

## Design an Arduino-based rice ATM machine system using RFID and ultrasonic sensors

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### ABSTRACT

A system has been developed for an Arduino-based rice ATM machine that utilises RFID and ultrasonic sensors. The system employs a quantitative research strategy and is designed to automatically distribute rice to the public. This device utilises the Arduino Uno microcontroller as its primary controller. The sensors employed for detection of rice quantity in the rice ATM machine are Ultrasonic Sensors. The activation card reader utilised to dispense rice is an radio frequency identification (RFID) reader. The output components responsible for the operation of the rice ATM machine are a Servo Motor, a 2X16 LCD, and a Buzzer. The study yielded satisfactory results as each component tested and utilised in the rice ATM machines successfully executed the controller programme commanded by Arduino. This programme effectively dispensed rice in the desired quantity, detected unauthorised cards, and accurately determined rice balances. Furthermore, the application of these components proved to be straightforward and uncomplicated. In public, this can be demonstrated through testing conducted on individual components or machines. RFID technology is used to read the frequency from the RFID card, while ultrasonic sensors detect the quantity of rice and generate a code using a buzzer. Additionally, an LCD display provides comprehensive information about the rice ATM's status, which users can easily comprehend. The mechanical system of the servo motor enables the movement of the exit door for rice weighing over 15 kg.

**Keywords:** Arduino Uno; distribution; radio frequency identification; rice ATM

Received 24-08-2023 | Revised 29-11-2023 | Accepted 21-05-2024 | Published 19-07-2024

### INTRODUCTION

The Indonesian government has implemented many social policies to meet the needs of low-income people to meet the main needs of the poor, one of which is the Raskin rice social assistance which is intended for underprivileged or poor people, although many are also unable to meet the main needs of the poor [1]. Irresponsible individuals always take advantage of loopholes by taking advantage of a distribution system that is not always monitored, so that the amount and timing of Raskin rice distribution can be corrupted and no longer useful for the recipients [2].

One of them is the case in Garut where the former village head in Garut misappropriated social assistance funds in the form of Raskin rice for three consecutive years, namely from 2014 to 2016 by not distributing Raskin rice to

distribution points [3,4]. Based on the problems above, the author found one way to minimize the opportunity for fraud in the distribution of Raskin rice which could be exploited by irresponsible individuals for personal gain, namely by using Arduino. Based on the problems above, the author wants to conduct research and develop a tool in the form of a rice automated teller machine (ATM) with the title "Design of an Arduino-based rice ATM machine system using RFID and ultrasonic sensors". This final project aims to maximize the distribution system to the community by minimizing the weaknesses of previous research and conducting research on making automatic rice ATMs to maximize the process of distributing Raskin rice social resources to aid recipients, in this case, the community, so that it becomes more useful. This research aims to design an Arduino-based rice ATM system

using RFID and ultrasonic sensors and to determine the performance of an Arduino-based rice ATM using RFID and ultrasonic sensors.

## LITERATURE REVIEW

ATM is an electronic machine that allows bank customers to withdraw money and check their savings accounts without needing to be served by a human "teller". Many ATMs also allow depositing money or checking amounts, transferring money, or even buying stamps. Initially, ATM technology was used to assist customers in making cash withdrawals where there were no bank branches [5].

An ATM requires a card as an intermediary between humans and machines. A card has a line called a magnetic chip. The magnetic chip functions as a sensor to detect the owner's identity. The magnetic chip is very sensitive to various situations, for example, if the magnetic chip is rubbed against an object then the magnetic chip has lost its function. because if there is friction on the magnetic chip, the ATM cannot detect the ATM card owned by a customer [6].

In 1939 Simjian patented an early ATM prototype which later proved less successful [7]. Some argue that a Scotsman named James Goodfellow was the earliest patent holder (1966) for a modern ATM and John D White (from Docutel) in the United States is also often referred to as the inventor of the first free-standing ATM design [8]. In 1967, John Shepherd-Barron invented and installed an ATM at Barclays Bank in London [9]. A year later (1968), Don Wetzel invented the American-made ATM [10]. ATMs only became an important part of banking starting in the 1980s [11,12].

Rice is a basic need for Indonesians. According to the big Indonesian dictionary (KBBI), the meaning of the word rice is rice whose skin has been removed (which becomes rice after being cooked) [13]. Another meaning of rice is grain as explained in the Qur'an, Surah Al-An'am, Verse 95. Allah Subhanahu Wa Ta'ala says, which means "Indeed, Allah is the

one who grows grain (rice) and seeds (dates). He brings out the living from the dead and brings out the dead from the living. That is Allah's (power), so why do you still turn away?" [14].

Based on the explanation above, it can be concluded that rice is a class of grains (rice grains) that God grows on the face of the earth as a source of life for mankind and as a source of life, the distribution of rice should be something more useful, based on the big language dictionary Indonesia (KBBI) ATM is an automated teller machine for dispensing cash using techniques such as using a card that has a chip [15]. From the 2 explanations above, it can be concluded that a rice ATM is an automated teller machine that is used to withdraw rice grains which are one of the sources of life or an electronic machine that allows ATM cardholders to withdraw their rice without needing to be served by a human and is automatic.

The following is an example of research on rice ATMs that was previously carried out, the first is research entitled "Automatic Raskin collection machine using RFID based on an Arduino microcontroller" [16]. amounting to 1 kg and does not have a monitoring system for the amount of rice filled in the tank, which is contrary to the author's goal of making it easier to distribute rice because it will complicate the distribution process and is ineffective. Next is the final assignment entitled "Implementation of a rice ATM design using Arduino Uno R3 DIP ATMEGA328P and PLC Siemens S7-300" [17] in this tool the weakness is the use of a program logic controller (PLC) because it has a high sensitivity to environmental conditions, especially hot temperatures because it can damage the tool itself and then What is also a weakness is that the rice ATM must be placed in an open place to reduce pressure when applying it to many rice ATM users, in this case the public, the next weakness is the monitoring system for the amount of rice in the rice storage tank which this tool does not have ATM, then the final project entitled "Rice ATM with RFID activation system" [18] this research aims to

maximize distribution to remote areas such as rural areas. This research has weaknesses in real time relies on signals and is not equipped with media in the form of an LCD as a provider of information. words and numbers to become one-way information between the user and the machine.

## **RESEARCH METHODS**

### **Research Time**

This research is planned for January 1 – January 15, 2023.

### **Research Place**

This research was conducted in the lecture building of the Faculty of Science and Technology, North Sumatra State Islamic University, Medan, Jl. Golf Course No.120, Kp. Tengah, Pancur Batu District, Kab. Deli Serdang, North Sumatra.

### **Research Tools**

The tools used in this research are as follows:

1. Arduino Uno as a clipboard chip to control the work of the design system.
2. The Ultrasonic Sensor functions to detect the amount of rice in the rice atm.
3. Servo motor as a torque that opens and closes the rice exit door.
4. RFID reader as an RFID tag reader to open the rice exit door on the rice ATM machine.
5. RFID tag provides a command code to the RFID reader to open the rice ATM door.
6. The 2X16 LCD functions as a display to display the situation inside the rice storage tube.
7. The relay functions as a controller connecting the system circuit.
8. Electric soldering is used to bond components with tin.
9. PCB functions as a place for designing components.
10. Stepdown functions to reduce voltage.

11. Jumper cables function to connect several components.

## **Materials Used in Research**

The materials used in the research were rice, which served as a test material for the working of rice ATMs

## **Complete Range of Tools**

This chapter will present an explanation of the complete series of tools. The complete series of tools aims to simulate the component design process using a project board using designed software before assembling and placing components on the tool with a mechanical design in its original version.

## **RESULTS AND DISCUSSION**

In this chapter, the results of tool testing will be discussed, and a discussion on how the tool system that was created works and data will be collected on the rice ATM with the title "Design and Build an Arduino-Based Rice ATM System Using RFID and Ultrasonic Sensors" which aims to find out how the whole tool works. and the performance of each component of the tool so that it can produce valid data and the tool can work according to its function and purpose.

### **Research Result**

In the research results, it was found that by testing and calibrating each component and sensor used as well as testing the tool as a whole by looking at the performance of each tool, the output results and discussion will be written into data that can be seen in the form of a test table which has been carried out several times on each component and the machine as a whole, the rice ATM is a system that works as an automatic system for taking rice with the name of the machine "Arduino-based rice ATM machine system design using RFID and ultrasonic sensors", this machine uses hardware

consisting of Arduino as a microcontroller board, RFID as a card detection sensor, Ultrasonic Sensor as a distance sensor that measures the height of the rice, Servo Motor as the torque that moves the rice exit door, LCD plays the role of providing exit signals and uses command application software using the C programming language which can be sent to the Arduino board and stored on the microcontroller. The appearance of the rice ATM can be seen in Figure 1.

Testing of the machine as a whole was carried out five times using three different types of RFID cards with the desired amount of rice of 1 kg and 0.5 kg. The experimental data for the rice ATM can be seen in Table 1.



**Figure 1.** Rice ATM.

**Table 1.** Rice ATM experimental data.

Test	Card series	Rice out (kg)	Rice exact (kg)	RFID initialization
1	42 AC 80 2D	0.25	0.5	Accepted
2	52 34 44 2D	0.5	0.5	Accepted
3	B4 59 16 22	0.6	1	Accepted
4	42 D6 17 2D	1.1	1	Accepted
5	42 B1 5D 2D	2.2	2	Accepted

### Testing All Component Functions

In this sub-chapter, testing will be carried out on all components and discussions will be held to determine the performance of each sensor and other components to be used as a source for collecting research data with thorough and gradual implementation. Before testing the tool as a whole, a more complex test is needed to determine the number of errors or damage values in the rice ATM by testing each component of the tool first before placing it on the mechanical part. Meanwhile, each data taken will be presented in the form of a table containing information. is quantitative and is explained physically for each percentage error that each component has with the following formula:

$$Error = \frac{V_{Experimental} - V_{Exact}}{V_{Exact}} \times 100\% \quad (1)$$

### CONCLUSION

Based on the results of trials that have been carried out on sensor characterization and linearity along with machine performance tests, it was concluded that the Arduino-based rice ATM system design using RFID and ultrasonic sensors was designed by starting with testing the characteristics and linearity of the sensors. When the sensor and output work according to commands and the results are optimal with an error percentage below 10%, coding of the entire circuit is then carried out using the Arduino IDE application. If the electrical, programming, and mechanics are complete, the Rice ATM is ready to be tested. The performance of the Arduino-based Rice ATM Machine using RFID and an Ultrasonic Sensor can work according to program commands and all components run when the RFID TAG is attached, the servo motor moves according to the data read by the RFID reader, the buzzer

sounds when the ultrasonic sensor reads the amount of rice that exceeds the limit normal in the sense that the amount of rice is low and the LCDs information that can be read by Rice ATM users.

## REFERENCES

1. Ketmoen, A. (2022). Implementation of the poor rice program in an effort to support and improve community food security (case study in Air Mata Village, Kota Lama District, Kupang City). *Jurnal REP (Riset Ekonomi Pembangunan)*, **7**(2), 271–294.
2. Alcadipani, R. & de Oliveira Medeiros, C. R. (2020). When corporations cause harm: A critical view of corporate social irresponsibility and corporate crimes. *Journal of Business Ethics*, **167**(2), 285–297.
3. Aspiranti, T., Amaliah, I. & Shahrudin, A. (2023). Poverty Alleviation Pattern: Top Down or Bottom Up Approach? (Indonesia and Malaysia Benchmarking). *KnE Social Sciences*, 354–368.
4. Basuki, A. T. & Nengsih, W. (2024). Analysis of factors affecting poverty in districts and cities in West Java. *ProBisnis: Jurnal Manajemen*, **15**(2), 74–84.
5. Indrayani, C. W., Aritra, S. & Muda, I. (2019). Customer satisfaction as intervening between use automatic teller machine (ATM), internet banking and quality of loyalty (Case in Indonesia). *International Journal of Financial Research*, **10**(6), 54–66.
6. Osakwe Charity, I. & Akunna Racheal, C. (2023). Assessing bank customers perception and ease of using automated teller machines in Awka Metropolis. *International Journal of Trend in Scientific Research and Development*, **7**(1), 332–338.
7. Chandrasekaran, S. & Narayanan, S. M. (2019). Perception of digital payment in professionals. *Emerging Trends in Banking, Insurance and International Trade*, 106–109.
8. Gibbs, E. (2024). Foreign direct investment policy, multinationals, and subsidiary entrepreneurship success and failure in post-war Scotland. *Business History*, **66**(4), 927–949.
9. Gupta, R. (2022). A Study on Growth and Usage of ATM/POS in India: Pre and Post Covid19. *Journal of Positive School Psychology*, 11872–11881.
10. Sri, M. S., Chaithanya, J. K. & Dhruthiee, N. (2022). Design and implementation of smart atm under idle application. *2022 7th International Conference on Communication and Electronics Systems (ICCES)*, 1410–1417.
11. Singh, R. K. H., Radzi, W. N. W. M., Isa, E. V. M. & Saraih, U. N. (2020). An investigation of customer satisfaction towards the service quality of ATM machine. *Journal of Social Science and Humanities*, **3**(5), 35–39.
12. Maixé-Altés, J. C. (2019). The digitalization of banking: A new perspective from the European savings banks industry before the Internet. *Enterprise & Society*, **20**(1), 159–198.
13. Juliana, S. (2024). Analysis of language mistakes in description text works of BIPA Students. *Talenta Conference Series: Local Wisdom, Social, and Arts (LWSA)*, **7**(2), 184–189.
14. Zaini, N. S. M. & Mohd, R. A. (2022). The concept of plant-based food in Verse 99 of Surah Al-An‘Am: A thematic study of Tafṣīr Mafātīhul Ghayb. *Ma‘ālim al-Qur‘ān wa al-Sunnah*, **18**(2), 176–190.
15. Sari, F. K., Fadly, Y. & Ramadhan, P. R. (2022). The effect of changes in the value of conventional interbank transfers and digital banks in technological development. *Britain International of Humanities and Social Sciences (BIOHS) Journal*, **4**(2), 246–257.
16. Billah, M. M., Nugroho, A. B. & Auliq, M. A. (2018). *Mesin otomatis pengambilan raskin menggunakan RFID berbasis*

- mikrokontroler arduino*. Undergraduate Thesis, Universitas Muhammadiyah Jember.
17. Nasution, T. H. (2019). *Implementasi Rancangan ATM beras menggunakan Arduino uno R3 DIP AT Mega 328P dan PLC Siemens S7-300*. Undergraduate Thesis, Universitas Muhammadiyah Sumatera Utara.
18. Mallawakkang, M. N. (2020). *ATM beras dengan sistem aktifasi RFID*. Doctoral dissertation, Universitas Hasanuddin.



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