



Implementation of IoT (Internet of Thing) in the Design of a Smart Robot Prototype for Automatic Waste Disposal Based on Arduino at Mega

Badriah Nursakinah
Pamulang University

Corresponding Author: Badriah Nursakinah badriahnursakinah@gmail.com

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ABSTRACT

The background of this research is to design a prototype for an automatic waste disposal robot based on Arduino AT Mega which is integrated with IoT (Internet of Things). Where the Internet of Things can generally be interpreted as objects around us that can communicate with each other via the internet network. Internet Of Thing has the concept of expanding the benefits of being connected to a continuous internet connection. The aim of this research is to design a prototype for an automatic waste disposer that was developed by integrating with IoT technology. The input process is carried out as an integration process between the Arduino and the HC-SR04 sensor and the Infrared Line Tracking sensor. So that the Arduino and HCSR 04 and Line Tracking sensors can work optimally, the main thing to do is carry out the configuration process using a beardboard and jumper cables as well as LED lights to ensure whether the sensors and other supporting tools are integrated with the Arduino. Where in the integration process between the Arduino buit and the ESP8266 so that the movement of the prototype can be easily monitored only via a smartphone or laptop even remotely

INTRODUCTION

The existence of the internet among humans has provided many positive changes in life for interaction, communication, socialization and culture. The internet is able to change the world where the internet has provided conveniences where the presence of the internet as a communication link between humans which able to change the world. It should be noted that the internet is not only for connecting lots of equipment, anything that can be connected, the Internet of Things, abbreviated as IoT, is an implementation of network communication of interrelated objects that connected and communicating each other. It can be said that the smartphones that are widely available are devices capable of developing IoT, where smartphones have the ability to connect to the internet and equipped with sensor features. To develop IoT, the sensor must be able to communicate with other devices that have been installed with an application that capable of doing this.

In general, IoT is a media that can be used to increase work efficiency which can be accessed via the internet network. Media that can be used as a medium for information and communication today. Arduino is an Internet of Things (IoT) component that can be applied as a control system. Arduino can be used to control relays which function as switches. This device can be accessed via Android smartphone by utilizing internet services so it can activate and deactivate electrical loads without having to be at the location. In research conducted by Mochammad Hariono, M. Jasa Afroni and Oktriza Melfazen entitled Prototype of Home Load Control Using an ATmega 328P Microcontroller with the IoT Concept as Remote Control. The results of the research are hardware design consisting of an Arduino where the Arduino is a microcontroller-based development board, the ESP8266 is an embedded chip designed in such a way to carry out WiFi-based communication. In this research, the results obtained are that the test results can be said to be accurate if the overall system stability is 86% but the house load control application is still not auto-synchronized (Mohammad Hariono, M. Jasa Afroni, Oktriza Melfazen, 2019).

LITERATURE REVIEW

Artificial intelligence (AI) in robots is an algorithm that is considered intelligent which is programmed into the robot controller. The definition of intelligence here is very relative. And the use of AI in the controller is carried out to obtain the dynamic characteristics of the controller intelligently. It can be said that this classical controller is not yet intelligent because it is not able to accommodate non-linearity or dynamic changes both in the robot system itself and load or environmental disturbances. In other applications, AI can also be used to help the process of identifying models of robotic systems, environmental or disturbance models, models of robot tasks such as making trajectory plans. Where in the AI concept it is not only used directly into the controller, but also indirectly (Pitwarno, 2005)

Arduino is a single board microcontroller that works with opensource software projects. In the world of research, Arduino is widely used to create interactive electronic devices based on hardware and software that are flexible and easy to use. There are various versions of Arduino, one of which is Arduino

Mega. Arduino Mega is a microcontroller with a large number of pins and memory capacity. Arduino MEGA has 54 digital pins and 16 analog pins, and has 256KB flash memory which can be used to store programs.

The aim of making an automatic waste disposer prototype that is integrated with IoT (Internet of Things) is to make it easier for users to monitor the work process of the prototype even though it is quite far away. The platform can be used as a tool for monitoring the work process of the automatic waste disposer robot that is integrated with IoT with use the Blynk platform, where the step of Blynk platform works is to provide email or chat notifications to users when the prototype starts operating until it finishes operating. The Thingier Io platform is used by users as a tool to help users monitor the temperature of wheel motor and battery during prototype is operating.

METHODOLOGY

This research use several methods including:

1. Data collection: several techniques were used to collect data in this research, including:
 - a. Observation
This technique is carried out by direct observation of the running system.
 - b. Interview
At interview method, researchers can find out the materials (Bill of Materials) which will be designed in terms of mechanics and build which will be used in developing software system.
 - c. Literature
Data collection was carried out directly from other sources such as journals and several other reference books.
2. Software Analysis and Design
In this process, researchers analyzed several systems that would be used, especially in terms of hardware and software, which would later be needed in the design process for the prototype of this smart automatic waste disposal robot.
3. Software Creation
Analyzing several systems that will be used, such as hardware and software, which will be needed in the prototype design process, this is necessary to find out what tools will be used in making the prototype.
4. Software Creation (Arduino IDE 1.8.5) and Node MCU ESP 8266
In the process of making this software, it is a process of creating source code for each tool that will be used as a supporting tool, where this process needs to be detailed because it needs to adjust the source code script requirements for each sensor and other tools. The language that very familiar to use is the C++ programming language, using the opensource Arduino IDE platform. Before downloading the Arduino IDE platform, make sure the version you want to download is the latest version so that you are not difficulties when updating the tools in the libraries.
5. Test LM35 Sensor Data (Temperature Sensor)
The wheel motor used in the prototype needs to be temperature monitored so that heating does not occur on the wheel motor, therefore the LM35 sensor will

be used as a temperature measuring device on the wheel motor. The wheel motor is said to have a hot temperature level if it reaches a value of 50°C. Therefore, the LM35 sensor will help in monitoring the temperature capacity of the wheel motor. Before the sensor is installed on the wheel motor, it is necessary to configure the sensor with Aduino in real time. The following displays the program and serial monitor in real time.

6. System Testing and Evaluation of Hardware and Software

In this stage the research team are tested the system using the black box method. This test was to find out whether the configuration process that had been carried out one by one for the tools used could function optimally to obtain valid data, so trial and error was carried out with a testing process until 10 tests. , If one of the tools does not function, it will affect the performance of the prototype.

According to Wikipedia, the Internet of Things or also known as the abbreviation IoT is a concept to expand the benefits of continuously connected with internet connectivity. Capabilities such as data sharing, remote control, and so on also include objects in the real condition. For example, food, electronics, collections, living objects, all of which are connected to local, and global networks via embedded active sensor. Another similar meaning Internet of Things (IoT) is a concept or scenario where an object has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. "A Thing" in the Internet of Things (IoT) can be defined as a subject, for example a person with a heart implant monitor, a farm animal with a biochip transponder, a car that is equipped with a built-in sensor to warn the driver when the tire pressure is low.

RESULTS AND DISCUSSION

Overall System Testing

From the test results of each sensor and the driving device used, the test results can be seen in the following table:

Tabel 1. Overall System Testing

No	Testing	Process and Output	Function Results	
			Appropriate	Not Appropriate
1	Front Limit Sensor	Detects the maximum recoil limit of the arm	√	
2	Rear Limit Sensor	Detects the maximum forward limit of the arm	√	
3	Upper Limit Sensor	Detects the maximum limit of upward movement of the arm	√	

4	Lower Limit Sensor	Detects the maximum limit of downward arm movement	√	
5	Detection Sensors	Detect objects when dumping trash	√	
6	Sensor Level	Detecting the height of the waste level	√	
7	Sensor Tracking	Give input to the Arduino regarding the position of the robot along a predetermined path	√	
8	LCD	Displays robot status	√	
9	Driver Motor DC	Controlling the speed and direction of rotation of the robot wheel	√	
10	Motor Lifting Up and Down Arm	For the process of going up and down the robot arm	√	
11	Servo Motors	Open and close the trash can	√	
12	DC Motor Forward and Reverse Arm	To move the robot arm back and forth	√	
13	Trash Can Rotating DC Motor	To rotate the trash can forward and backward	√	
14	Right and Left Wheel Motors	To move the robot wheels so that they can go forward and backward	√	

Time Test Analysis Results on the Blynk Platform

In testing the delay time on the Blynk platform, the tolerance specified is ≥ 30 seconds. If the delay time is more than 1 minute, the robot's performance in providing notifications to Blynk is considered poor. Test results can be seen in Table 2.

Table 2. Monitor Time Testing on Blynk with a Network Speed of 4.12 Mbps

Data To	Data Display Time						Delay (s)
	Wemos Tools			Blynk			
	Hours	Minutes	Seconds	Hours	Minutes	Seconds	
1	16:00	10	01.00	16:00	10	01.88	0.88
2	16:00	10	01.20	16:00	10	01.90	0.7
3	16:00	12	01.25	16:00	12	01.91	0.66
4	16:00	12	01.90	16:00	12	02.00	0.1
5	16:00	12	02.05	16:00	12	02.10	0.05
6	16:00	12	02.08	16:00	12	02.11	0.03
7	16:00	12	02.15	16:00	12	01.88	0.27
8	16:00	12	02.25	16:00	12	01.92	0.33
9	16:00	12	02.35	16:00	12	01.95	0.4
10	16:00	12	02.40	16:00	12	01.98	0.42
11	16:00	12	02.45	16:00	12	02.05	0.4
12	16:00	12	02.47	16:00	12	02.10	0.37
13	16:00	12	02.49	16:00	12	02.15	0.34
14	16:00	12	02.50	16:00	12	02.16	0.34
15	16:00	12	02.57	16:00	12	02.18	0.39
Average Delay							5.68

Based on the data in Table 2, it can be seen from the results are the average delay is 5.68 seconds, which means the data transfer performance from Wemos to Blynk is good and compared with the time delay tolerance that has been set at value ≥ 30 seconds.

Blynk Platform Testing

In testing sending e-mail notifications on the Blynk platform, there are 4 categories of conditions when the robot is working, including when the arm is under and at the back of the arm, when the robot starts moving along the track, when the track sensors all have logic 0 and when the robot has finished throwing away the trash. The e-mail sending categories displayed on the LCD on the prototype can be seen in the table.

Table 3. Blynk Platform Testing

No	Condition	Blynk Status				LCD Display
		A	B	C	D	
1	When the arm is down and at the back or when the bottom limit switch is active and the front is active	√				On Line 1 "Robot Ready" On Line 2 "Wait Trash Full"

2	When the robot starts to navigate the track		√			On line 1 "On Tracking Now" On line 2 "Going Ahead"
3	When all track sensors have logic 0			√		On the 1st line "Robot Arrived" On the 2nd line "On Destination"
4	When the robot has thrown away the trash				√	On the 1st line "Robot Finish" On the 2nd line "Going Home Now"

Here are some email notification images that match Blynk's status.

1. When the arm is at the bottom and at the back or when the bottom limit switch is active and the front is active (in status A).

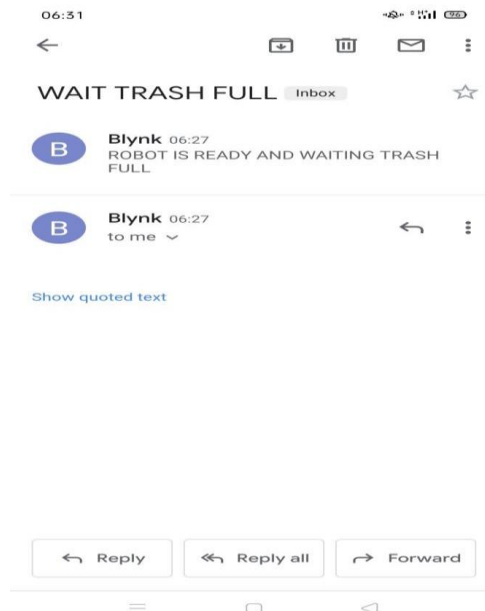


Figure 1. Blynk's Status

2. When the robot starts to navigate the track (when status B)

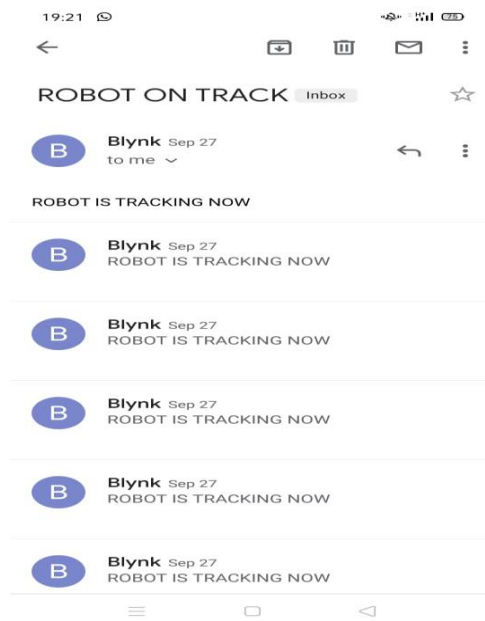


Figure 2. Robot Notification Starts Track Navigation (When Status B)

3. When all track sensors have logic 0 (in status C)

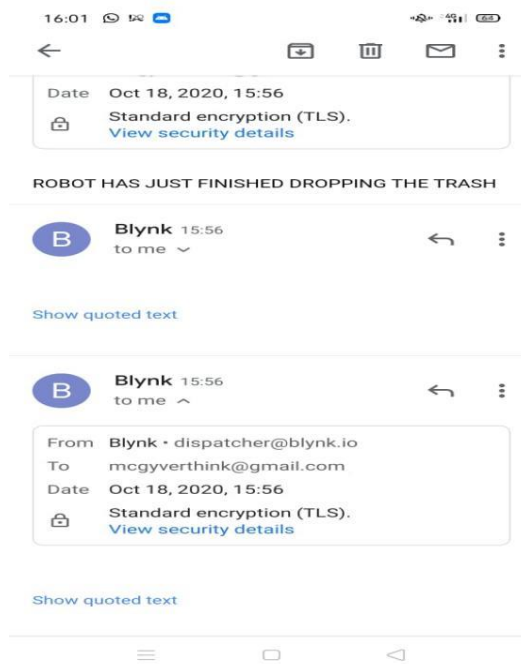


Figure 3. Track Sensor Notifications All Have Logic 0 (in Status C)

4. When the robot has thrown away the trash (during status D)

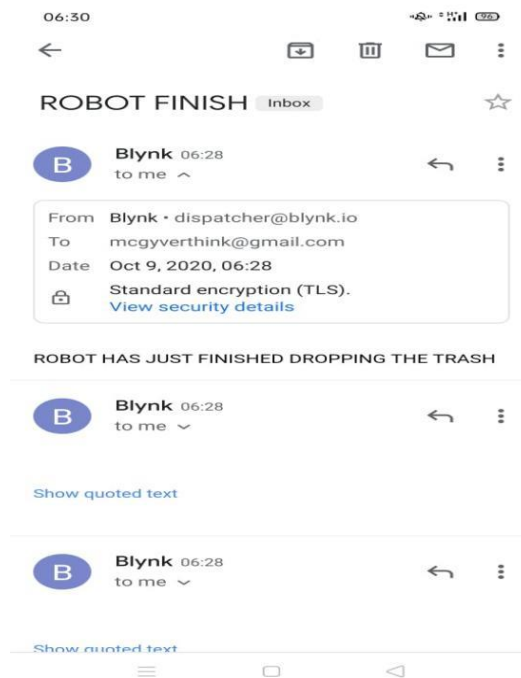


Figure 4. Robot Notification Has Taken Out the Trash (During Status D)

5. When the arm is at the bottom and at the back or when the bottom limit switch is active and the front is active (in status A)

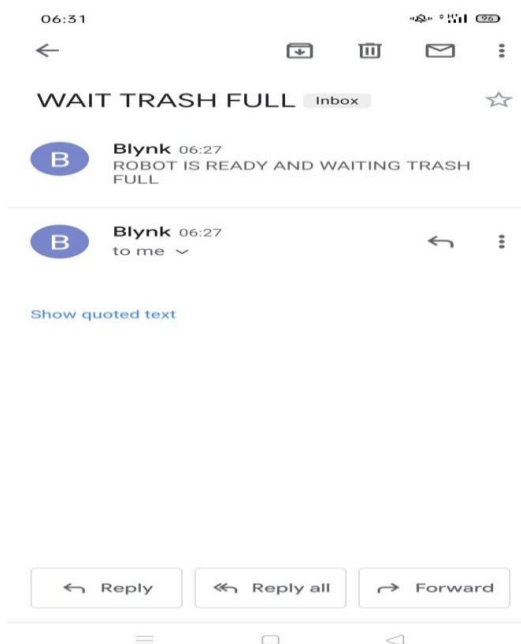


Figure 5. Condition of the Bottom Limit Switch Being Active and the Front Being Active (in Status A)

6. When the robot starts to navigate the track (when status B)

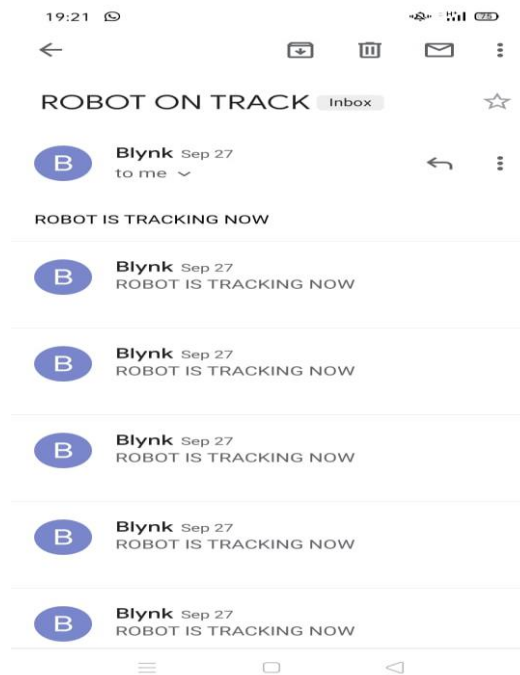


Figure 6. Robot Notification Starting Track Navigation (When Status B)

Test Results on the Thinger Io Platform

From the travel time test results in Table 2, it is known that the longest error difference is 0.31 seconds, this is because the battery voltage factor decreases, this factor cannot be monitored automatically, therefore the author integrates this smart robot prototype with the Thinger Io platform where this platform propose to control battery power and wheel motor temperature capacity via gadget. The results of creating the Thinger Io platform can be seen in the image below.

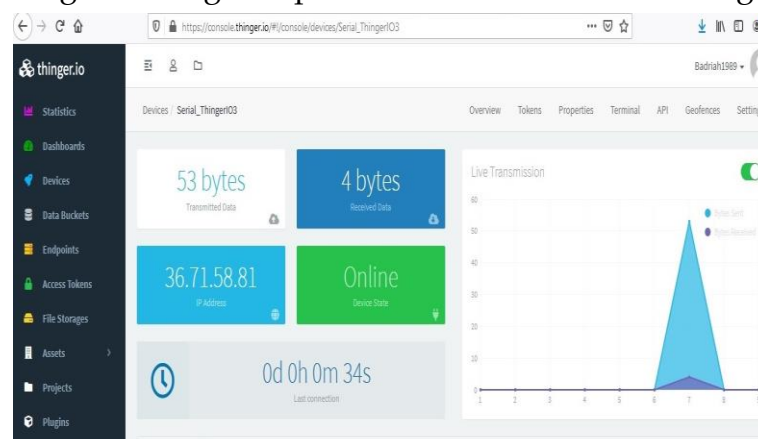


Figure 7. Thinger Io Platform Now Online (Device Page)

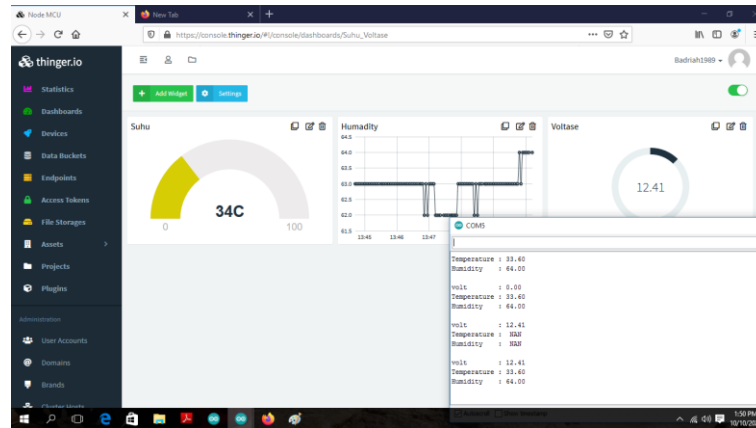


Figure 8. Thingier Io Platform Now Online (Dashboard Page)
Source: (Thingier Io Platform Creation Results)

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research and discussion regarding the design of a smart robot prototype for automatic waste disposal using a microcontroller integrated with IoT (Internet of Things) technology, these are:

1. Be able to control the robot's performance from the robot starts moving until the robot finish carrying out activities and tasks, you can use the Blynk platform as a user interface which can provide email notifications to the user when the user is not in the place. From the results of time testing on the Blynk platform, it can be seen that the average delay is 5.68 seconds, it is meaning data transfer performance from Wemos to Blynk is good and compared with time delay time tolerance at ≥ 30 seconds.
2. The robot able to monitor the battery power and temperature capacity of the wheel motor with a long distance, you can use the Thingier Io platform as a user interface which can monitor the battery power and temperature of the wheel motor while the robot is operating or after the robot has finished operating even though the user at quite a distance
3. The robot can run stably, the tires can be replaced with real rubber, and to improve the prototype so the robot can run without a tracking track, compass or GPS navigation can be added. Then the addition of a microcontroller so that the robot can walk over obstacles.
4. Continuously develop further research into a better version. With this system, users can find out about the robot's work from start of operation to completion of operation via email notifications and can monitor trash bin capacity via the Blynk platform. A database can be added which can be displayed in web form.
5. In the Thingier Io user interface, you can add Data Buckets (Bucket Data Export) so that the robot data operating until the robot has finished operating can be exported to Excel data. This can make it easier for users to read robot movement data every day.

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