ABSTRACT

There is still a lack of public awareness and concern for environmental cleanliness, the problem of waste is still a serious problem for the government. The lack of knowledge about waste management information technology by janitors causes the slow handling of waste. Information on the condition of the volume of the bins can help prevent waste buildup and disease transmission. Therefore, ordering an early detection tool about the condition of the volume of the trash can can send information that the trash can is full to be placed quickly.

Using the Ldr sensor to read the type of trash is see-through or not and the IR sensor to determine the object that is coming. Garbage that is read as transparent will be considered as organic waste and if the waste is read see-through then the waste will be read as inorganic. The data that will be obtained is then sent by the ESP8266 NodeMCU module as a liaison between sensors

This project proposed to create a smart trash bin that can separate organic and inorganic waste. This research uses plastic waste and dried leaves waste for analysis and uses data stored from Thingspeak to be processed using fuzzy to find out when the garbage is full and will be picked up within a day. Result of this project creates a website to monitor the capacity of the trash that facilitates the cleaning process.

Keyword: IOT, waste separation, fuzzy logic

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CHAPTER 1
INTRODUCTION

1.1. Background

Waste production in Indonesia is very large and is considered normal if people throw garbage so that it is considered endless. Bad impacts will be felt if residents are lacking in education on how to properly dispose of waste. The amount of garbage mixed together causes unpleasant odors and diseases to the surroundings if not disposed of in its place. This main problem also spurs on the problem of residents who are not educated about waste disposal. There is still a lack of public awareness and concern for environmental cleanliness. The waste problem is still a serious problem for the government. Lack of information technology waste management by cleaning officers which causes slow waste handling. Information about the condition of the bin volume can help prevent trash accumulation and disease transmission. Therefore, by ordering early detection tools about volume conditions the trash can send information that the trash is full for immediately placed quickly.

Based on the described problem, this project proposed creating a smart trash bin that can separate between organic and inorganic waste. The prototype made using NodeMCU ESP 8266 as the microcontroller, the LDR sensor as a tool for sorting organic and inorganic waste without metal content, Using IR sensor for detect trash to read the movement of incoming trash, NodeMCU itself is available using Wifi from its microcontroller to send data to thingspeak, servo motor to open, close and sort waste according to directions from the LDR later. This application system is used using the Arduino IDE as a cross-platform application. This research uses plastic

waste and dried leaves waste for analysis and uses data stored from Thingspeak to be processed using fuzzy to find out when the garbage is full.

In this analysis, the results to be sought are the accuracy of the waste sorting and also the fuzzy algorithm itself to pick up the waste. This project creates a smart trash can that can separate organic and Inorganic waste. Smart trash can connect to a website to monitor the capacity of the trash that facilitates the cleaning process. (menambahkan benefit apa yang di dapat):

1.2. Problem Formulation

From the background described above, the focus on this problem as follows:

1. How does the LDR sensor read the organic and inorganic waste as transparent and opaque objects?
2. How does the Fuzzy Logic algorithm determine the status of the garbage height level ?

1.3. Scope

Limitation of the problem that the authors put forward in this study are as follows:

1. The datasets used are tissue, paper, cashier receipts, fresh leaves, thin leaves, clear bottles, frosted bottles, plastic bottles with stickers,orange peel, lemon peel, broad dry leaves, small dried leaves, mica plastic, purple plastic, tea bags, medicine bottles.
2. The sensor used to detect organic and inorganic waste is the Photosensitive LDR and IR sensor for detection of the object.
3. Organic and inorganic waste data stored in thingspeak processed using website based on PHP (Hypertext Preprocessor).
4. Fuzzy logic algorithm used to implement calculation of smart trash bin status consist Clean,Normal,Need to clean.

5. Testing the original classification of waste with true and false information

1.4. Objective

The purpose of this analysis is to create a prototype of a smart trash can that separates organic and inorganic waste based on IoT using fuzzy logic as a determinant of the level of fullness of the waste so that it is easier to clean. The light sensor that detects translucent and opaque light in reading objects is not completely translucent or opaque. The result is getting optimal results in reading translucent and blurry objects.

CHAPTER 2
LITERATURE STUDY

In the research of organic and inorganic smart bin are motivated by several concepts that can be used as a reference in this study:

Smart bin with notification based IoT with microcontroller WeMos D1 has been created [1]. This research is used to determine whether the waste is full or not using a microcontroller. The method that authors used is the Prototype model, based on building. Analyze and testing sensor ultrasonic and microcontroller and all works fine to detect the garbage is full or not and after the height of the garbage is detected, the microcontroller will send the results to the existing application. The main of limitation is There are still many errors in measuring the volume of waste because the shape is still a prototype.

Build a smart bin with a volume of trash height with efficient measurement via the web based on NodeMCU [2], data from the surroundings regarding a full trash can that is full. The design is very mature and very neat without any cables scattered in front. The method used by the author is fuzzy logic. The main limitation is use a buzzer to find out whether the trash is full or not so that people immediately know where it is.

A prototype system for Measure the Level of Garbage Surface at Temporary Disposal Sites with Arduino and Web Gis [3], design and the system is running well and the web can be used properly to determine the height of garbage. The author retrieved data from the Pekanbaru city park office regarding the volume of waste in the city. The method used by the author is waterfall prototype model. The limitation is only using ultrasonic sensors to which other helpful sensors can be added.

Build a tool for Designing a waste moisture device using a microcontroller [4]. The author use data by Experiments at PT Mallsampah with a waste moisture detector. This research is used for a tool for designing a waste moisture meter using a microcontroller. The method that authors used is prototype model, based on building. The design and systems are running well and running according to schedule. After designing and testing, the tool is put in a box and placed in the trash to measure humidity and will get a phone if the trash is too damp. The main of limitation is still using 2 Arduino which takes up too much space

A prototype trash can for sectoring of organic and inorganic waste with sensor inductive proximity has been built [5]. Data from trash can organic and inorganic surroundings. The method that author used is prototype model, based on building. Making smart bin using inductive proximity sensors and data collection that is less understood from the article. The main of limitation is can add an SMS alert in the form of a message not only from the LED and Buzzer.

A trash can with automatic modem signal with arduino nano using battery for home electricity is safe[6]. The research is focused on taking out the trash without touching the trash. The method that the author uses is prototype model, based on building.design and construction and testing with GSM modem went very well without problems.With a power source from electricity can actually be replaced with a battery or something. The main limitation is it still depends on the home electricity and there is an error of about 1.94% in the ultrasonic reading of the still dependable movement..

Metal and non-metal waste sorting bin based on microcontroller with highest success rate[7]. This design focuses on sorting metal and non metallic waste.with experiment for 50 times, and the tool works as it should with a success rate of 88%.this article is still rarely found as long as this search is only one thing so it can be a good reference for all.The method that author use is prototype model, base on

building.The main limitation is ultrasonic sensor that only reads objects as far aways as 20 cm so that small metal waste does not separate

Smart bins designed to sort organic and inorganic waste through and android application [8]. Ultrasonic sensor for waste volume,proximity sensor and percentage of successful sorting and application display. The method that the author uses is Fuzzy logic. there is no clarity regarding the power used. The main limitation is sensors that are closely spaced to allow reading errors.

Detect volume from trash bin and then send it to telegram application using microcontroller [9]. The design focus on detects the volume of trash and then sends it via telegram app.with the accuracy of measuring success is 99.14% and can be accessed via telegram. It's just that it only uses a few sensors to which other sensors can be added. The method that author use is prototype model, base on building. The main limitation is cannot be used for foam and foam waste.

Smart bin by using the blynk app to send information [10], application use data from Performing tests on servo and ultrasonic sensors along with the Blynk application using a watch stopwatch. sensor reading error from a distance of 30 to 5 cm with press the error percentage for 6 attempts is only 1-2% with an error percentage of 1.28% .The method that author use is prototype model, based on building. The main limitation is You should add a Buzzer or with LEDs to make it look nicer.

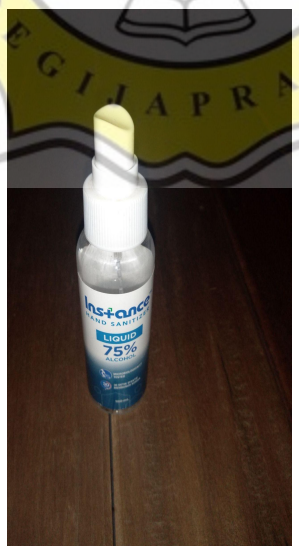
CHAPTER 3
RESEARCH METHODOLOGY

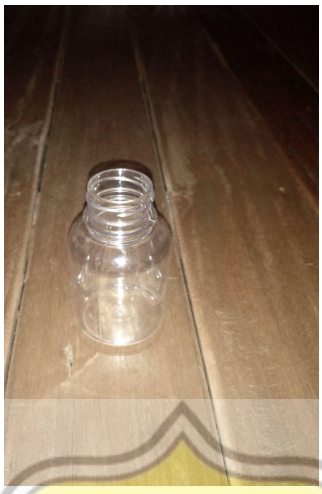
The purpose of this analysis is to create a prototype smart trash can for sorting organic and inorganic waste for organic and inorganic waste sorting based on IOT using fuzzy logic implemented using web based programming language. The steps are carried out in the research will be shown as follows.

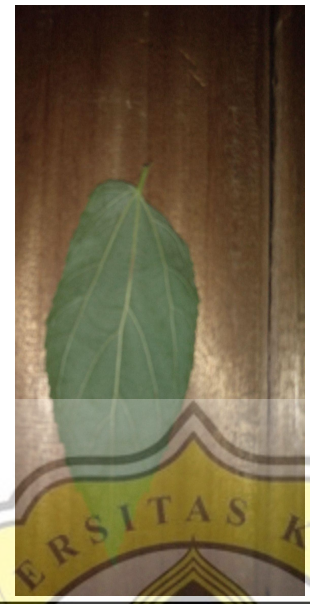
1. Collecting Data

The data to be used in this research are organic and inorganic waste in the form of plastic bottles and foliage from wet to dry. Data sample is shown as in table 3.1

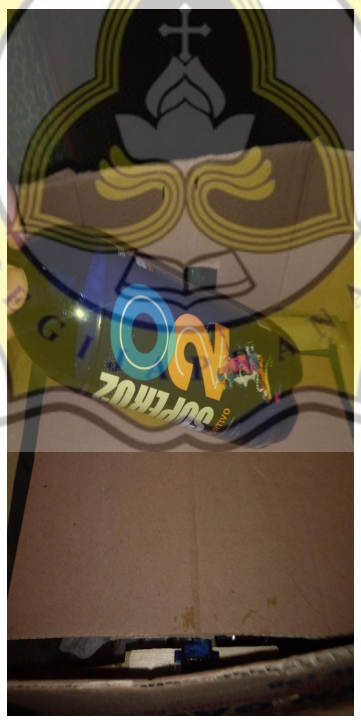
Table 3.1: Sample Data

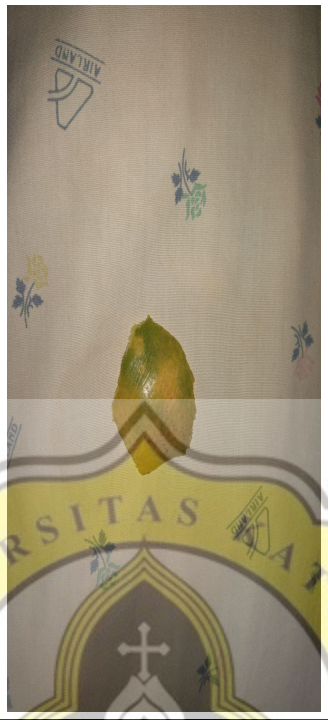
No	Image	Category
1		Inorganic

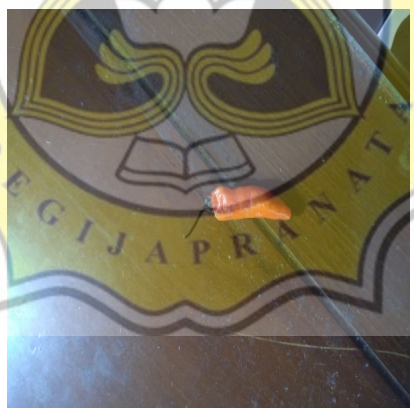
2		Inorganic
3		Inorganic

4		Organic
5		Organic

6		Organic
7		Inorganic
8		Organic

9		Organic
10		Inorganic

11		Organic
12		Organic

13		Inorganic
14		Organic

15		Organic
16		Inorganic

17		Organic
18		Organic

19		Inorganic
20		Inorganic

2. Application Design

Design in this project contains use IOT architecture and flowchart diagram. IOT architecture will represent interaction between microcontrollers that control trash can and application on the user's view based on the website. Flowchart will represent sequence of steps to perform a process from connection to display data as a chart.

3. Development

Development of prototype smart trash can for sorting organic and inorganic waste for organic and inorganic waste sorting based on IOT using fuzzy logic with Arduino IDE and AtomIO for code website monitoring smart trash can. Development will implement code of process includes connecting smart trash can to the thingspeak, get data from thingspeak, fuzzy calculation and show data as chart. Result of the development is application monitoring smart trash can capacity and cleaning status.

4. Testing and Evaluation

The testing process was conducted to determine the failure or error in programming languages written in this project. Tool used to check for determine failure or error is Arduino IDE. Evaluation of the smart trash can prototype using accuracy. The accuracy will calculate number of correct sorting for organic or inorganic waste.

CHAPTER 4
ANALYSIS AND DESIGN

4.1. Analysis

The problem in this project is the separation of organic and inorganic waste. The waste data used is the type of plastic waste and dried leaves. In addition, this project also resolves the problem of online trash monitoring. Existing garbage data is sent to thingspeak to be processed into a fuzzy algorithm.

Garbage entering the trash is detected by the IR sensor then the LDR sensor reads the incoming light, if transparent light is detected by inorganic waste then the servo moves to the right, if not translucent organic waste is detected then the servo moves to the left. Based on the detected garbage NodeMcu will send data to thingspeak. The website that is used to monitor the capacity of the trash can retrieve data from thingspeak in the form of the amount of waste. The data on the amount of waste is then processed using a fuzzy algorithm to determine the clean, medium or full capacity category of the smart bin.

4.2. Design

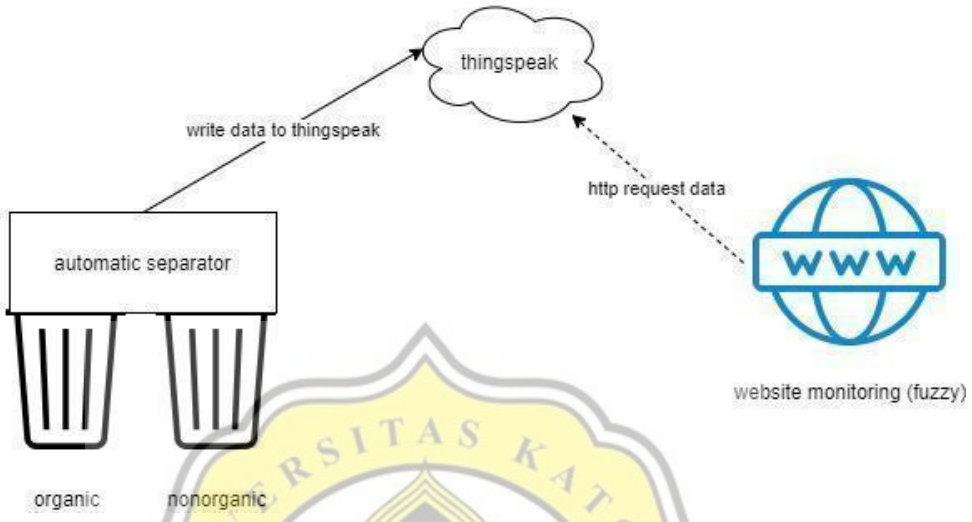


Figure 4.1 System Architecture

Figure 4.1 shows the architecture of all components to create a smart trash can. There are three main components in making this project, namely smart trash, thingspeak and website monitoring. Smart trash can is a prototype trash can that can separate organic and inorganic waste based on IR and LDR sensors that are processed using NodeMCU ESP8226. Data is sent from NodeMCU to thingspeak using API write. In thingspeak the data is stored in the form of fields that have been created to store data on the amount of organic and inorganic waste. On the waste monitoring website, data is taken from thingspeak using the http get protocol. The data taken in the form of the current waste capacity is then processed using a fuzzy algorithm to determine the status of cleaning the trash.

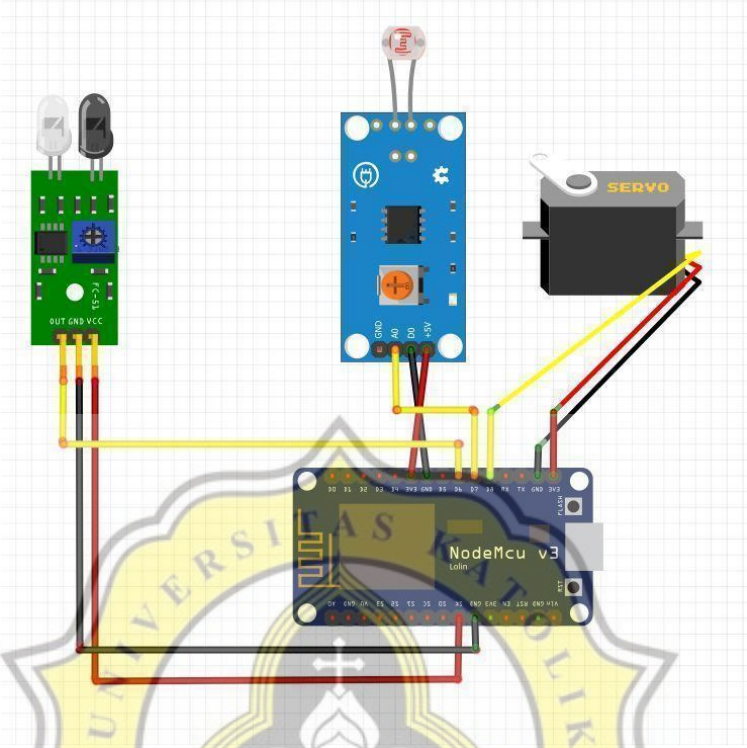


Figure 4.2 Sensor Part Connection

Figure 4.2 shows a series of sensors and NodeMCU in making smart bin. There are two sensors used in this project. Those IR Obstacles and an LDR sensor. Those 2 sensors are assembled on Node MCU. NodeMCU works by receiving sensor input, processing the input and providing output to the servo motor.

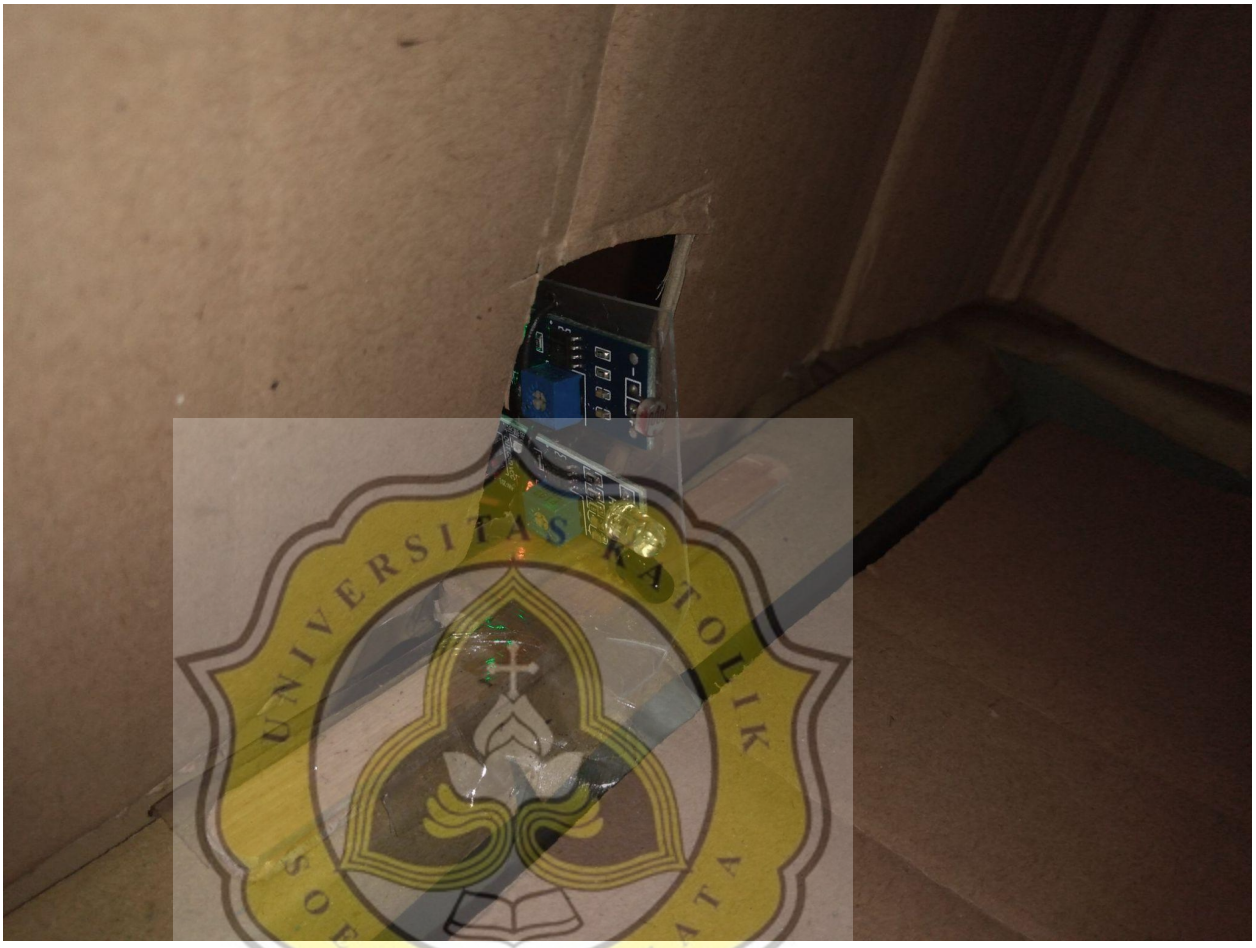


Figure 4.3 Sensor Picture

Figure 4.3 shows the LDR and IR sensors arranged to make it easier if there is garbage entering or detecting incoming light. glued to the plastic mica to hold it in place so it can be adjusted. As long as the IR sensor does not detect objects, the data will not be sent or read. The sensor will be read as a whole if there are objects detected by the IR sensor to be sorted by type of waste.

Figure 4.4 Front view of trash bin

Figure 4.4 is a picture of the front of the prototype trash sorter. The head of the trash can is glued together with glue and also on scotch tape. Two trash bins used in the selection process makes it easy to sort and don't mix if you want to clean.

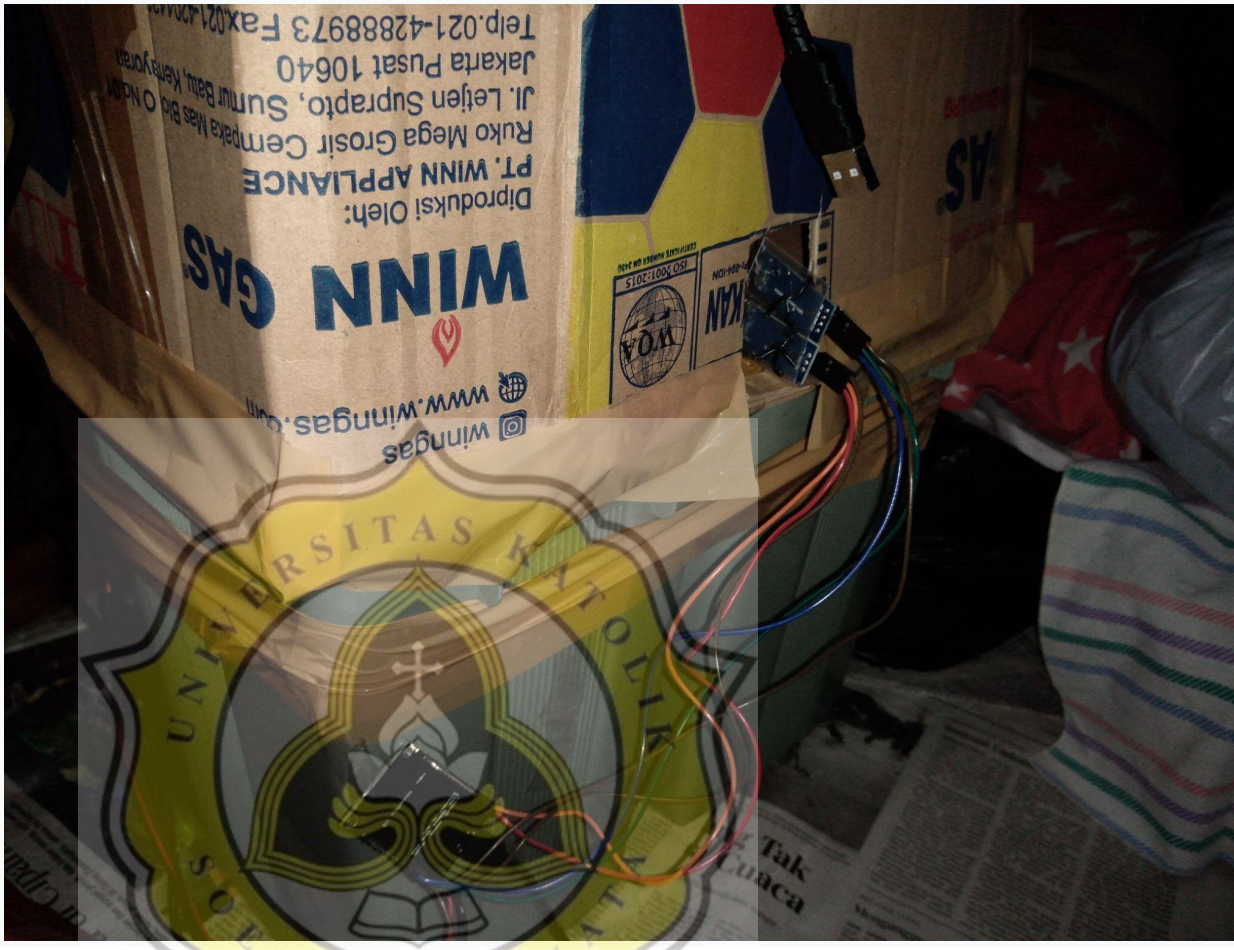


Figure 4.5 Sensor and Module NodeMCU ESP8266

Figure 4.5 is a picture of the back of the waste sorter prototype. where on the back is the NodeMCU ESP8266 module and also the LDR sensor and IR sensor. The jumper wires are interconnected between the sensor and the module.

The connection mapping between from figure 4.2 NodeMCU describe as follows:

1. Module IR Obstacle to NodeMCU

Table 1.1. Module IR Obstacle to NodeMCU

NodeMCU	IR
D6	OUT
G	GND
3V	VCC

2. Module LDR sensor to NodeMCU

Table 1.2. Module LDR sensor to NodeMCU

NodeMCU	LDR
D7	D0
G	GND
3V	VCC

3. Module motor servo Sg90 to NodeMCU

Table 1.3. Module motor servo Sg90 to NodeMCU

NodeMCU	Servo sg90
D8	Kuning / data
G	Hijau/ hitam
3V	Merah

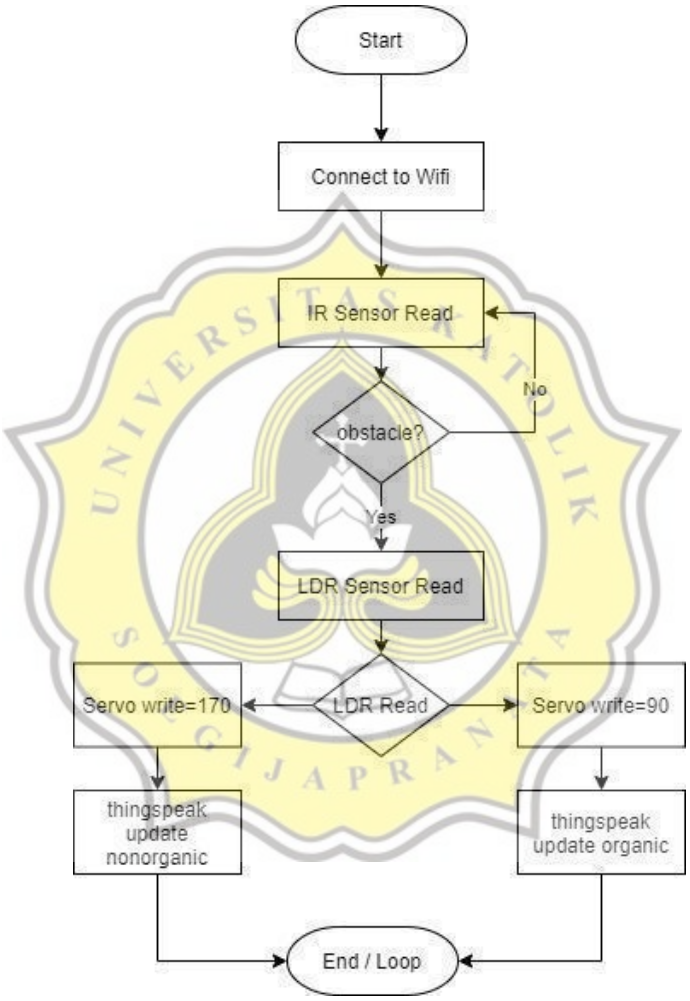


Figure 4.3 Waste Separation Flowchart

Figure 4.3 shows a flowchart in sorting organic and inorganic waste. The flowchart is the flow of programming that is implemented in NodeMCU. The initial initialization of NodeMCU is to connect the device to the configured wifi. Then the IR sensor reads if there is an obstacle it will be forwarded to the LDR sensor. The LDR sensor will read the light condition if it is translucent then the servo will rotate

to the left then send data updates to thingspeak for the amount of inorganic waste, if it is not translucent the servo will rotate to the right then send data updates to thingspeak for the amount of organic waste.

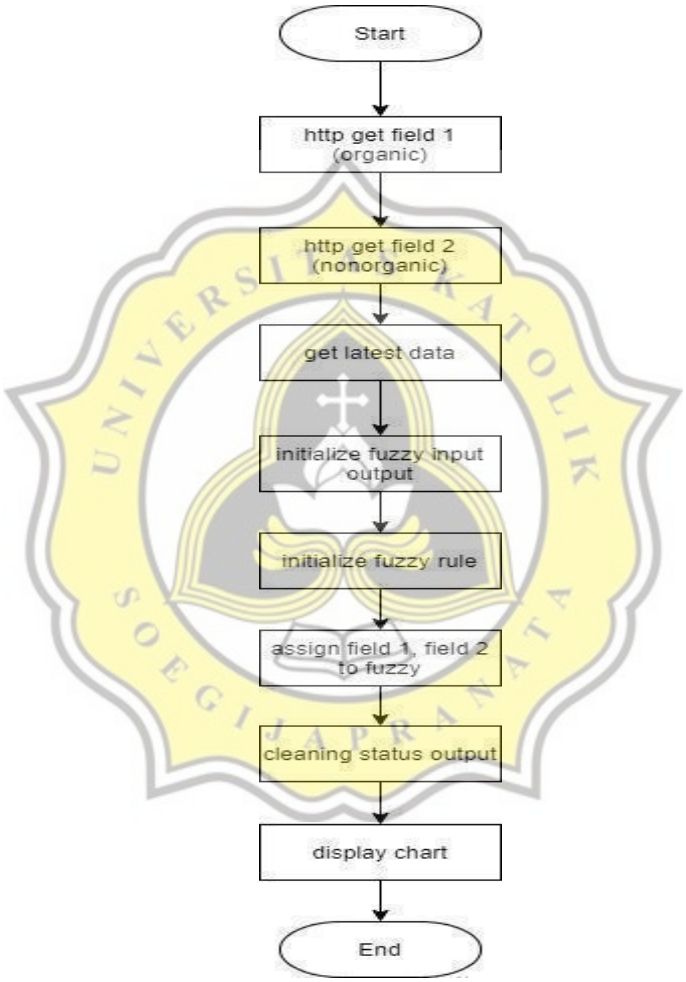


Figure 4.4 Website Monitoring Flowchart

Figure 4.4 shows a flowchart from the smart trash can monitoring website. The initial step starts from retrieving data from thingspeak. The data taken is field 1 organic and field 2 Inorganic. The data in the fields taken is in the form of the latest

data on the amount of waste. The process of a fuzzy algorithm starts with input and output initialization, then fuzzy rule initialization. After initialization, the original data in the form of field 1 and field 2 are entered into the fuzzy model that has been created. The output of the fuzzy algorithm is a garbage cleaning status. The final result is displayed in chart form. with the following explanation :

A. Determine variable fuzzy

At this stage it is explained that we have the right to determine in advance the fuzzy variables, both input variables and output variables, as shown in the following table:

Table 4.1 Variable fuzzy

Variable Type	Variable Name
Variable Input	Organic Non Organic
Variable Output	Status

B. Determine Linguistic value

The following is a table of linguistic variable names and values.

Table 4.2 Linguistic value

Variables Name	Linguistic Value
Organic	Low , Medium , Full
Non Organic	Low , Medium , Full
Status	Clean , Normal , Need to Clean

C. Determine Fuzzy rule

Fuzzy rules are created based on the author's own logic (in this project I created my own fuzzy rules).

Table 4.3 Fuzzy rule

Variable		Status
Organic Low	Nonorganic Low	Clean
Organic Low	Nonorganic Medium	Clean
Organic Low	Nonorganic Full	Need to Clean
Organic Medium	Nonorganic Low	Clean
Organic Medium	Nonorganic Medium	Normal
Organic Medium	Nonorganic Full	Need to Clean
Organic Full	Nonorganic Low	Need to Clean
Organic Full	Nonorganic Medium	Need to Clean
Organic Full	Nonorganic Full	Need to Clean

Table 4.3 is an explanation of the fuzzy rules themselves. Fuzzy rules are made based on the logic of the author himself with different cases. so that they can understand more easily about the rules of the fuzzy.

D. Determine the realm of linguistic values

Table 4.4 Realm Linguistic Values

Variable Names	Linguistik Value	Value
Organic	Low	0; 20; 40

	Medium	20; 50; 80
	Full	60; 80; 100;
Nonorganic	Low	0; 20; 40
	Medium	20; 50; 80
	Full	60; 80; 100;
Status	Clean , Normal, Need to Clean	

Table 4.4 explains that there are variable names such as organic and non-organic as well as status. In the linguistic value there is the height of the trash such as low, medium and full. The result of the linguistic value in the form of a number range from each linguistic value.

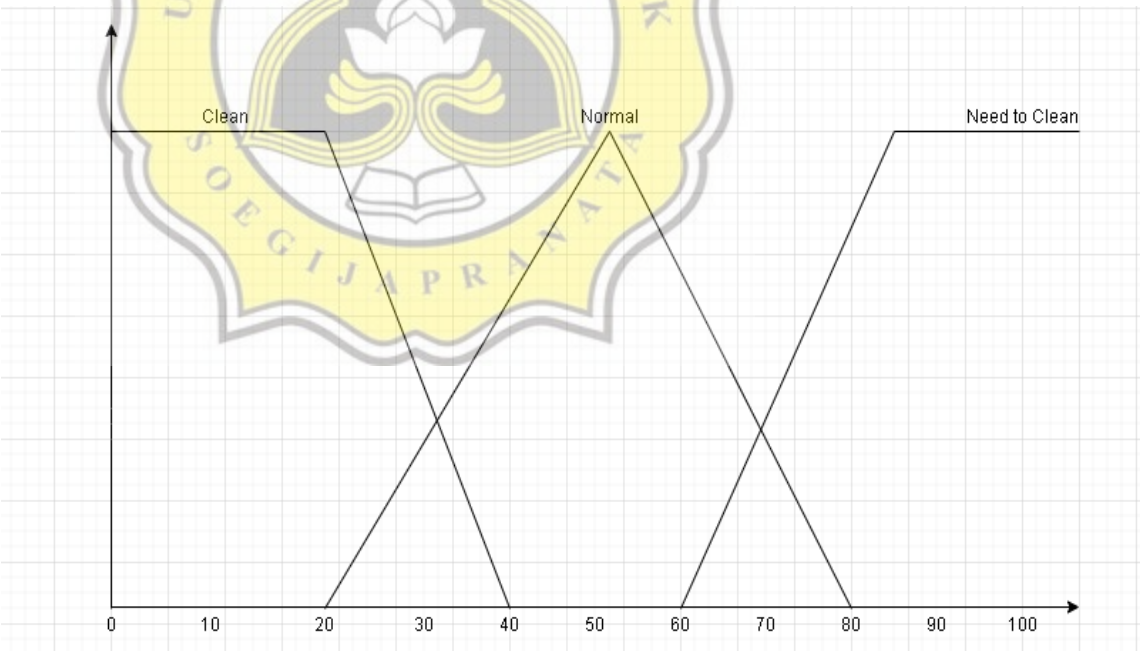


Figure 4.5 Membership function input organic and inorganic

Figure 4.5 shows an image of the membership of the fuzzy output variable, with a value range of [0-100]. This output variable consists of 3 sets, namely

membership function CLEAN with a number range between (0.20,40) membership function NORMAL with a number range between (20,50,80), membership function NEED TO CLEAN with a number range between (60,80,100).

Below is an explanation of the fuzzy set graph formula from organic and inorganic sets, with formulas such as for example :

$$\text{NilaiClean}[X] = \begin{cases} 1 & , x \leq 20 \\ \frac{20-x}{50-20} & , 20 \leq x \leq 50 \\ 0 & , x \geq 50 \end{cases}$$

$$\text{NilaiNormal}[X] = \begin{cases} 1 & , x = 50 \\ \frac{x-20}{50-20} & , 20 \leq x \leq 50 \\ \frac{80-x}{80-50} & , 50 \leq x \leq 80 \\ 0 & , x \leq 20 \vee x \geq 80 \end{cases}$$

$$\text{NilaiNeedclean}[X] = \begin{cases} 0; & x \leq 50 \\ \frac{x-50}{80-50}; & 50 \leq x \leq 80 \\ 1; & x \geq 80 \end{cases}$$

Figure 4.6 Formula Himpunan Organik

The formula above is the formula for the graph of the set x, which is the graph of the set of organic values. The membership function of fuzzy clean, normal, and needed clean sets. Value of x will be used in the reference value to be able to calculate.

$$\text{NilaiClean}[Z] = \begin{cases} 1 & , Z \leq 20 \\ \frac{50-x}{50-20} & , 20 \leq Z \leq 80 \\ 0 & , \geq 50 \end{cases}$$

$$\text{NilaiNormal}[Z] = \begin{cases} 1 & , Z = 50 \\ \frac{Z-20}{50-20} & , 20 \leq Z \leq 50 \\ \frac{80-Z}{80-50} & , 50 \leq Z \leq 80 \\ 0 & , Z \leq 20 \vee Z \geq 80 \end{cases}$$

$$\text{NilaiNeedclean}[Z] = \begin{cases} 0; & Z \leq 50 \\ \frac{Z-20}{80-20} & ; 20 \leq Z \leq 80 \\ 1; & Z \geq 80 \end{cases}$$

Figure 4.7 Formula himpunan inorganic

In the above formula is the formula for the graph of the set z, which is a graph of the set of inorganic values. Fuzzy clean, normal, and need clean set membership functions. The z value will later be used in the reference value to be able to calculate.