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Design of Smart Trash Using ESP32 with Blynk Integration

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Abstract

Earthquakes are natural disasters that can cause major damage and even loss of life in a short time. Therefore, an early detection system that can provide warnings before an earthquake occurs is very important to reduce the impact of damage. This study aims to develop an earthquake detection tool that utilizes Internet of Things (IoT) technology. This system uses the SW420 sensor to detect earthquake vibrations and the MPU6050 sensor to measure acceleration and changes in orientation. The method used in this study uses the Research and Development (RnD) method, where this research starts from problem identification, system design, to system testing and evaluation. This system uses ESP32 as a microcontroller to process data from sensors and send the data through the Blynk application in real time. The test results show that this tool is able to detect an earthquake when the magnitude reaches a predetermined minimum limit. With this IoT integration, it is hoped that it can increase community preparedness in facing the threat of earthquakes.

Keywords— *Internet of Things(IoT), ESP32, Blynk, Smart Trash, Servo SG90*

1. INTRODUCTION

Along with the increasing development and population, the waste problem is also increasing. (Cahya Nova Putri Maharani, 2024). Trash cans are temporary containers for storing waste before being disposed of. Some trash cans are equipped with top covers to reduce the unpleasant odor from the trash. However, most trash cans still use a manual system that is less efficient and has the potential to cause hygiene problems. (Musyarrofah, 2024).

In addition to hygiene issues, the use of manual trash cans can also have a negative impact on the environment, such as the spread of bacteria and viruses. The lack of public awareness and concern for environmental cleanliness causes the waste problem to still be a serious problem. (Ali Wafi, 2020). To overcome this problem, innovation was carried out by creating smart trash cans based on the Internet of Things (IoT).

The application of IoT to trash cans provides an opportunity to create a smarter and more integrated waste management system. Waste officers who are responsible for cleaning trash cans located at several points in the location are very much needed. However, supervision of trash cans is still carried out manually, so that trash officers are required to check the trash cans by visiting each trash can registered in their office area. (Ridwan Ahmad Ma'arif, 2019).

Traditionally, waste collection systems often rely on routine schedules, which can cause delays in collecting full bins before the waste collection time arrives. (Saputra, 2022). The Internet of Things (IoT) is a concept in which an object has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. (Raemon Syaljumairi, 2023).

Through sensors and internet connectivity, trash cans can monitor filling levels, provide notifications, and even connect to waste collection systems. Of course, with fully automated

equipment, humans can do all their activities more efficiently. This allows for optimization of collection routes and reduces operational costs.

This tool uses ESP 32, 2 infrared sensors, and Servo SG90. ESP 32, as one of the microcontrollers or brains of the system. Infrared sensor 1 is used to detect the presence of hands/objects placed on the trash can lid. Infrared sensor 2 is used to detect the filling level of the trash can. The servo motor can move the trash can lid, so it can be concluded that the overall smart trash can work system can function properly according to the design that has been made. (Fa`iq Khotibul Umam, 2024).

This study aims to design, build, and test the performance of a prototype of an IoT-based smart trash can that can detect the contents of the trash can. Open and close the lid automatically. (Mualief Anwar Ismail, 2021). Then provide a notification when the trash can is full. The notification in blynk will open if the LED lights up green and if it is full it lights up red and can be opened and closed manually.

In an effort to increase productivity, humans continue to innovate to create new technologies. One sector that is greatly helped by technological advances is the trash can. Currently, temporary waste storage is still done manually. This has an impact on time and extra energy and has an impact on the contents of the trash can which is too full so that it can cause an unpleasant odor and lots of bacteria. So the idea arose to create a smart trash can that can manage waste automatically and efficiently.

2. RESEARCH METHODS

Every research activity must always follow a gradual process. (Fadli, 2021). The method used in this study is Research and Development (R&D) with the Prototype method. (Muliadi, 2020). This method is the beginning of the system that will be developed by the author to get a clearer picture of its features and functions.

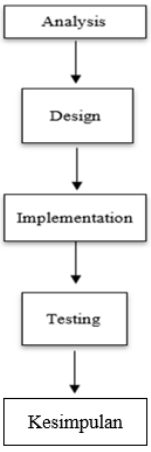

Figure 1. Research flow chart

This study uses a prototype method to develop an IoT-based smart trash can, with the following steps:

1. Analysis

Find out more about the tool you want to make, and evaluate how well each alternative can solve the problem from previous references. (Yogi Nurfauzi, 2023). This stage explains the analysis of literature study data from previous researchers, through several sources by observing the shortcomings of previous tools.

2. Design

In this section, the author prepares the design of a smart trash can tool by making various designs such as a circuit in the installation using fritzing and flowcharts. The first stage of design carried out is to design a wiring diagram using the fritzing application by creating a circuit schematic of all the devices needed. (Zainal Amrah, 2023)

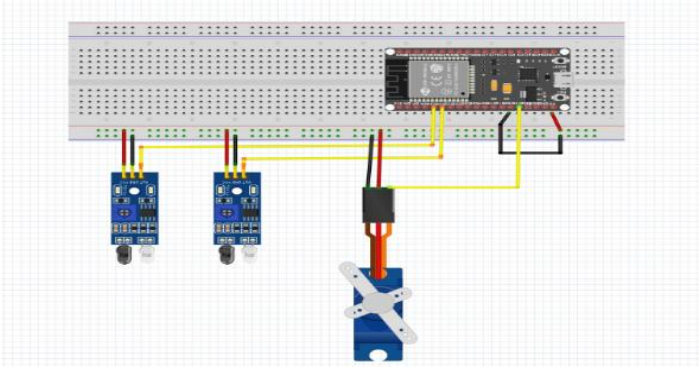

Figure 2. Schematic with fritzing

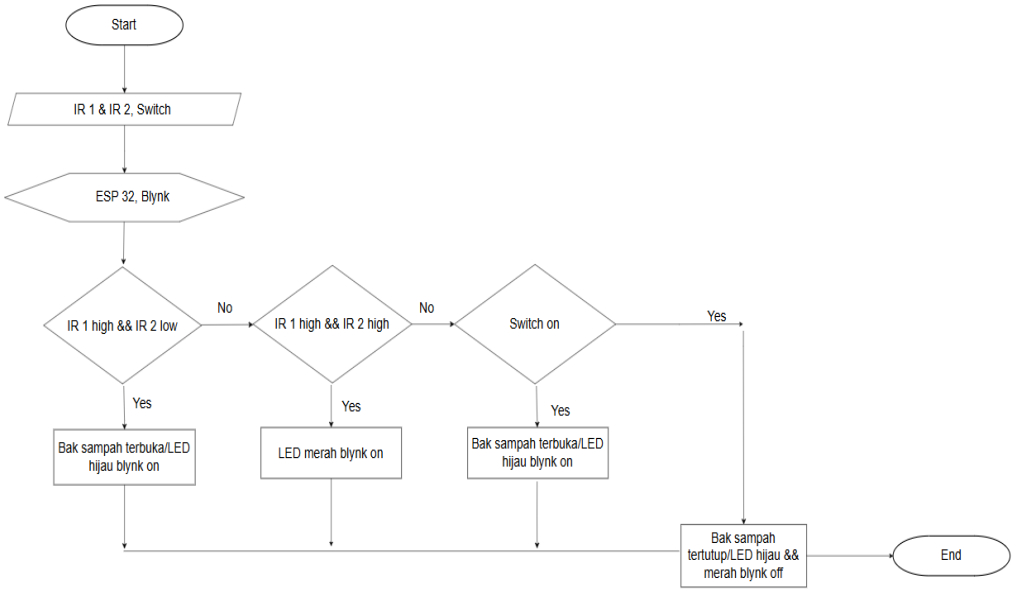

Figure 3. Flowchart the system

In the flowchart section, it can be explained that the ESP 32 will process the input given from IR 1 and IR 2. Furthermore, if IR 1 is high and IR 2 is low, the trash can lid will open and the green LED on the blynk will light up, the red LED on the blynk will not light up. Then the trash can lid will be closed again for 5 seconds and the process will be completed and then it will return to the beginning. If IR 1 and IR 2 are both high, the trash can will remain closed, the red LED on the blynk will light up and cannot be opened and the process will be completed and then it will return to the beginning. Then if the switch is on, the trash can lid is open, the LED on the blynk will not light up and the trash can lid will be closed again for 5 seconds and the process is completed and then it will return to the beginning. If there is no sensor reading and the switch is off, the trash can lid will remain closed and the process is completed and then it will return to the beginning. 3. Implementation

The programming process uses software using Arduino IDE as the program control center on ESP 32.

4. Testing

Tool testing aims to ensure that the tool works as it should and can function according to the design that has been made since the beginning of the author's wishes. (Khulud Anshori, 2020).

5. Conclusion

This final stage is the collection of data from the system that has been completed and maintenance is carried out for system updates. At this stage, the researcher conducts a validation test on the operational model that has been produced. This stage is the final revision stage on the tool. The researcher makes final improvements to the final model. (Waruwu, 2024).

4. RESULTS AND DISCUSSION

Overall system testing is carried out to determine whether the smart trash bin that has been created has worked well or not. If the results of the usability test do not meet expectations, the design will be evaluated and used to improve the system in the future. (Nike Kristanti, 2022). Based on the tests that have been carried out, it was obtained with several stages as follows:

Testing Infrared Sensor 1 when detecting an object.

This stage is carried out to obtain the level of accuracy on the infrared sensor 1. This test is carried out to determine the sensitivity of the infrared sensor 1 and the data sent by the system to the blynk application, as seen in Figure 4 which shows the reading on the infrared

When the infrared sensor 1 detects an object, the blynk will turn green then the lid of the trash can will open and will close again within 5 seconds.

Figure 4. Infrared readout

Infrared Sensor Testing 2 detects when the contents of the trash bin are full

This stage is carried out to obtain the level of accuracy of the infrared sensor 2. This test is carried out to determine the sensitivity of the infrared sensor 2 and the data sent by the system to the blynk application, seen in figure 5 which shows the results of infrared 2.

When the infrared sensor 2 detects that the contents of the trash bin are full, the blynk will be red and cannot be opened when the contents of the trash bin are full.

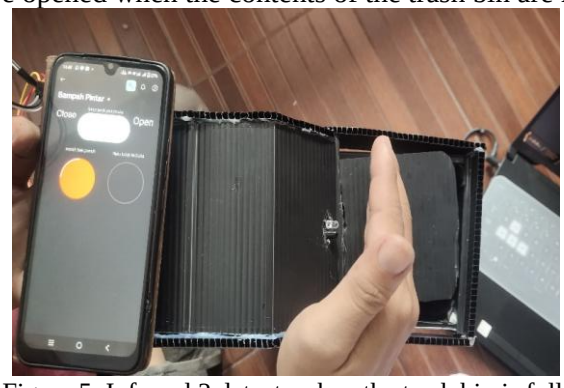

Figure 5. Infrared 2 detects when the trash bin is full.

Testing the switch on the blynk application in the on condition.

This stage is carried out to obtain the level of accuracy of the switch in the blynk application. This test is carried out to determine the accuracy of the switch in the blynk application, as seen in Figure 6 which shows the results of the switch when in the on condition. When the switch on the blynk application is clicked in the on condition, the door of the trash bin will open, then when the switch on the blynk application is turned off, the trash bin door will close again.

Figure 5. Switch in Bylink is On

Testing on Infrared 1, infrared 2, and switch

This stage is carried out to obtain the level of accuracy on the switch in the blynk application, infrared 1 and infrared 2. This test is carried out to determine the accuracy of the components used as seen in Figure 6 which shows when there is no object approaching infrared 1, the contents of the trash bin are not filled, the switch in the blynk application is in the off condition then nothing happens to the device.

Figure 5. testing on infrared 1 and 2, and switch

Results

Based on the tests that have been carried out, it can be seen in Table 1 that the smart trash system that was designed has fulfilled the functions that the author wanted. The smart trash can has functioned well when testing the device. In the first test results, an object was detected on infrared 1, so the green LED light on the blynk was on, the red LED light on the blynk was off and the condition of the trash bin lid was open. In the second test results, the contents of the trash bin were detected to be full, infrared 2 responded and the green LED light on the blynk was off, the red LED light on the blynk was on and the condition of the trash bin door was closed and could not be opened. In the third test results, the condition when the switch was off, the green and red LEDs were off, and the condition of the trash bin door was still in its original state and nothing happened. In the fourth test results, when no object was detected on infrared 1, infrared 1 and 2 would turn off and then the condition of the trash bin door was still in its original state. In the fifth test results, infrared 2 detected that the contents of the trash bin were not filled, so the green and red LEDs were off and then the condition of the trash bin door

was in its original state and could be opened if infrared 1 detected an object. In the results of the sixth test, when the switch is in the on position, the green LED on the blink will light up and the red LED on the blink will turn off, then the trash bin door will open using the remote control.

Tabel 1. System test results

No.	Testing	Green LED	Red LED	Condition	Status
1	Infrared 1	On	Off	Open	Object detected
2	Infrared 2	Off	On	Closed	Detected full contents of trash bin
3	Switch	Off	Off	Closed	Swich is off
4	Infrared 1	Off	Off	Closed	No object detected
5	Infrared 2	Off	Off	Closed	Detected that the contents of the trash bin are not filled
6	Switch	On	Off	Open	Switch is on

5. CONCLUSIONS

The Internet of Things (IoT)-based smart trash bin designed using an ESP32 microcontroller and configured with the Blynk application successfully functions well in detecting objects and the level of filling the trash bin automatically. The application of this technology not only increases efficiency in waste management but also helps reduce cleanliness problems that often occur in manual systems. In addition, this system offers a faster response compared to previous systems that use ultrasonic sensors and Arduino microcontrollers, and allows for better integration with Wi-Fi networks for remote control. This research opens up opportunities for further development in smart waste management technology, which can be implemented in various environments to improve efficiency and cleanliness.

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