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Prototype Manufacture of the Arjuno Autobost Covid-19 Robot

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Abstract

Purpose: The study presents the design and development of the Arjuno Autobost, a temperature-detecting robot created to aid in the prevention of COVID-19 spread by assisting in health screening and sanitation tasks. This robot was developed to automate processes that were traditionally carried out by multiple people, thus reducing the workload of human workers while ensuring safety protocols are maintained in public spaces.
Research Methodology: The Arjuno Autobost robot was developed using an Arduino-based system, which includes components like a temperature sensor, hand sanitizer dispenser, and an audible alarm. The design focuses on ensuring the robot can automatically detect temperatures and administer hand sanitizer. The development process was conducted over several months, despite challenges posed by large-scale restrictions.
Results: The robot successfully detects the temperature of individuals and alerts them with a sound if the temperature exceeds 37.8°C. If the temperature is within normal limits, the robot proceeds to dispense hand sanitizer. This automated system significantly reduces human effort and increases efficiency in public health management.
Conclusions: The Arjuno Autobost robot demonstrates a practical and effective solution for enhancing public health safety, particularly during pandemics. It combines technology and automation to streamline the process of temperature checking and sanitization. The robot not only mitigates human error but also supports the reduction of infection transmission.
Limitations: The study faced challenges due to the large-scale restrictions caused by the COVID-19 pandemic, which impacted the production and testing process. Future improvements can include better integration of AI for more accurate detection and interaction capabilities, along with a broader range of health checks.
Contributions: This research contributes to the development of a new class of autonomous robots designed for public health applications. The findings offer valuable insights into the integration of robotics with public health efforts, presenting a replicable model for other regions dealing with similar health crises.

Keywords: *Arjuno Autobost, Prototype, Robot*

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1. Introduction

The entire world has recently been facing a major challenge in the form of the coronavirus outbreak or Covid-19. The virus originated in Wuhan, China, resulting in numerous fatalities. Likewise, in Indonesia, the number of positive Covid-19 cases is increasing significantly daily, surpassing 100 people, and the death toll from the virus has exceeded 100. Indonesia has become the country with the highest number of deaths from Covid-19 in Southeast Asia. Furthermore, the country's economy has plummeted, with the rupiah weakening to Rp. 16,500 per person, exceeding the level during the reform era in (Alsamhi & Lee, 2020).

This is what prompted us, the young generation of this nation and state, to participate in handling the Covid-19 virus by creating a new technology, the Arjuno-Autobost (Covid-19 Virus Prevention Education Robot). This robot is designed with an Arduino system that detects each person entering its premises. The robot's working mechanism will detect the person's temperature, then, once. If it is safe, in the second stage, the robot sprays hand sanitizer on the person (Aymerich-Franch & Ferrer, 2021).

However, if the person's temperature during the temperature testing stage exceeds 37.8 oC, the robot will sound a warning sound, so that a person detected with Covid-19 can be immediately treated by medical personnel. We, a student team representing Dian Nusantara University in the development of this robot, are submitting a proposal for funding assistance for our successful design of the Arjuno-Autobost Robot, an educational robot for preventing the spread of COVID-19 in the community and public spaces, particularly in Jakarta, the epicenter of its spread (Bogue, 2020). We request moral and material support for the development of this robot. The problem identification in this study is the actual value of the PLTU plant heat rate before periodic repairs, the causes of the increase in the PLTU plant heat rate value and steps to reduce the PLTU plant heat rate value so that the plant heat rate value can approached the conditions during the commissioning test (Chauhan, 2021).

The coronavirus disease (COVID-19), caused by the SARS-CoV-2 virus, has led to a global health crisis. Originating in Wuhan, China, in late 2019, the virus rapidly spread worldwide, severely impacting health systems, economies, and daily lives (Clipper, 2020). As of 2020, the pandemic's effects were felt across the globe, with countries facing lockdowns, increased infection rates, and massive healthcare system strains. In Indonesia, the situation became dire as the virus spread quickly, overwhelming hospitals and leading to a significant increase in mortality rates. As of mid-2020, Indonesia had one of the highest COVID-19 death tolls in Southeast Asia, and the economic fallout was equally severe, with the country's GDP shrinking and the national currency depreciating (Di Lallo et al., 2021).

In response to this crisis, various measures were adopted to control the spread of the virus. One of the most widely recommended strategies by health organizations, including the World Health Organization (WHO), was the use of personal protective equipment (PPE), physical distancing, frequent hand sanitization, and the monitoring of symptoms such as elevated body temperature (D'Ausilio, 2012). In the context of rapidly evolving public health strategies, technology has emerged as a key ally. Automation, robotics, and artificial intelligence (AI) are transforming the healthcare sector, offering innovative solutions that assist in mitigating the spread of diseases and supporting healthcare workers (González & Calderón, 2019).

The Arjuno Autobost Robot is a result of this technological evolution, specifically designed to assist in combating the COVID-19 pandemic (Holland et al., 2021). This robot's development was driven by the need to provide an efficient, non-invasive solution to monitor individuals' health in public spaces, particularly in high-traffic areas like hospitals, shopping malls, airports, and government buildings (Khamis et al., 2021). One of the primary features of the robot is its ability to detect the body temperature of individuals, a crucial step in identifying potential COVID-19 cases. The robot utilizes an Arduino-based system to measure body temperature using an integrated thermometer, which ensures that individuals with high temperatures are immediately flagged for further medical assessment. This process, which is vital in preventing the virus's spread, is further enhanced by the robot's automatic dispensing of hand sanitizer, reducing the need for human intervention and ensuring consistent hygiene practices (Khan et al., 2020).

The need for a robot like Arjuno Autobost becomes evident when considering the challenges that humans face during a pandemic (Magid et al., 2021). The ongoing need to monitor large crowds, enforce social distancing, and maintain hygiene measures creates significant pressure on healthcare professionals and public sector workers. Traditional manual methods, including temperature checks and hand sanitizing, often require multiple personnel and can lead to delays and inconsistencies. By automating these tasks, the Arjuno Autobost Robot reduces human resource requirements, streamlines operations, and enhances safety, providing an essential tool for public health management (Mbunge et al., 2021).

Furthermore, the Arjuno Autobost Robot serves as an educational tool for the public. With its integrated system that emits audible alerts when detecting a fever, the robot not only performs a health check but also educates individuals about the importance of temperature monitoring and sanitation in controlling the spread of infectious diseases (Murphy et al., 2022). This educational aspect is crucial in fostering public understanding of preventive health measures and encouraging compliance with safety protocols. As a result, the robot helps to shift the public's mindset towards a more proactive approach to health, which is particularly important in times of crisis.

Technologically, the Arjuno Autobost Robot employs a simple yet effective mechanism built on widely accessible components such as the Arduino microcontroller, DC motors for movement, and ultrasonic sensors for distance detection (Nam, 2018). The choice of Arduino is particularly noteworthy, as it is an open-source platform that provides flexibility in programming and hardware design. This makes it an ideal choice for the development of prototype systems, where affordability and adaptability are critical factors. By utilizing Arduino, the robot can easily be programmed to perform specific tasks, such as body temperature measurement, hand sanitizer dispensing, and warning signal generation, all of which are vital for its operation.

Moreover, the robot's modularity allows for further enhancements and upgrades. For example, additional sensors or software functionalities can be integrated into the system, such as face recognition for security, facial expression detection for emotional intelligence, or even AI-based predictive analytics to detect trends in temperature variations across different demographics (Nguyen et al., 2018). As the world continues to grapple with the pandemic and its aftermath, the potential for robots like Arjuno Autobost to evolve into multifunctional health monitoring devices becomes more apparent. This adaptability not only enhances the robot's immediate utility but also positions it as a sustainable solution for future health crises.

In a broader context, the Arjuno Autobost Robot exemplifies the role of innovation in addressing urgent global challenges. The robot's development reflects the contributions of the younger generation in harnessing technology to combat a deadly virus. It is an example of how university students, often at the forefront of technological innovation, can respond to the needs of society and contribute to solving real-world problems. The Arjuno Autobost Robot is a prime example of how interdisciplinary collaboration—combining engineering, healthcare, and social responsibility—can lead to the creation of a technology-driven solution with significant public health implications (Nnadi et al., 2021).

The implementation of such technologies in public spaces is not only a timely response to the immediate challenges posed by COVID-19 but also a step towards a future where robotics and automation play a central role in managing public health and safety (Raje et al., 2021). The Arjuno Autobost Robot, though designed for the specific context of the pandemic, holds promise for future applications in other areas such as general health monitoring, disaster response, and public safety management. Its potential to scale and be adapted for other use cases, combined with its educational and preventive capabilities, makes it a valuable addition to the technological arsenal against infectious diseases and other public health threats. This study aimed to analyze the actual heat rate of a coal-fired power plant (PLTU) compared to the actual value at commissioning using the heat loss method. The results of this analysis are expected to provide recommendations for the repair of such structures. It is hoped that the plant heat rate after repairs will approach the conditions at the time of commissioning.

2. Literature Review

2.1 Economic Value of Banking

2.2 Arduino Uno

Arduino is a microcontroller board based on ATmega328. It has 14 input/output pins, of which 6 can be used as PWM outputs, six analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Arduino platform supports microcontrollers and can be connected to a computer using a USB cable. Arduino is an open-source microcontroller minimum system board. In the Arduino board circuit, there is an ATMega 328 series AVR microcontroller, which is a product of Atmel (Russo et al., 2021).

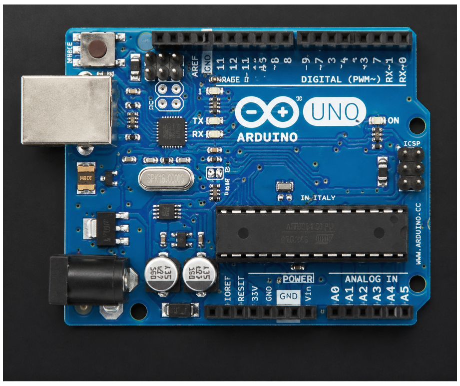

Figure 1. Arduino Uno

Arduino has its own advantages compared to other microcontroller boards; besides being open source, Arduino also has its own programming language in the form of C (Sahu et al., 2022). In addition, the Arduino board itself already has a loader in the form of USB, making it easier to program the microcontroller in Arduino. While on most other microcontroller boards that still require a separate loader circuit to enter the program when we program the microcontroller.

The USB port can be used as a loader during programming and as a serial communication port. The Arduino provides 20 I/O pins consist of six analog input pins and 14 digital input/output pins. The six analog pins can also be used as digital outputs if additional digital outputs are required in addition to the 14 available pins. To convert the analog pins to digital pins, the pin configuration in the program is simply changed. On the board, we can see that the digital pins are labeled 0-13. Therefore, to use analog pins as digital outputs, we changed the analog pins labeled 0-5 on the board to pins 14-19. In other words, analog pins 0-5 also function as digital output pins 14-16. The open-source nature of Arduino also offers many advantages when using this board. This means that the components we use are not limited to a single brand but allow us to use any component available on the market. The Arduino programming language is C, with simplified syntax, making it easier to learn and explore the microcontrollers (Sang et al., 2021).

2.3 DC Motor

An electric motor is an electromagnetic device that converts electrical energy to mechanical energy. DC motors, often called direct current motors, are more frequently used for applications requiring speed control than AC motors are. The primary reason for using DC motors, especially in modern industries, is because their operating speed is easily controlled over a wide range, in addition to the numerous speed control methods are available. DC motors are known for their diverse applications. By combining various field windings in shunt, series, or separately, a motor can be designed to exhibit a wide range of volt-ampere or speed-moment characteristics for both dynamic and steady-state applications (Scott et al., 2020). Owing to their ease of control, DC motor systems are often used in applications requiring a wide speed range or precise control of the desired output.

DC motors require a direct current supply to the field coil for conversion into mechanical energy. The field coil in a DC motor is called the stator (the non-rotating part), and the armature coil is called the rotor (the rotating part). If the armature coil rotates in a magnetic field, a voltage (EMF) is generated that changes direction every half rotation. The working principle of direct current is to reverse the phase of the voltage from a wave with a positive value using a commutator. By providing a voltage difference across the two terminals, the motor rotates in one direction, and if the polarity of the voltage is reversed, the direction of the motor's rotation is also reversed. The polarity of the voltage applied to the two terminals determines the direction of rotation of the motor, and the magnitude of the voltage difference across the two terminals determines the speed of the motor (Seidita et al., 2021).

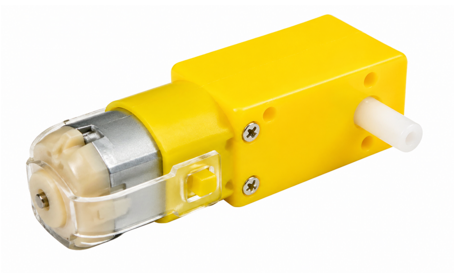

Figure 2. DC Motor

2.4 L298L Motor Driver

There are several types of DC motor drivers commonly used, such as those using relays activated by transistors as switches; however, these are considered inefficient and too complicated in terms of hardware. With the development of the IC world, there is now an H-Bridge packaged in a single IC that simplifies the implementation of hardware and control, especially if Arduino is used, which will feel even easier to use. A familiar IC is the L298 IC. This IC has its own advantages and disadvantages. The L298N motor driver is the most popular motor driver used to control the speed and direction of motor movement, particularly in line follower/line tracer robots. The advantage of this L298N motor driver is that it is precise in controlling the motor. In addition, the L298N motor driver is easy to control. Six microcontroller pins are required to control the L298N driver, 6 microcontroller pins are needed. Two enable pins (one for the first motor and the other for the second motor) are used. This L298N driver can control two DC motors) 4 to regulate the speed of the motors. 2.4 L298N Motor Driver (Shen et al., 2020).

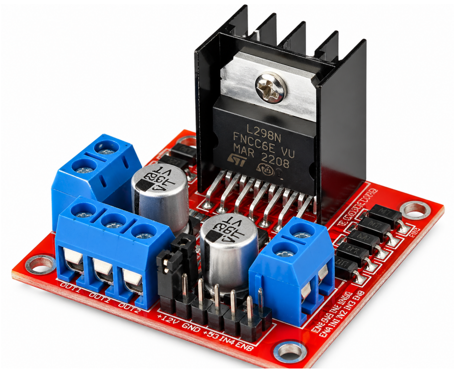

Figure 3. Motor Driver

2.5 DF Player Mini

Module is an mp3 module with a serial connection integrated with mp3, and WMV hardware. This module can be connected to an SD Card and is supported by FAT16 and FAT32 systems. Through serial commands, it can play music without complicated basic operations. The DFPlayer Mini module, with dimensions of 2 cm × 2 cm × 1.2 cm, is small, and the output can be connected to speakers or headsets. This module can be used directly with a battery source, and can be combined with an Arduino UNO or others with an RX/TX connection. DFPlayer Mini has 16 pins with each function in the following table. DFPlayer Mini can work alone as a standalone or can work together with a microcontroller Uddin et al., 2021.

Pin	Description	Note
VCC	Input Voltage	DC3.2~5.0V;Type: DC4.2V
RX	UART serial input	
TX	UART serial output	
DAC_R	Audio output right channel	Drive earphone and amplifier
DAC_L	Audio output left channel	Drive earphone and amplifier
SPK2	Speaker-	Drive speaker less than 3W
GND	Ground	Power GND
SPK1	Speaker+	Drive speaker less than 3W
IO1	Trigger port 1	Short press to play previous (long press to decrease volume)
GND	Ground	Power GND
IO2	Trigger port 2	Short press to play next (long press to increase volume)
ADKEY1	AD Port 1	Trigger play first segment
ADKEY2	AD Port 2	Trigger play fifth segment
USB+	USB+ DP	USB Port
USB-	USB- DM	USB Port
BUSY	Playing Status	Low means playing High means no

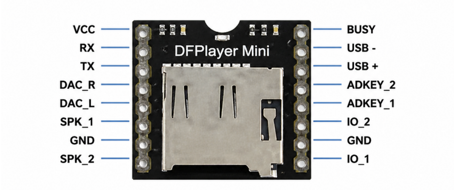

Figure 4. DF Player

2.6 Using DF Player Mini as a Standalone

When using the DFPlayer mini module, the S3 and S4 pushbuttons connected to the ADKey pin can be ignored. It only requires 2 pushbuttons and 1 mini speaker. Press S1 and S2 quickly to go to the next or previous song, and press S1/S2 while holding to adjust the volume. Figure 5 shows the schematic of the standalone DFPlayer Mini (Wu et al., 2021).

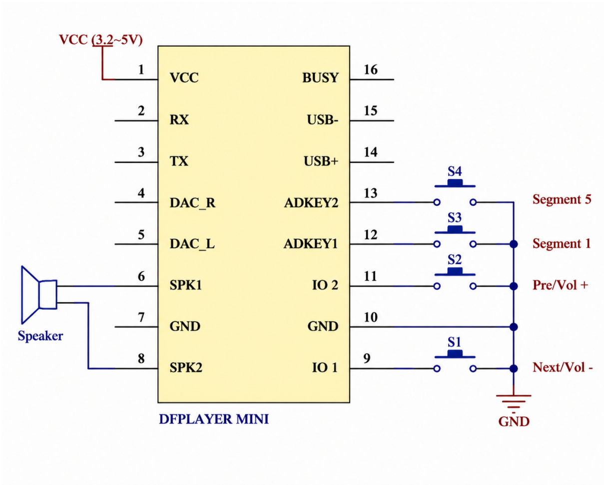

Figure 5. DF Player in Standalone Mode

2.7 *AD Key (Analog to Digital) Mode*

The DFPlayer mini module has two analog-to-digital converter (ADC) pins on pins 12 and 13 that can be used as input methods to trigger the internal MCU of the DFPlayer mini to interpret several button commands (Yang et al., 2020). The method is to create a button array similar to the one on the LCD button module, which can create 20 pushbuttons with 20 different functions. Figure 6 shows a schematic of the DFPlayer Mini with AD Key Mode.

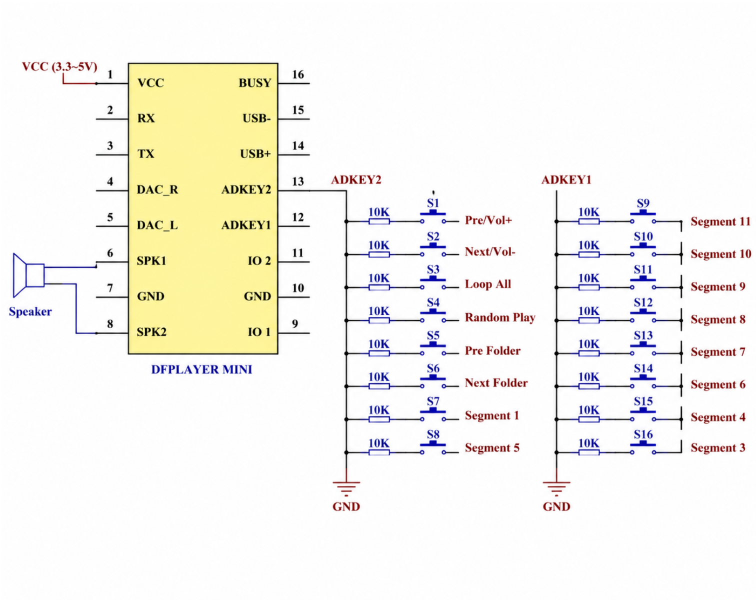

Figure 6. AD Key (Analog to Digital) Mode

2.8 *Ultrasonic Sensor*

The HC-SR04 ultrasonic sensor measures the distance of an object. This sensor works on the principle of sound wave reflection; if the sound wave hits an object, it will reflect back the sound wave. By knowing the reflection time of the sound wave, the distance of an object can be determined. The ultrasonic sensor emitted ultrasonic waves at a frequency of 20 kHz. Ultrasonic waves cannot be heard by humans and can propagate through liquids, gases, and solids (Yoganandhan et al., 2021).

Figure 7. Ultrasonic Sensor

The distance range that can be measured by the ultrasonic sensor is 2 – 400 cm, with an accuracy of 3 mm. By knowing the reflection time of sound waves, the distance of an object will be known using the formula distance = 340 / /2, where 340 m/s is the constant speed of sound. Figure II.1 shows the HC-SR04 ultrasonic sensor. One of the ultrasonic sensors is HC-SR04. The ultrasonic sensor has four pins: GND, ECHO, TRIG, and VCC. The HC-SR04 ultrasonic sensor works by applying a positive voltage to the Trigger pin for 10 microseconds (ÿs) to activate a burst of 8 × 40 kHz ultrasonic waves on the generating element (Zemmar et al., 2020). Next, the signal was received on the echo pin. To measure the distance of the object that reflects the signal, the time difference between sending and receiving the signal is used to determine the distance of the object. Figure 8 explains the timing diagram of the HC-SR04 ultrasonic sensor.

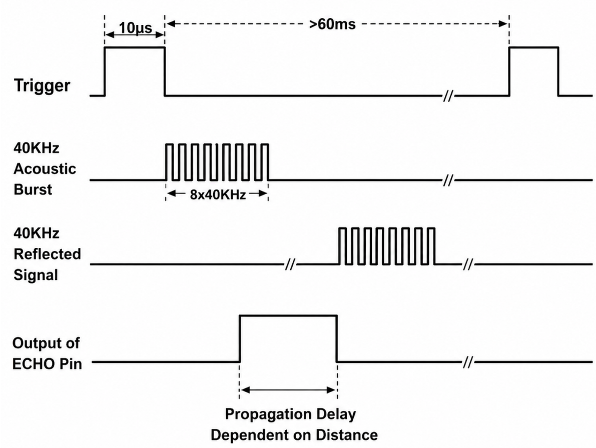

Figure 8. Timing Diagram of HC-SR04 Ultrasonic Sensor

2.9 Tower Pro MG 996R Servo Motor

A servo motor is a DC motor equipped with a control system that can provide feedback on the rotational position of the motor from 0 °to 180 °. In addition to providing feedback on the rotational position of the motor, it also has a relatively strong torque. The servo motor wiring system consists of three parts: Vcc, GND, and control (PWM) (Zeng et al., 2020). Applying The PWM signal to the servo motor causes the servo to move to a certain position and then stop (position control).

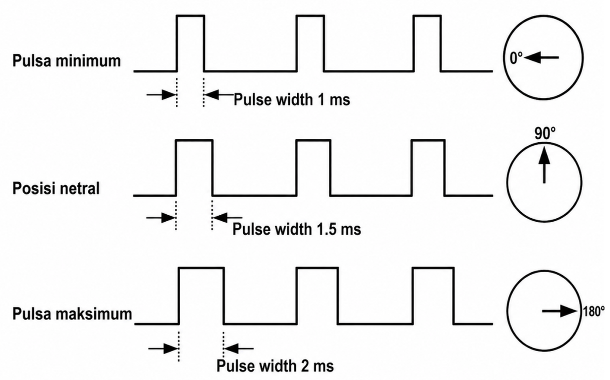

Figure 9. Relationship Between PWM Pulse Width and Servo Motor Rotation Direction

The MG996 servo motor is a newer version of the MG946 and MG995 series servo motors, which are high-performance servo motors with metal gears, double ball bearings, 180° rotation, and 30 cm long connection cable, and come with accessories for use as needed. This servo motor is suitable for applications requiring a motor with sufficient torque of up to 13 kg/cm (stall torque limit at 7.2 Volts). Compared with its predecessor (MG995), this servo operates more accurately, is faster and more responsive, and has more power.

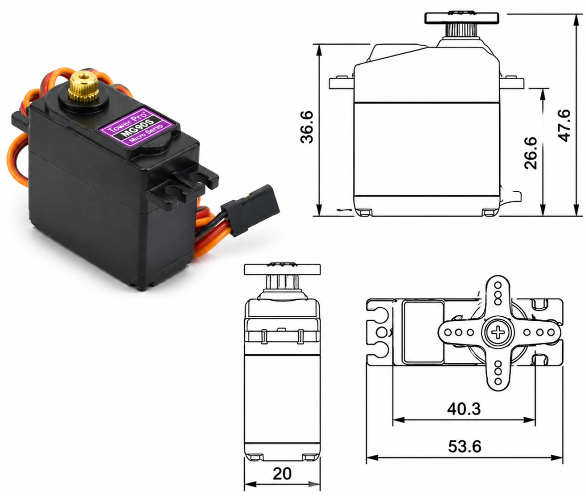

Figure 10. Servo Motor

The Tower Pro MG996R servo motor has a minimum voltage of 4.8 Volts to operate this motor, and the operating speed of this motor reaches 0.17 s for a 60° rotation (at 4.8 Volts without load), with a stall torque limit of 9.4 kg/cm. For a maximum voltage limit of 7.2 Volts, it is recommended to limit the power supply voltage to 6 V. At 6 VDC, this motor is capable of operating at a speed of 0.14 seconds per 60° (typical current consumption between 500 mA   900 mA) with a stall torque limit of 11 kg/cm (maximum current consumption / stall current 2.5 A). MG996 servo motor specifications: ÿ, Weight: 55g ÿ, Dimensions: L 40.7 mm × W 19.7 mm × H 42.9 mm ÿ Stall torque: 9.4 kg/ cm (4.8 V) - 11 kg/ cm(6.0 V) ÿ Gear: Metal gear set ÿ, Operating speed: 0.19 sec/ 60 degree (4.8 V) - 0.15 sec/ 60 degree (6.0 V) ÿ Servo Plug: JR (Fits JR and Futaba). Operating or controlling a servo motor differs from controlling a DC motor in that it requires a voltage source and control signal. The control signal is obtained using the PWM (Pulse Width Modulation) method, which is obtained through the ADC mapping conversion process on the Arduino.

3. Methodology

Research methodology refers to the stages of research that must be established before problem-solving can be undertaken. This allows for focused research and facilitates the analysis of problems. The following flowchart of the research method used is shown in Figure 11.

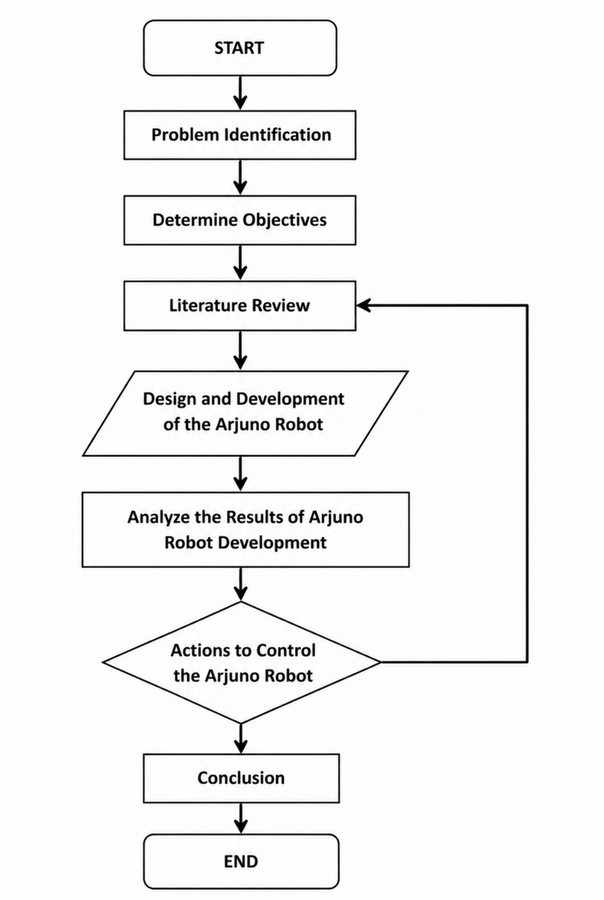

Figure 11. Servo Motor

The manufacturing location is in Bogor, precisely on Jl. Tajur Tapos RT. 24/08, Hambalang Village, Kec. Citeureup Kab. Bogor. From March 25 to June 27, 2020. In this study of the Covid 19 incident that occurred in Indonesia, after we analyzed and got the Arjuno Autobust robot and worked after the robot detected objects/humans and after that the robot would detect the temperature when the temperature exceeded 38°C the robot would issue an alarm set with an LED, besides that, Arjuno Autobust can also spray hand sanitizers.

4. Results and Discussion

4.1 The origin of the name Arjuno- aoutobust

This robot's name comes from a wayang story, namely the wayang Arjuna, one of the Pandawa characters who serves as a role model for true male characters in the Javanese society. Wayang Arjuna is the protagonist in the Mahabharata story. He is renowned as one of the Pandawa with the most captivating appearance and a gentle character. Hence, we named the robot Arjuno-Autobost, an Indonesian heroes during the COVID-19 pandemic. This robot was designed using an Arduino robotic system, which is often used to make robots. The Arjuno-Autobost robot operates as follows:

1. When someone enters the door or elsewhere, this robot will face the person who arrives.
2. The robot's head will see the face of the person approaching with its eyes glowing red.
3. On the right hand, a thermometer is attached, which we made ourselves.
4. The robot's right hand extends towards the head of the person who arrives, and the temperature is measured.
5. An LCD on the robot's chest displays the temperature test results.
6. If a person's body temperature exceeds the specified temperature limit of 37.8 OC, this robot will automatically sound the siren that we have installed, and the top light will turn on.
7. If the person's body temperature is normal, they will proceed to the next stage.
8. We installed a hand sanitizer on the left hand of the robot, which automatically sprays the palm of a person.
9. If it is completed, the person can continue their journey.

Figure 12. Arjuno-Autobost Robot

Figure 13. Arjuno-Autobost Robot Manufacturing Process

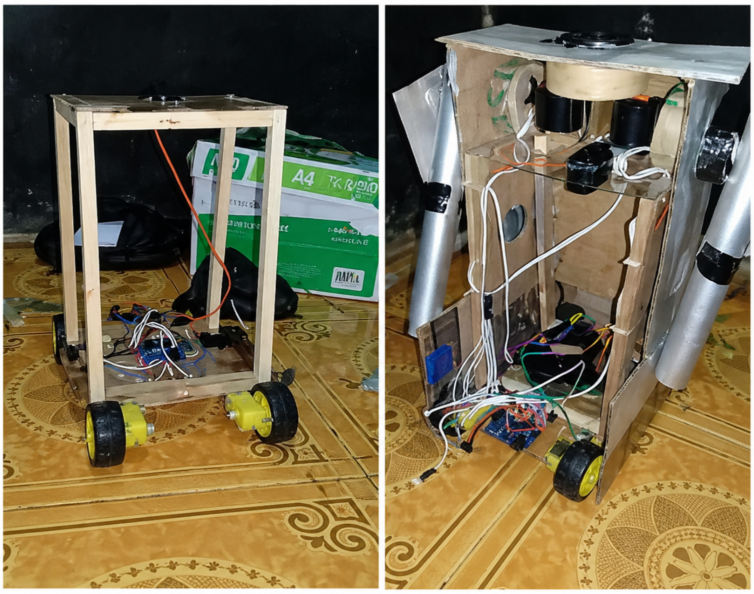

Figure 14. Arjuno-Autobost Robot Assembly Process

With the results of the robot work that we create, we can provide various benefits for the nation and state, namely:

1. Breaking the chain of the spread of Covid-19, which is increasingly widespread.
2. Educating the public about the importance of social and physical distancing.
3. Indonesia is a pioneer in preventing Covid-19 with a technological system.
4. Motivating the younger generation to participate in handling Covid-19

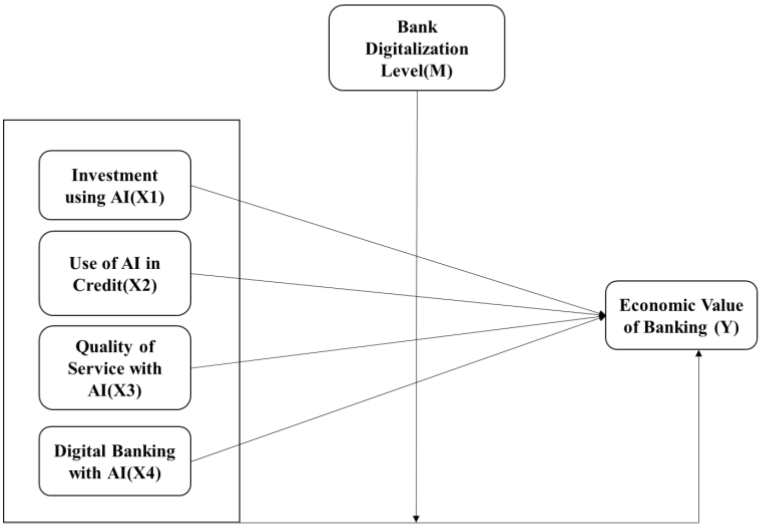

Figure 15. Research Model

5. Conclusions

Based on our research analysis, we understand that the production of Arjuno requires a large amount of equipment and space for its production. However, large-scale restrictions this year have made it difficult for us to meet, and we have also had to devise a way to carry out our research without meeting face-to-face. Therefore, we divided our tasks into two parts. Despite these challenges, our research was completed within the time frame.

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Author Contributions

The study was conceptualized by NIA, who conducted the literature search and data analysis, and drafted the manuscript. SUA provided expertise in the banking and digitalization sectors, contributing to the methodology and assisting in data interpretation. NS supervised the study, offering critical revisions to the manuscript and ensuring the accuracy of the references used. All authors contributed to the final manuscript, reviewing and approving the content.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this study. This research was conducted independently, and no financial or personal relationships influenced the results or interpretation of the findings.

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