to the lack of E-Card attachment to the Reader. When attaching the E-Card it takes 3 seconds for successful payment. Because the Arduino IDE program coding is set for 3 seconds.

3.4 Failure When the Balance Amount is Less

Fig.7. Underbalance

Figure 7 shows the failure of payment. This is because the nominal balance is less, the nominal selling price is greater than the nominal balance.

4. Conclusion

Based on the results of this research, there are four important conclusions. First, the E-Card reading distance test to the E-Card reader is only able to read at a maximum distance of 3.5 cm. If the distance exceeds 3.5 cm, the reader cannot detect the card. Second, if the E-Card reading distance test is given a paper and plastic barrier the results have no effect and the results are the same as testing cards without barriers. Unlike the aluminum plate barrier, the E-Card reader cannot read the E-Card at all. This is due to the lack of flux from the magnetic field, which results in the E-Card sensor not being able to work because the electromagnetic waves emitted by the E-Card reader are disturbed by the aluminum plate barrier. Third, the payment of refillable water using this E-Card has been as expected, as during the payment process it is in accordance with the predetermined price, and the balance reduction is always the same as the selling price. Fourth, when the customer makes a payment by attaching the E-Card it takes 3 seconds, if the time the customer attaches the E-Card is less than 3 seconds then the payment will fail. Because the Arduino IDE program coding is set at 3 seconds. Related suggestions for further research, developing payment tools that use coins.

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