Development of a Smart Charity Box Robot Based on Microcontroller
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ABSTRACT
Nowadays, many people use technology rather than using their energy. In Indonesia, many people also use technology as a tool to make work easier. This is because many people think that carrying out work manually wastes too much time and energy. Like distributing charity boxes. Usually, charity boxes in mosques are circulated by being distributed from one person to the person next to them, and so on. This can drain energy, especially for elderly congregants. To overcome this, we came up with an idea to develop a smart charity box robot that can walk on its own with the help of lines. With this smart charity box robot, it is also hoped that it can create comfort for mosque congregations in terms of distributing charity boxes, namely how smart charity boxes can work automatically. The aim of this research is that by developing this robot, it is hoped that it will make it easier for mosque congregations to move charity boxes, which are usually transferred from one person to another. The research method used is research and development (R&D) with 9 stages, namely, 1) potential and problems, 2) data collection, 3) product design, 4) design validation, 5) design revision, 6) trial product, 7) product revision, 8) trial use, 9) product revision. The results of this research are that charity box robots are very worthy of being developed and mass-produced.
INTRODUCTION

Indonesia is a country whose average population is Muslim, with a large population of Muslims, Indonesia certainly has many mosque buildings which are places of worship for Muslims. Especially in Aceh, we can easily find mosques standing firmly. As we know, in mosques there are usually small charity boxes that are distributed after congregational prayers. Usually, the distribution of these charity boxes is done manually by one of the administrators visiting the congregation by walking along the aisle, or the charity boxes are pushed from one congregation to the last congregation. To overcome these problems, researchers have an idea to develop a smart robot charity box that can walk on its own. Considering that today’s society is more inclined to use technology, researchers hope that the results of this work can be useful in overcoming obstacles in running charity boxes in mosques. This is because the distribution of charity boxes in mosques is still done manually, namely by giving the charity box from one person to the person next to him. To overcome this, researchers came up with an idea to develop a smart charity box robot that can walk on its own. Because when charity boxes are usually distributed manually, the congregation must give the charity box to the person next to them. To overcome this, researchers came up with an idea to develop a smart charity box robot. Apart from that, the presence of this smart charity box robot is also hoped to create comfort for mosque congregations in terms of distributing charity boxes, namely smart charity boxes that can work automatically. In the development of the avoider robot for smart charity boxes that run automatically, it is hoped that it will help facilitate the performance of the congregation and reduce the burden of energy expended to push the smart charity box, especially for elderly congregations, and also not disturb the solemnity of the congregation who are worshiping. The avoider robot is a robot that can avoid various obstacles.

Apart from that, the development of this smart charity box also aims to maintain the solemnity of the mosque congregation. When the charity box is being distributed manually, the congregation must give the charity box to the person next to it. However, there are several fundamental problems in creating a charity box robot, namely:
1. In today’s society, when the mosque charity box is distributed, the congregation still does it manually by pushing the charity box from the position of the first person, second person, and so on.
2. The charity box needs to be pushed further and even requires you to get up if it goes too far and drains your energy.

Currently, there are still many charity boxes that are distributed manually, carried out from one congregation to another. The problem formulation of this research is how to develop a microcontroller-based smart charity box robot. The aim and benefit of this research is that by developing this smart charity box robot, it is hoped that it will make it easier for mosque congregations to move charity boxes, which are usually transferred from one person to another. It is also hoped that the presence of this charity box robot can make it easier for congregations in mosques so that they no longer need to move them manually.
1.1 Avoider Robots

An avoider robot is a robot that can avoid various obstacles (Akhmad, Try, & Faisal, 2021).

1.2 Arduino

According to (Steven, et al., 2016) Arduino is an open-source physical computing platform based on a simple input/output (I/O) circuit and a development environment that implements a processing language. Arduino can be used to develop stand-alone interactive objects or can be connected to software on your computer (such as Flash, Processing, V, or Max/MSP). The circuit can be assembled by hand or purchased. The Arduino IDE (Integrated Development Environment) is open source.

2.1 Robot and Components

The robot is designed to be able to run automatically and make it easier for the congregation to donate, especially for elderly congregation members. The complete components that make up the robot can be explained as follows.

a. Arduino Uno

![Arduino Uno](image)

Figure 1. Arduino Uno

Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and originally released in 2010. The board is equipped with a set of digital and analog input/output pins that can be connected to various expansion boards and other circuits.

B. Ultrasonic Sensor

![Ultrasonic Sensor](image)

Figure 2. Ultrasonic Sensor

Ultrasonic sensors are devices that generate or sense ultrasound energy. They can be divided into three broad categories: transmitters, receivers and transceivers.

C. Infrared Sensors

![Infrared Sensor](image)

Figure 3. Infrared sensor
An infrared sensor is an electronic device, which emits light from an LED and the light is received by a photodiode. This sensor can also detect heat and movement of objects. This type of sensor only measures radiated radiation. Usually, the emitted object has a different heat effect on the sensor. The signal emitted by the transmitter is received by the infrared receiver and then decoded as a binary data packet.

d. L298N Motor Driver

The L298N motor driver is an electronic module used to control the direction of rotation and control the speed of a DC motor. The L298N motor driver input is in the form of PWM (Pulse Width Modulation) where the PWM width can affect the speed of the DC motor. Configure the input and output of the L298N motor driver module.

![L298N Motor Driver](image)

**Figure 4. L298N Motor Driver**

**LITERATURE REVIEW**

According to (Andi, Ardiansyah, & Hidayatama, 2013) Arduino UNO is a microcontroller board based on the ATmega328. Arduino UNO has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB interface, a power connector, IC button header for reset.

**METHODOLOGY**

The method used in this research is research and development (R&D), which is a research method used to produce certain products and test the effectiveness of these products. The research and development method used by researchers refers to the Sugiyono development model with a procedure of 9 (nine) stages, namely: 1) Potential and problems, 2) Data collection, 3) Product design, 4) Design validation, 5) Design revision, 6) Test try the product, 7) Revise the product, 8) Test use, 9) Revise the product.

**RESULTS**

The results of research and development of the smart charity box robot refer to Sugiyono's development model with 9 (nine) sequential (procedural) steps, namely:

1) Potential and Problems

The potential is the use of an item as a basic material in making a smart charity box robot that is easy to find around the madrasah environment. Some of the potential raw materials in this research include Arduino Uno R3, DC gearbox motor dynamo, 4WD robot chassis, ultrasonic sensor, L298N motor driver, battery and used cardboard. From these materials, researchers will make a useful product.
2 Data Collection

After the potential problems were discovered, the researchers collected information through observations at the Al-Huda mosque in Banda Aceh as material for product planning which is expected to overcome existing problems. Information was obtained through open interviews with several random mosque congregants.

3 Product Design

Based on the results of the analysis above, the next step is for researchers to design the product to be developed. The product produced in this research is a smart charity box robot. The charity box robot product design drawing is presented in Appendix 5.

4 Design Validation

After designing the product, the researchers validated the design with several validators/experts or experts who were experienced in their fields to assess the weaknesses and strengths of this product design, namely the lecturer in Electrical Engineering Education at Ar-Raniry University, Mr. Mursyidin, MT and Rizki Aulia Nanda, S.T., M.T. from the lecturer. Mechanical Engineering, Buana Perjuangan University, Karawang.

The conversion results validate the design for assessing the feasibility of a smart charity box robot to make it easier for the congregation during donation activities, especially for elderly congregations. Percentage with relative frequency, a value of 100% is obtained in the less appropriate category. The validator's suggestions for validating the smart charity box robot design include: initially the ultrasonic sensor is placed at the bottom of the charity box, but we can place the ultrasonic sensor at the front of the charity box.

1 Product Revision I

Product revisions are carried out by creating products based on suggestions from validators. The results of product revisions based on suggestions from validators in the development of a microcontroller-based smart charity box robot are presented in Figure 2 below.
2. Product Trial

Product trials are carried out after making design improvements based on suggestions from the validator. Product trials are carried out using Focus Group Discussion (FGD) and validators fill out a feasibility test questionnaire. The results of the conversion of product trials assessing the feasibility of the smart charity box robot by the validator were presented as a percentage with relative frequency, so a value of 100% was obtained in the feasible category. The validator's suggestions for design validation activities include: from the initial ultrasonic sensor distance of 15 cm, it was changed to 25 cm and the charity box could be made of light material.

2. Product Revision II

Revisions are carried out to perfect the product being developed. The results of product revision II based on suggestions from the validator in developing the charity box robot by reducing the speed of the robot so that the speed of the robot is only moderate, can be presented in Figure 8 below.
3. Trial Use
The aim of using the smart charity box robot is to determine the effectiveness of the product to be developed. The results of the assessment of the feasibility of trial use of the smart charity box robot by the validator trial use were presented as a percentage of relative frequency, so a score of 100% was obtained in the very feasible category. When testing the use of an ultrasonic sensor placed on the front of the charity box, the ultrasonic sensor was placed on the front of the charity box at a distance of 25 cm, using a charity box robot walking line follower with an ultrasonic sensor to detect obstacles in front of it. If you want to donate, the donor's hand must be placed in front of the ultrasonic sensor so that the charity box robot stops. After donating, the charity box robot will run automatically, therefore the researchers carried out the next stage, namely product revision.

![Figure 9 Trial Use](image)

4. Product Revision III
At this stage, the researchers changed the distance from 15 cm to a distance of 25 cm on the charity box robot. This distance can be used very effectively to stop the progress of charity box robots who want to donate. This is the result of product revision III, for 10 seconds the robot will stop, after that, the robot will start again if there are no obstacles in front of the robot's ultrasonic sensor. These are the results of product revision III,

![Figure 10. Product Revision III](image)
DISCUSSION

Research results from (Yaakub, 2018): the movement of a beam-moving robot uses a DC motor as an actuator to move the robot's body and handle. Turn left, turn right, and push and lift the blocks. Using the arm as a block lifter to do its job, this robot arm clamps the block and lifts the block using a DC motor. It is possible to move blocks 25cm long, 20cm wide, and 30cm high. AtMega 128 microcontroller is used as the control center.

Research results from (Akil, Muchtar, & Fitriati, 2020): This robot uses a motion system that reads the condition of sensors that read the path or path through the welfare box. The Infaq accompanying congregation can prevent the charity box from reaching the charity box simply by giving a hand signal in front of the robot which has an ultrasonic sensor to detect obstacles. Making this model will then continue with the execution stage where a charity box will be created that will be used during the New Normal.

Research results from (Intang, Rusnadi, Junita, & Sati, 2023) Socialization of the components of the tools used in planning the charity box automation system for the administrators and congregation of the Baitul Iman Mosque, the rubber gutter provides a good understanding of the simplicity of a robotic system that can be seen in the system. automation of charity boxes as socialized.

Research results (Qalbi & Rasyid, 2020) Sikomal is an innovation that is the result of the thinking of our group, which was inspired by problems that often occur regarding the distribution of charity boxes and the security system in mosques but are not given much attention. Sikomal is designed in such a way, that the form of a charity box equipped with several supporting features

The research results from the journals above are not much different from the results from our research journals, it's just that the discussions in each journal are different from those discussed in this journal. This research is in line with the research of Muhammad Akil, et al by using an ultrasonic sensor as a barrier. The charity box robot will walk automatically following the line that has been created from the black lasiban as the robot's path.

Developed a charity box robot that has been tested for validation of product suitability 3 times. In the first validation, it was 100% in the inadequate category because the distance to stop the robot was too far, namely 15 cm, and the layout of the ultrasonic sensor was not strategic enough to stop the robot, which was placed in the middle of the robot. In the second validation test, it got 100% in the feasible category, by changing the stopping distance of the charity box robot from 15 cm to 25 cm, it can stop effectively, and changing the layout of the ultrasonic sensor in the middle of the charity box makes it easier for pilgrims who want to donate by placing their hands in front of the sensor. ultrasonic. The third validation test by the validator received 100% with the category very feasible to be developed by changing the distance to 25 cm. This distance is very effective and can be used to stop the progress of the charity box robot who wants to donate and hopefully, the charity box robot can be developed and mass-produced.
CONCLUSIONS AND RECOMMENDATIONS

A robot is a mechanical device that can perform physical tasks, both with human supervision and control. Or use a program that has been defined first. The term robot originates from the Czech language "robots" which means worker or coolie whose job is to help complete human tasks without getting tired or bored. One of the robots we made is a smart charity box robot that functions to help mosque congregations who initially had to move the charity box by lifting or moving the charity box and what this does takes a lot of energy, therefore, the existence of this smart charity box robot can save the energy of mosque worshipers who come to the mosque, especially elderly people. Apart from that, the existence of this smart charity box robot can provide comfort to people who come to the mosque to worship. Apart from that, this robot can also function to maintain the solemnity of the congregation at the mosque. Based on the research results of the charity box robot, it can be concluded that the robot has succeeded in answering the research objective, namely the development of an Arduino Uno-based charity box robot that can drive automatically. By giving a product feasibility questionnaire to the validator, the final result is very worthy of development. The method used is R&D (Research and Development), a research method used to produce certain products and test the effectiveness of these products by developing Sugiyono with a 9 (nine) stage procedure, namely, 1) Potential and problems, 2) Data collection, 3) Product design, 4) Design validation, 5) Design revision, 6) Product testing, 7) Product revision, 8) Usage testing, 9) Product revision. The results of research on the development of a microcontroller-based smart charity box robot at MTsN 1 Model in Banda Aceh City are 100% very feasible. Based on the results, several suggestions can be written for further development and research. The suggestions are:
1. In the future, security will be added to the charity box in the form of a fingerprint or password
2. This charity box robot can be developed more widely in all mosques in Banda Aceh
3. This product can be developed with an IoT (internet of thing) system

FURTHER STUDY

This research still has limitations, so it is necessary to carry out further research related to the topic of Development of a Smart Charity Box Robot Based on Microcontroller in order to improve this research and add insight to readers.

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