CHAPTER 4
ANALYSIS AND DESIGN

4.1 Analysis

This section discusses the objectives of project analysis, sensor analysis, testing methods and problem analysis.

A. Objective of Project Analysis

The purpose of the project analysis here is to obtain the results of whether there is a problem from the main objective of this study, namely to determine the optimum distance from the Inductive Proximity sensor and determine the accuracy of the Inductive Proximity sensor in reading objects against objects that are not fully metal.

B. Sensor Analysis

Ultrasonic Sensor HC-SR04:

Illustration 4.1 Ultrasonic Sensor HC-SR04

Serves to detect human objects when going to throw trash and as a garbage volume detector.

The ultrasonic sensor is set at a maximum distance of 100 cm, but the sensor will detect human objects at a distance of <30 cm and will order the servo to open the lid of the trash.

The HC-SR04 Ultrasonic Sensor also functions as a garbage volume detector. The ultrasonic sensor is set at a maximum distance of 100 cm, but the sensor will detect the volume of garbage when the trash is full and the garbage is read by a sensor with a distance of <10 cm and will send e-mail notifications to users via library PHPMailer using Http Request.

Table 4.1: HC-SR04 Ultrasonic Sensor Data Analysis Table

No	The Object	Distance	Results
1	Human	<30 Cm	Detected by sensor
2	Human	>30 Cm	Not detected by the sensor
3	Garbage Volume	<10 Cm	Detected by sensors, full garbage
4	Garbage Volume	>10 Cm	Not detected by sensors, garbage is not full

The table above explains the HC-SR04 ultrasonic sensor data analysis table, where the test data uses human objects with a distance of less than 30 cm and more than 30 cm and garbage objects to measure the volume with a distance of less than 10 cm and more than 10 cm to get results that can be analyzed.

Inductive Proximity Sensor:

Illustration 4.2 Inductive Proximity Sensor

Functioning to detect metal objects, the Inductive Proximity sensor generates a sensor value when a metal object is detected and adjusted when the sensor value = 1, the sensor reads the metal trash object and will instruct the servo at the stopbox to open the trash door for metal, but if the sensor value = 0 then the sensor reads a non-metallic trash object and will instruct the servo at the stopbox to open the non-metallic trash door.

Table 4.2: Inductive Proximity Sensor Data Analysis Table

No	Trash	Trash Type	Metal Waste Composition
1	Drink Cans	Metal	100 %
2	Spike	Metal	100 %
3	Perfume Cans	Metal	70 %
4	Scissors	Metal	50 %
5	Used Cable	Metal	20 %
6	Paper	Non-Metal	0 %
7	Used Cloth	Non-Metal	0 %
8	Plastic Bag	Non-Metal	0 %
9	Plastic Snacks	Non-Metal	0 %
10	Styrofoam	Non-Metal	0 %

The table above explains the analysis of Inductive Proximity Sensor data with some garbage data samples that are used as tests with the type of waste, the metal composition of the waste.

C. Testing Methods

The method of testing Inductive Proximity sensors to determine the optimum distance of Inductive Proximity sensors in reading objects is to bring metal waste to the sensor and find the optimum distance. Tests carried out with a distance of 0.1 cm, 0.3 cm, 0.5 cm, 1 cm, 1.5 cm and 2 cm.

The method of testing Inductive Proximity sensors to determine the accuracy of sensors in reading objects against objects that are not fully metal, namely by scanning the four sides of metal waste to the Inductive Proximity sensor as much as 5x testing, the first test using scrap metal scrap cable with 25% metal composition, testing the second uses scissors metal trash with 50% metal composition, the third test uses perfume metal trash with 75% metal composition, the fourth test uses beverage can metal trash with 100% metal composition, the fifth uses metal nails with 100% metal composition.

D. Problem Analysis

In the sensor analysis process there is a problem where the reading of the Inductive Proximity sensor to metal objects has an inconsistent response time. Where one metal object with another has a different response time when the metal object is brought closer to the

Inductive Proximity sensor. For non-metallic objects there is no difference in response time because basically the Inductive Proximity sensor detects only metallic objects, for non-metallic objects the Inductive Proximity sensor does not issue any output.

4.2 Desain

A. Flowchart System

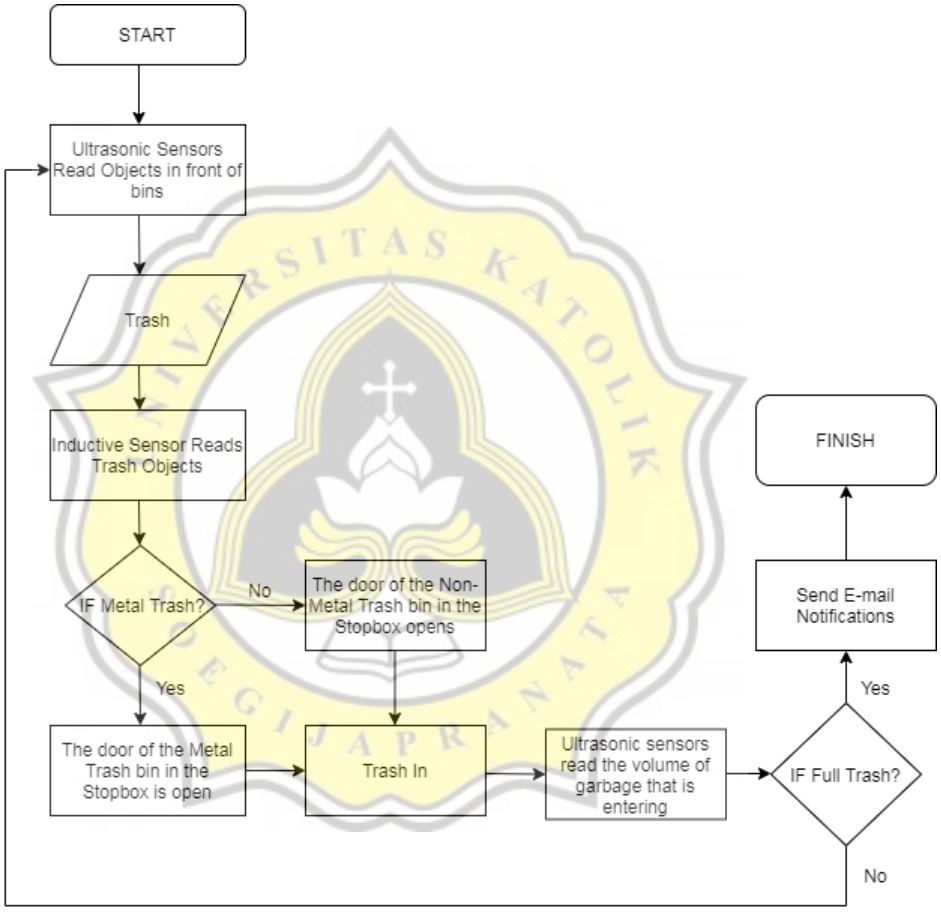

Illustration 4.3 Flowchart System

This section explains the design of the IoT-based flowchart prototype Trash Separation System, where users who will dispose of waste will be detected by an ultrasonic sensor in front of the trash bin, then the incoming garbage will be detected by Inductive Proximity sensors in the trash bin stopbox system if the trash is made from metal then the servo will open the metal trash door on the stopbox, if the trash is made of non-metal, then the servo will open the non-metal trash door on the stopbox. Furthermore, the incoming garbage and ultrasonic sensor

inside the trash will detect the volume of the trash if the trash can is full, it will send e-mail notifications to the user if not then wait for the next garbage to enter until the garbage volume is full.

B. Prototype Design

In this section, the overall design of the IoT-based Trash Separation System prototype will be explained. The components used are as follows:

Table 4.3 Component Table

No	Component Name	Amount
1	Arduino Uno	1
2	Ethernet Shield	1
3	Ultrasonic Sensor HC-SR04	2
4	Sensor Inductive Proximity	1
5	Micro Servo SG90	3
6	Breadboard	1
8	Jumper Male to Male Cable	10
9	Jumper Male to Female Cable	10

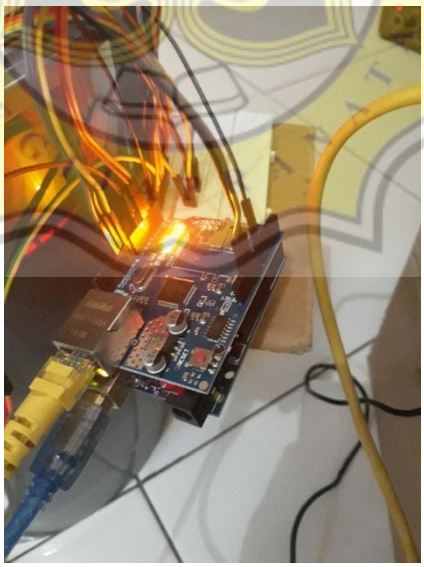

Illustration 4.4 Arduino Uno with Ethernet Shield

Arduino Uno is connected to the Ethernet Shield where the Ethernet shield functions to connect the internet using an RJ-45 cable to Arduino and pc via IP services. Later the Ethernet

shield is used to communicate between the server and the client to send e-mail notifications when the HC-SR04 ultrasonic sensor detects the volume of junk in full.

Illustration 4.5 HC-SR04 Ultrasonic Sensor Front

The HC-SR04 Ultrasonic Sensor has two functions in the design of the prototype of this study, the first as a detection of human objects in front of a trash can. When the Ultrasonic sensor detects an object in front of the trash can with a distance of less than 30 cm, the sensor will send a signal to Arduino Uno to order the servo to open the door of the trash. HC-SR04 ultrasonic sensor here is used as input to Arduino Uno and servo here as Output.

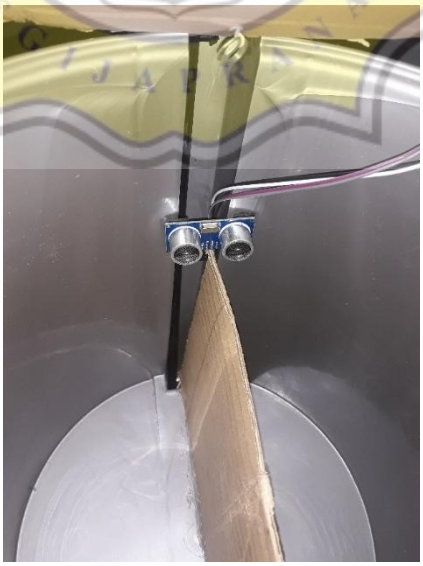

Illustration 4.6 HC-SR04 Ultrasonic Sensor Inside

Secondly as a detector for the volume of the trash, the HC-SR04 Ultrasonic sensor is inside the trash. When the ultrasonic sensor detects that the trash can is full with the distance of the trash object read by the sensor less than 10 cm, the sensor will send a signal to Arduino Uno to send e-mail notifications via Ethernet Shield.

The Inductive Proximity sensor design section is attached to the stopbox mechanism, the function of the stopbox mechanism here is as a garbage checkpoint before the trash enters the trash bin where the stopbox mechanism has two garbage doors, a left door as a non-metal waste door and a right door as metal trash door. In the middle of the stopbox there is an Inductive Proximity sensor as a metal waste detector. This stopbox system also serves to prevent trash from getting out of place. If the Inductive Proximity sensor reads metal junk, the servo will open the metal junk stopbox door, but if the Inductive Proximity sensor does not read metal junk, the servo will open the non-metal junk stopbox door.

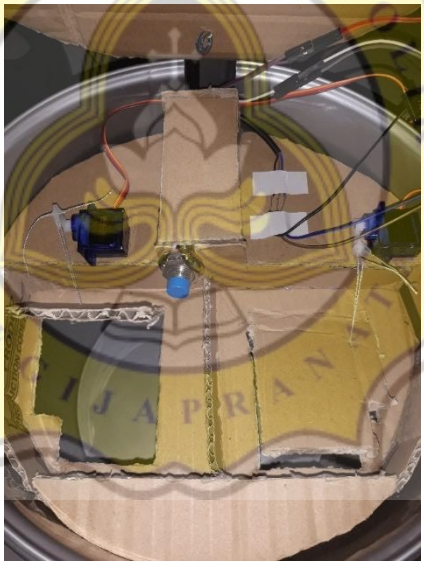

Illustration 4.7 Servo on the Stopbox opens a non-metallic trash door

In the picture above shows the Inductive Proximity sensor when the sensor does not read metal waste, the servo opens the non-metal waste door on the left.

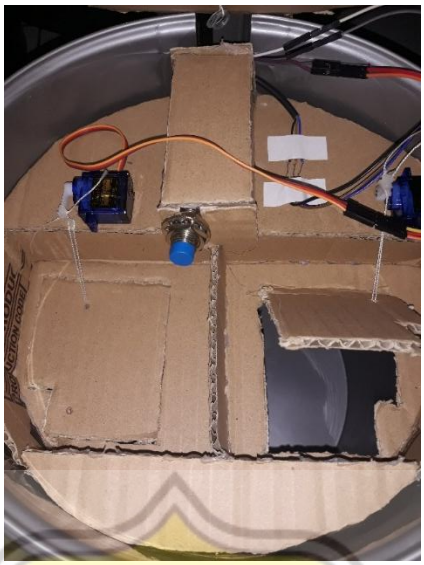

Illustration 4.8 Servo on the Stopbox opens the metal trash door

In the picture above shows the Inductive Proximity sensor when the sensor reads metal waste, the servo opens the metal waste door on the right.