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Smart Charity Box with ESP32 and Chatbot

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ABSTRACT

The purpose of this project is to: (1) Create a security system tool on the door of the charity box at the Al Huda Mosque, Sirau Village, Kemranjen, Banyumas using the ESP32 microcontroller. (2) Know the function of all components used such as the ESP32 microcontroller, RFID, servo motor and ultrasonic sensor. (3) Know the performance test of Telegram to control the smart charity box project. Based on the design results, it shows that: (1) Produce a smart charity box tool using ESP32 components, ultrasonic sensors, RFID and servo motors as door drivers. The features it has can detect the remaining height of the charity box space and access the door via the RFID module or Telegram bot. (2) The results of functional tests on each component, both hardware such as ESP32, RFID, ultrasonic sensors, servo motors or software, can work well. (3) The results of the performance test show that this project can detect the remaining height of the space in the charity box and open the door by tapping the RFID card or accessing the Telegram bot.

Tujuan dari proyek ini adalah untuk: (1) Membuat alat sistem keamanan pada pintu kotak amal Masjid Al Huda Desa Sirau Kemranjen Banyumas dengan menggunakan mikrokontroler ESP32. (2) Mengetahui fungsi seluruh komponen yang digunakan seperti mikrokontroler ESP32, RFID, motor servo dan sensor ultrasonik. (3) Mengetahui uji kinerja Telegram untuk mengontrol proyek kotak amal pintar. Berdasarkan hasil perancangan menunjukkan bahwa: (1) Menghasilkan alat kotak amal pintar dengan menggunakan komponen ESP32, sensor ultrasonik, RFID dan motor servo sebagai penggerak pintu. Fitur yang dimilikinya dapat mendeteksi sisa ketinggian ruang kotak amal dan mengakses pintunya melalui modul RFID atau bot Telegram. (2) Hasil uji fungsional pada setiap komponen baik hardware seperti ESP32, RFID, sensor ultrasonik, motor servo maupun software dapat bekerja dengan baik. (3) Hasil uji kinerja menunjukkan bahwa proyek ini dapat mendeteksi sisa ketinggian ruang di kotak amal dan membuka pintunya dengan mengetuk kartu RFID atau mengakses bot Telegram.

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1. Introduction

Technology according to KBBI has the meaning of one of the scientific methods to achieve concise or practical goals, technology is also one of the applied knowledge. Technology cannot be separated from life because it has become an important part. Humans have known and used technology since hundreds of centuries ago, starting from symbols or signals. The development and growth of science and technology can be seen since the beginning of the emergence of humans [1]. Since that time, humans have had knowledge related to the situation and conditions of the surrounding nature. In addition, humans at that time have also created several technologies that can be used as answers to problems that can be accepted at that time.

The development of technology today is increasingly rapid, requiring humans not only to use technology, but also to have the ability to improve their skills in making innovative tools to facilitate daily activities. Technology is developing very rapidly starting from the fields of education, security, economics, communication and so on. Currently, digital technology has shifted from using human power to a computerized system that can be read by computers. The development of this technology is increasingly advanced, driven by the ability of humans to innovate and be creative.

One thing that is no less important than the development of technology itself is the security system. Security systems are a form of prevention from criminal acts or threats in the surrounding environment. In everyday life such as worship or charity, security systems are also no less important, especially for charity boxes in mosques. Mosques are places of worship for Muslims or places of prayer for Muslims, mosques are not only used as places of prayer but also as places to carry out all activities that contain spirituality or obedience to Allah SWT.

"Design and Construction of Charity Box Security with Fingerprint Access Using ESP32-Cam and IoT-Based Telegram". In this study, two controllers were used, the first main controller used as a data processor for the design, namely using Arduino UNO and the second using ESP32-cam as a receiver that will send notifications to telegrams in the form of photos or sentences explaining that the image from ESP32-cam has been sent. In addition, this study also uses two input sensors, namely fingerprints by attaching the registered fingerprint which will give a command to the solenoid to open and vice versa. The Limit Switch Sensor is used as a detector when the charity box door is opened by force, the buzzer will sound [2].

"Design and Construction of a Security System for a Punia Fund Box Based on a NodeMCU ESP32 Microcontroller and Telegram Application". In this study, the main controller used is the NodeMCU ESP32. Then the telegram application as monitoring to send notifications. This study also utilizes a magnetic sensor that can send notifications in the form of theft and a fingerprint sensor as access to open the punia fund box. The conclusion of this study is that the project can work well which is indicated by the functioning of all components used [3].

"Cash Charity Box Security System with Integrated Telegram Based on ESP32 Microcontroller". In this study, the design begins by using the block diagram method, selecting specifications or functions that are in accordance with the block diagram, designing flowcharts, installing hardware or circuits and programming the system. The main controller used in this study is using ESP32 as a data processor from sensors that can be connected to Wi-Fi and Arduino Nano controller for MP3 modules. This study uses a SW-420 vibration sensor to detect vibrations, a KY-036 sensor to detect metal and RFID as access to open and close the door lock [4].

"Door Security System with Android Using NodeMCU". In this study, the main components used are ESP8266 and solenoid door lock which are able to send notification messages as well as reply messages to telegrams to open or close the solenoid. The results of the experiments carried out were by opening and closing the door lock 7 times with an average delay time needed when giving the command to the device to open, namely 1.72 seconds and 1.68 seconds to close the door [5].

In general, the causes of theft include, among others, the opportunity to easily take valuables without being detected, the lack of security in places that are loopholes for theft, items that are easily stolen are valuables such as money, jewelry, electronics and other valuables, poverty felt by thieves so that thoughts arise to steal, environmental problems that are less safe or have minimal lighting,

then the opportunity to commit crimes without significant consequences, meaning that the punishment for theft is not comparable to the stolen goods obtained. The author will create a security system based on the above problems in the form of a smart lock with ESP32, door access with RFID which can later only be opened or closed by mosque officers who have RFID cards that have been listed in the program. Then the author also adds a component in the form of an ultrasonic sensor that functions as a detector of the height or fullness of the money in the charity box and can later be sent via the Telegram API according to the program that has been created.

2. Problem Solving Approach

2.1 Smart Lock

Smart lock is a door lock security system that can be controlled with a mobile device, application or voice command [6]. One way to operate a smart lock is by using RFID or Radio Frequency Identification which is connected to the internet and some are not connected. The main function of a smart lock is to increase security compared to conventional locks, one of which is because the smart lock has the ability to record traces of entry and exit access where the owner is able to track who and when accessing the smart lock. In this study, the author created a smart lock project on a charity box that can be connected to the internet which can be seen as a notification with the telegram application. How the project works is that mosque officers who manage the charity box can access it by sending a message to the Telegram bot that has been created. In the Telegram bot there is an option "/ open" as a servo drive access connected to the door latch and "/ status" as monitoring to find out the height of the money in the charity box.

2.2 *ChatBot* Telegram

Telegram is a cloud-based application that is often used to send and receive messages, videos, share photos, voice and data [7]. The way to access the Telegram application is to have a data package or internet network. One of the telegram features that can be connected to the ESP32 microcontroller is the Telegram chatbot or Telegram bot, which is an account controlled by a virtual chat robot to answer questions from its users [8]. The answer to the command provides information or can execute a command from its user according to the command in the telegram. The benefits of this Telegram chatbot are to provide responses in a short time, can save costs, complete features and so on.

3. Tool Design

The process of making the project "Design and Construction of Smart Charity Boxes at Al Huda Mosque, Sirau Village, Kemranjen, Banyumas" consists of several stages, namely needs analysis, tool design, tool making, tool testing. The following is a flow diagram of the project making process:

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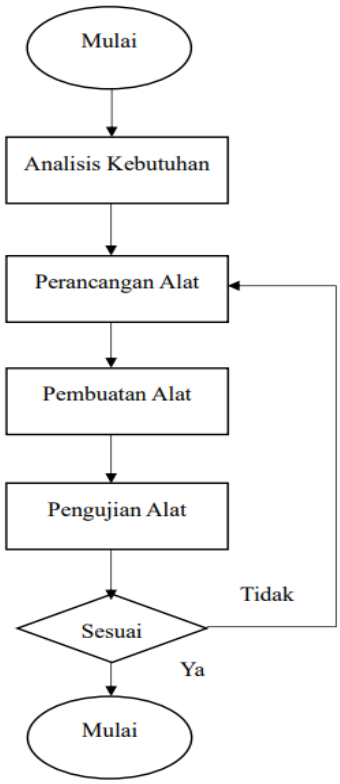

Fig. 1. Research Flow Chart

Needs analysis is the initial stage of research that aims to find out what needs will be needed before making a smart charity box design project at Al Huda Mosque, Sirau Village, Kemranjen, Banyumas. This analysis is carried out by conducting field observations and literature studies. Field observations are steps taken by observing what can be developed into a project and the title of the Final Project, while literature studies aim to find out what needs are needed to overcome problems found from the results of field observations.

3.1 System Flowchart

The image below is a working design of the system on the smart charity box. Access is used to open the charity box by tapping the RFID card or by sending the command "/open" to the Telegram bot that has been created.

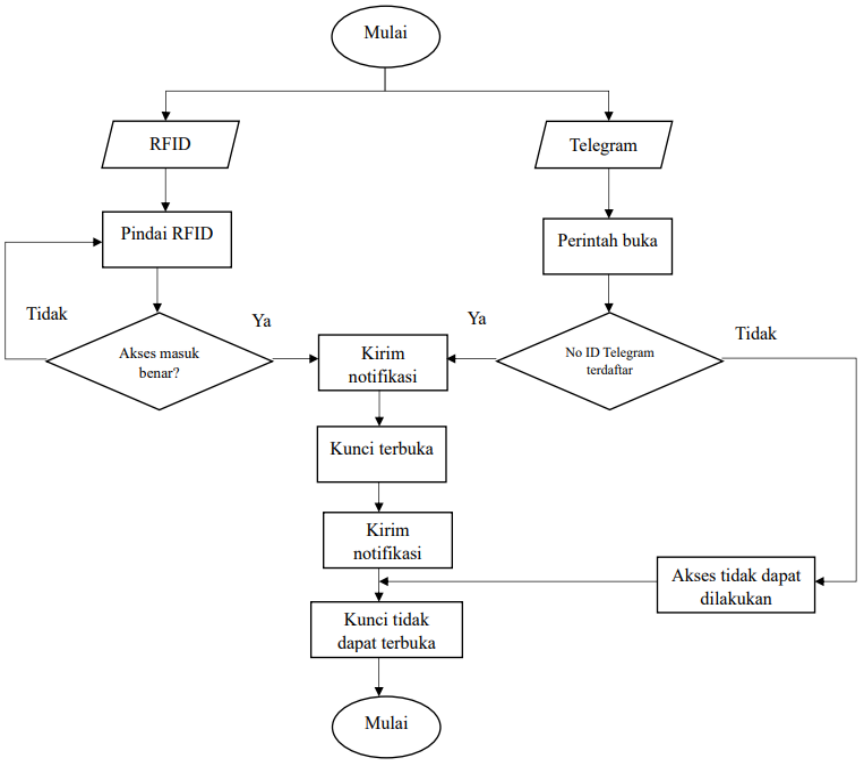

Fig. 2. RFID System Design

Ultrasonic sensors are used as detectors of the height of money in the charity box by sending a notification "/status" via the Telegram application. The flowchart design is made based on the placement of the components and software needed.

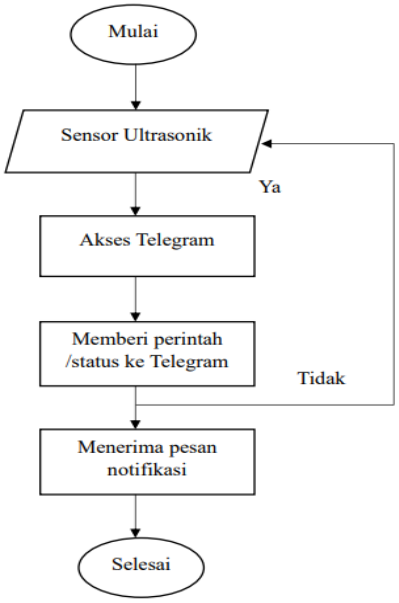

Fig. 3. Ultrasonic Sensor System Design

3.2 Hardware Design

Hardware design is divided into two, namely making electrical designs to design electrical wiring diagrams and making mechanical designs to design the physical form of the tools and

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mechanical components made. The following are the results of making hardware designs:

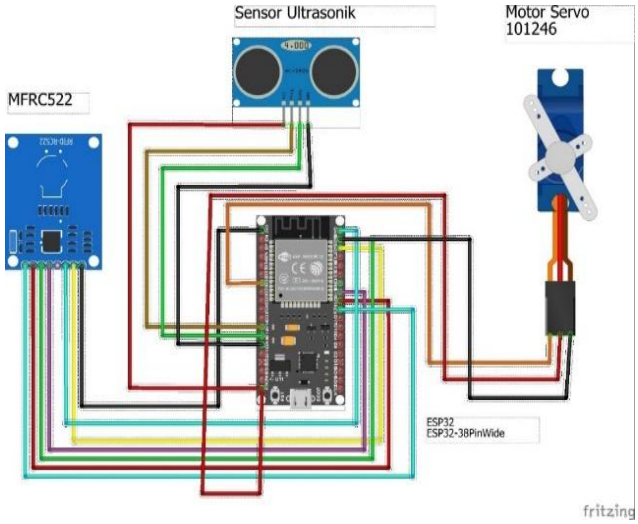

Fig. 4. *Wiring* Diagram

The image above is a wiring as a regulator of the design of use on each pin in components such as ESP32, RFID, Servo Motor and Ultrasonic Sensor. In addition to the wiring components, a charity box is also needed to store money and components used. The following is a design for a smart charity box project circuit.

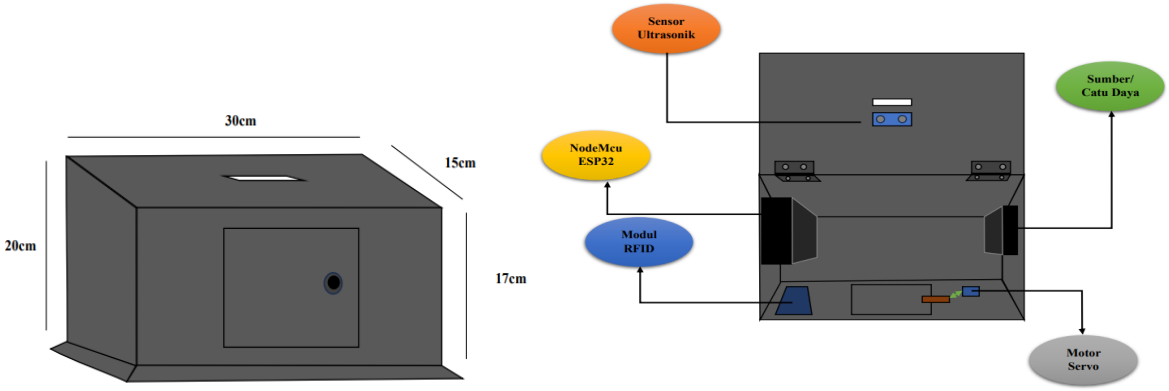

Fig. 5. Smart Charity Box

3.3 Software Design

The next stage is the creation of design and software design which aims to find out the process of creating a program from the smart charity box project. The creation of this program uses Arduino IDE software, the program contains to command ESP32 as a controller or controller of all components needed. The function of the components used is RFID to access the door lock using a registered RFID card or Telegram bot, then the servo motor as a door latch driver by accessing RFID first and an ultrasonic sensor as a detector of remaining space in the charity box. In addition to using Arduino IDE software, the Telegram application is also needed to send and receive message notifications, the following is a display of the Arduino IDE software and Telegram application.

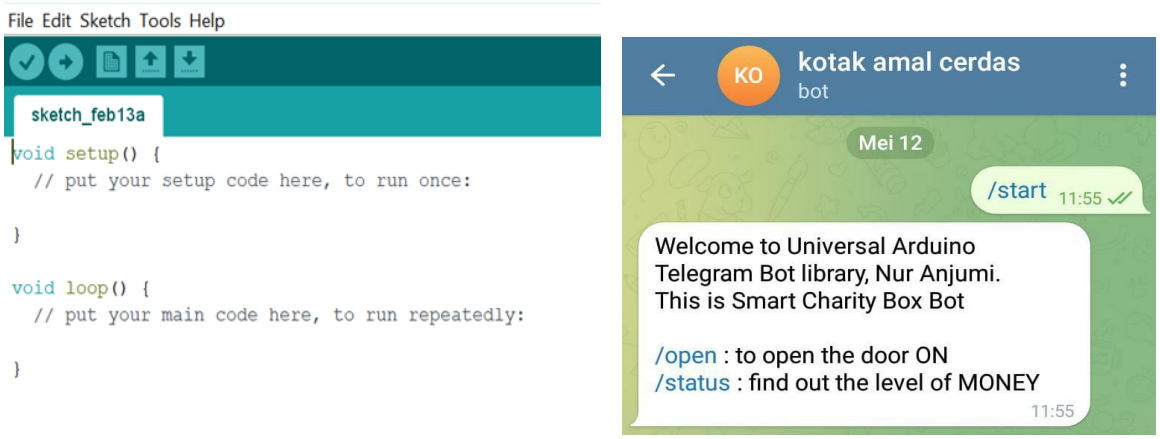

Fig. 6. View of Arduino IDE and Telegram Bot @smart charity box

4. Result and Discussion

4.1 System Hardware Creation Results

The results of making hardware consist of making electrical systems and mechanical systems. The electrical system is assembling all the tools and materials starting from installing cables to components to ESP32 properly and correctly according to the wiring diagram path that has been made and placed in a box-shaped box. The following is the result of the design of the smart charity box that has been made.

Fig. 7. Smart Charity Box

4.2 Results of System Software Creation

The creation of system software consists of two parts, namely creating a program using the Arduino IDE software and creating a display on the Telegram application. The following are the results of creating a program in the Arduino IDE software. The creation of the ESP32 program was done using the Arduino IDE software. The function of the ESP32 is as a controller for each component in this project so that it runs according to the function we want. ESP32 also has a feature in the form of Wi-Fi as a data sender so that it can read sensors to the IoT platform.

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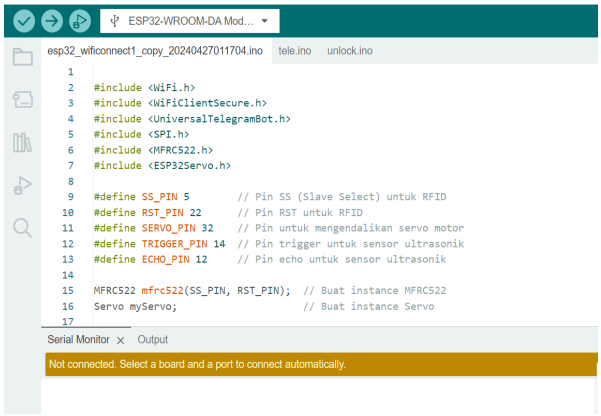

Fig. 8. Arduino IDE Programs

Telegram chatbot or commonly called Telegram bot is an account controlled by a virtual chat robot to answer questions from its users [8]. The answer to the command provides information or can execute a command from its user according to the command in the telegram. The benefits of this Telegram chatbot are to provide a response in a short time, can save costs, complete features and so on.

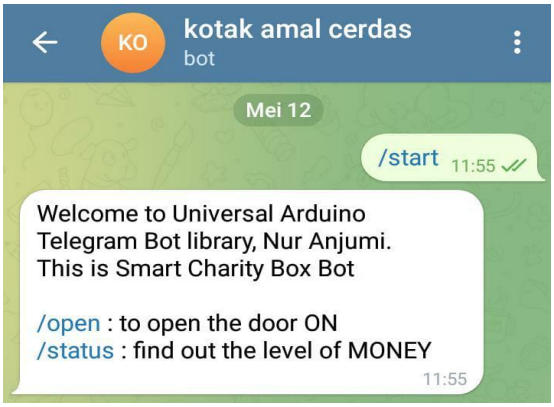

Fig. 9. Smart @charitybox Bot View

4.3 Performance Test Results

Project testing is the final stage in the creation of a smart charity box design tool at the Al Huda Mosque, Sirau Village, Kemranjen, Banyumas. At this stage, the Telegram chatbot is named @smart charity box, for testing the chatbot, it begins by giving a command in the form of "/start", the command "/open" to unlock the charity box and the command "/status" to find out the remaining height of the charity box space. The results of these commands can be seen in the table below, in addition to using the Telegram bot to access the door lock, the smart charity box can be accessed by tapping the RFID card whose UID has been registered in the program that has been created.

Table 1. Smart Charity Box Performance Test Results

No	Order	Trial Steps	Telegram View	Trial Results	Time Required
1.	"/start"	Type the command "/start" on Telegram. (@smart charity box)	A description is displayed that describes the name of the project created.	The menu can be displayed and can be used properly.	The time required to access this is 5 seconds according to the signal strength on the

		Then a menu such as "/open" and "/status" is also displayed.		cellphone and ESP32 with the XL AXIATA provider
2. "/open"	Type or click the "/open" command on Telegram. (@smart charity box)	Displays information that the door is open.	Information description can be displayed properly.	The time required to access this is 5 seconds according to the signal strength on the cellphone and ESP32 with the XL AXIATA provider
3. "/status"	Type or click the "/status" command on Telegram. (@smart charity box)	Displays information about the remaining height of the space in the charity box.	Information description can be displayed properly.	The time required to access this is 5 seconds according to the signal strength on the cellphone and ESP32 with the XL AXIATA provider
4. Tag RFID	Tapping the RFID module using RFID tags that have been registered in the program and those that have not been registered	Tapping notifications will appear on the Telegram bot (@smart charity box).	Notifications can be displayed properly on the Telegram bot (@kotak amal cerdas). The RFID tag that has been registered in the Arduino IDE program on this bot will provide a notification in the form of (Door Open!), then a trial using an unregistered RFID tag will display information in the form of (Access Failed/Denied!)	The time required to access this is 5 seconds according to the signal strength on the cellphone and ESP32 with the XL AXIATA provider

The table above is data from the trial project that has been created, the results of which are all components and notifications on the Telegram bot can function properly. This point will be explained regarding the discussion of how it works, access and trial images. How it works is the same as a smart lock in general, namely access to open and close without using a conventional door key. The author created this tool with Telegram API access and RFID tags, here are the steps:

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1. Enable Wi-Fi on your smartphone to connect the network to ESP32, after connecting to the network open the Telegram API (bot @kotak amal cerdas) then type "/start" to start. The image below is the initial display when giving the command "/start" to the kotak amal cerdas bot.

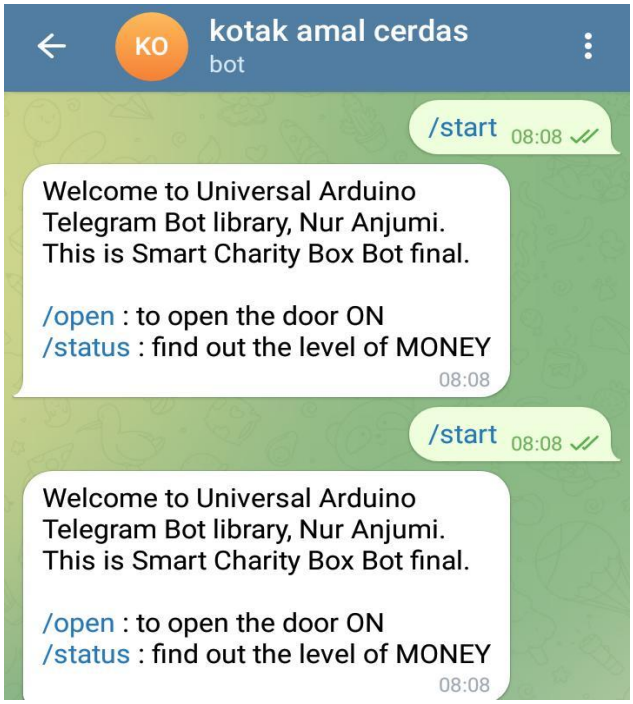

Fig. 10. Initial View "/start"

2. Next, to unlock it can be done in two ways, namely by accessing the Telegram API and RFID tags. Telegram bot @kotak amal cerdas type or select the option "/open" to be able to open the door latch. When it is open, Telegram will provide a notification in the form of an information message that the door has been opened such as "Door Open!". Then the RFID tag is used as tapping by bringing the RFID tag close to the RFID module. This experiment was carried out using two RFID tags that have been registered and unregistered in the Arduino IDE program, the following are the results of the trial.

Fig. 11. "/open" Command View

Figure 12 below is the result of the serial monitor by tapping an RFID card that is not registered in the Arduino IDE program with the UID tag 4E 7E 3E 7A.

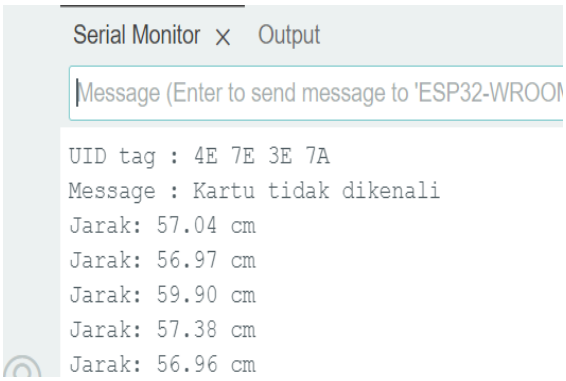

Fig. 12. RFID Card View Rejected

Figure 13 below is the result of the serial monitor by tapping the RFID card registered in the Arduino IDE program with the UID tag 53 87 21 AC.

Fig. 13. Tapping Registered RFID Card

Figure 14 below is a display of the smart charity box Telegram bot when trying to open the door with an incorrect RFID card or one that is not registered in the Arduino IDE program.

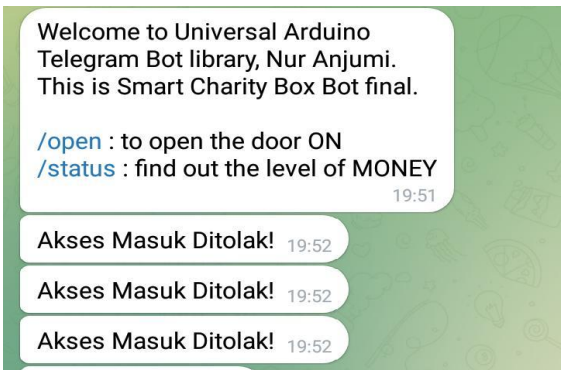

Fig. 14. Tapping Unregistered RFID Card

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3. The experiment to find out the remaining height of the money space in the charity box was carried out by accessing the Telegram bot @smart charity box. Type or select the option "/status", if the ultrasonic sensor has been installed and detected the bot will send a notification in the form of an information message regarding the remaining height of the money space in the charity box. For example, the information message is "Remaining space in the charity box: 14.85cm", the following are the results of the notification test on the Telegram bot and the Arduino IDE serial monitor.

Fig. 15. "/status" Command View

Figure 16 below is the result of measuring the distance on the serial monitor which was measured using an ultrasonic sensor component.

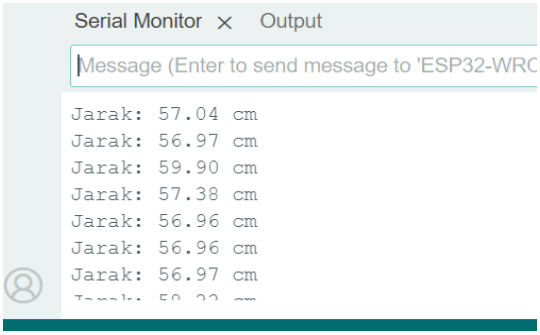

Fig. 16. Distance Display On Serial Monitor

5. Conclusion

The final project entitled "Design and Construction of Smart Charity Boxes at Al Huda Mosque, Sirau Village, Kemranjen, Banyumas" uses an ESP32 controller, RFID as door opening access, then an ultrasonic sensor as a detector of the remaining height of the space in the charity box and a servo motor as a door latch driver to open the charity box. The features of this project are that it can detect the remaining height of the space in the charity box and access the door via an RFID module or Telegram bot. Functional tests of each component that have been carried out such as ESP32, ultrasonic sensors, servo motors and RFID can function and work well. The test results are that ESP32, RFID, servo motors are in good condition and the ultrasonic sensor has an error of between 1.3% - 3.8%. The results of the tool performance test are: (1) Can detect the remaining height of the space in the charity box with a maximum height of the box made of 15cm. (2) Can access the charity box door by tapping the RFID card. (3) Can access the charity box door by giving the command "/open" to the Telegram bot. (4) It takes 5 seconds to be able to send or receive notifications on the Telegram bot.

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