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Designing A Web-Based Information System At SMP Negeri 1 Kualuh Hilir

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ABSTRACT
The rapid development of information technology in the era of globalization has brought significant changes in various fields, including education. SMP Negeri 1 Kualuh Hilir, as an educational institution, requires a web-based information system to facilitate easy and flexible access to information for students, teachers, and parents. This study aims to design and implement a web-based information system with the integration of the Internet of Things (IoT) concept for smart trash management, using the MQTT protocol and the WeMos D1 (R2) microcontroller. The research methodology includes literature studies, observations, needs analysis, hardware and software design, implementation, and system testing and evaluation. The results of the study indicate that the developed system and tools function well, with positive assessments from trials and adequate evaluation results.

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INTRODUCTION

The development of information technology that occurs in this era has made changes that occur in various fields, information technology is always developing very rapidly in the era of globalization, changing many of the main aspects for organizations and companies that are never separated from users using web-based. In the context of developing human resources, education is a very good means and vehicle for fostering human resources in the field of education, therefore education needs to get more serious attention, both by the government, society and education managers, especially in

SMP NEGERI 1 KUALUH HILIR is one of the state schools engaged in the field of education with the development of web-based information technology which is currently developing rapidly, so SMP NEGERI 1 KUALUH HILIR needs a system with an information system with a web-based education system that allows users (students, teachers, parents) to access and obtain information more easily anywhere and anytime. Based on the explanation above, the researcher determined several research problem formulations as follows:

1. How to design a web-based information system At State Middle School 1 Kualuh Hilir?
2. To implement the system as a notification of the status of the trash bin being closed/opened and implementing the IOT concept with the MQTT protocol and

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recording data into *database* which can be monitored with a web-based system and using a microcontroller *WeMos* D1 (R2).

Theoretical Basis

Basic theory about the concepts used in designing and creating the system in this research will be discussed in the following sub-chapters:

Definition of Waste

Basically, the general definition of waste that we know is something that is no longer useful. The definition of waste according to experts is as follows: Waste is solid waste consisting of organic and inorganic materials that are considered no longer useful and must be managed so as not to endanger the environment and protect development investments. Another theory says that waste is the remains of human daily activities and/or from natural processes in solid form. Types of Waste Based on its type, waste, especially solid waste, can be classified as follows:

1. Organic waste is a type of waste that consists of plant and animal components taken from nature or produced from agricultural, fishery or other activities. This waste is easily decomposed by natural processes. For example, dry leaves, wood, rotten vegetables, rotten fruit, and other types that are easily decomposed by natural processes and can be used as compost.
2. Inorganic waste is a type of waste that comes from non-renewable natural resources such as minerals and petroleum or is produced from industrial processes.

Some of these materials do not exist in nature, namely plastic and aluminum. Some inorganic substances cannot be completely decomposed by nature, while others are only decomposed slowly. This type of waste at the household level is in the form of: bottles, plastic bottles, plastic bags, cans, and glass.

Internet of Things (IoT)

Internet of Things or also known by the abbreviation IoT, is a concept that aims to expand the benefits of continuously connected internet connectivity that allows us to connect machines, equipment, and other physical objects with network sensors to obtain data and manage their own performance, allowing machines to collaborate and even act on new information obtained independently. Basically, IoT devices consist of sensors as a data collection medium, internet connections as a communication medium and *server* as a collector of information received by sensors and for analysis [3].

Microcontroller

A microcontroller is a functional computer system in a *chips* which contains a processor core, memory, equipment *input output* and control with programs that can be written and erased. Microcontrollers are commonly used to control electronic equipment, which emphasizes efficiency and cost-effectiveness.literally it can be called a “small controller” where an electronic systemwhich previously required many supporting components such as TTL and CMOS ICs can be reduced/smaller and finally centralized and controlled by a microcontroller [10].

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WeMos D1 (R2)

The WeMos D1 (R2) microcontroller is based on the ESP8266, which is an 802.11 wireless (WiFi) microcontroller module that is compatible with *Arduino* IDE. The layout of this microcontroller is based on the design *hardware Arduino* standard with the same proportions as *Arduino One* And *Leonardo*. This microcontroller also includes a set *Header Arduino* standard which means it is compatible with a wide range of Arduinos *shield*. Physical form of WeMos D1 (R2) itself can be seen in Figure 2.1.

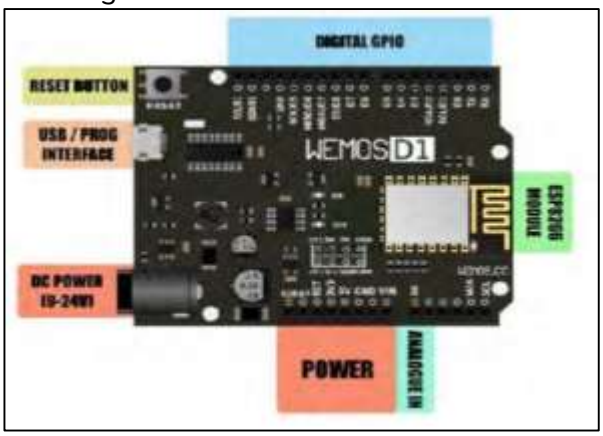

Figure 2. 2 WeMos D1 (R2) [11]

Table 2.1 WeMos D1 (R2) specifications [11].

Hardware	Specification
Microcontroller	ESP-8266EX
Operating Voltage	3.3 V
Digital I/O *Pins*	11
Analog Input Pin	1
Clock Speed	80MHz/160MHz
Flash Memory	4 MB
Length	68.6mm
Width	53.4mm
Weight	25g

Weight Sensor (Load Cell)

Load cell is an electronic device (*transducer*) which is used to convert pressure into an electrical signal quantity. *Strain Gauge Load Cell* is a sensor used to convert pressure into an electrical signal, through changes in resistance that occur in *Strain Gauge* with a pressure in the form of deformation (strain). *Load cell* usually consists of four layers *Strain Gauge* in bridge configuration *wheatstone*. Electrical signal output *Strain Gauge Load Cell* only a few *millivolts* so it requires amplification with a differential instrumentation amplifier before it can be used. *Output* from *Strain Gauge Load Cell* processed into an integrated algorithm to calculate the forces applied to the Strain *Gauge Load cell. Load cell* commonly used in industry to measure the weight of steel, containers and others. There are many types of *load cell* and has the ability to read weights of up to 10 tons. However *load cell* used in this study is *Load*

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Cell(LAB-BB) which has 4 red pins as VCC, black as GND, green and white as*output*, and can read weights up to 10kg. The following is*Load Cell*(LAB-BB).

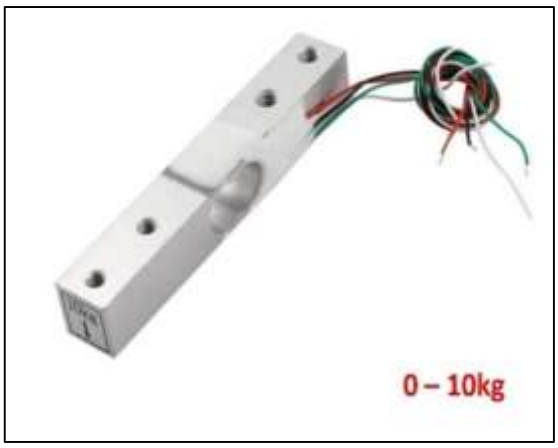

Figure 2. 3 Weight sensor (*Load ce*) [4]

HX711 Module

The HX711 module is an amplifier module that is commonly used in digital scale circuits as an analog to digital signal conversion module.*load cell*. Has high precision 24 ADC*high gain input*designed for various types of sensors*Bridge*. With two*channel*A and B (*fix gain*32) who communicate in a*multiplex*, this module can be programmed to*gain*128 or 64 (20mV or 40mV). The working principle of the HX711 module is as a voltage amplifier on the load cell when*load cell*working. HX711 24-bit precision*analog to digital converter*(ADC).

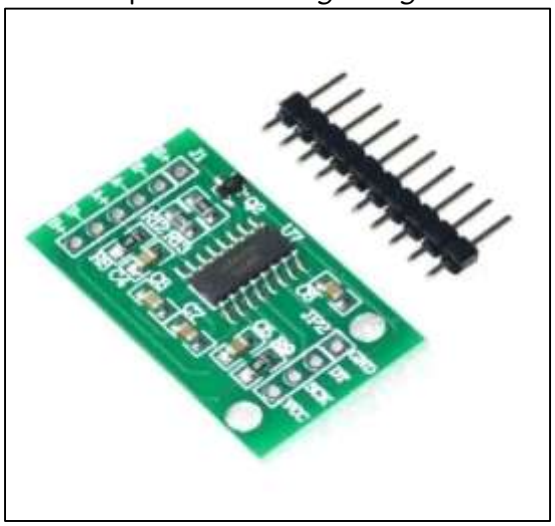

Figure 2. 4 ModuleHX711 [12].

Magnetic Switch Sensor (MC-38)

Sensor*magnetic switch*is a door opening/closing detector sensor that works based on the electromagnetic principle. Under normal conditions (sensor and magnet are not close together), the switch is in the open condition (*normally open*/ NO). In the active condition when the sensor and magnet are close or the door is closed, the switch is in the closed

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condition (*closed circuit*) with a resistance value of ±4Ω. This switch is a magnetic sensorwhich is paired with a natural magnet packed in a ready-to-stick plastic box that can be applied directly to doors, windows, drawers, cupboards and so on made of non-metal, on the sensor component there is a cable that can be directly connected to the microcontroller, or can also be used as a switch to activate other electronic circuits.

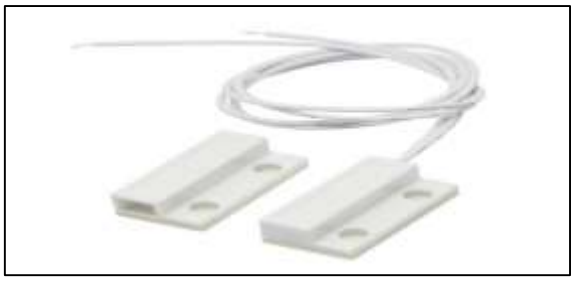

Figure 2. 5 Sensors*magnetic switch*[13].

Message Queuing Telemetry Transport (MQTT) Protocol

MQTT protocol (*Message Queue Telemetry Transport*) is a lightweight messaging protocol (*lightweight*) based*publish-subscribe*used on top of the TCP/IP protocol. This protocol has a data packet size*low overhead*small (minimum 2)*gigabyte*) with low power consumption. MQTT is open, simple and designed to be easy to implement, capable of handling thousands of*client*long distance with only one*server*. These characteristics make it ideal for use in many situations, including confined environments such as in communications.*Machine to Machine*(M2M) and context*Internet of Things*(IOT) where code is needed*footprint*small and/or limited networks. Message patterns*publish-subscribe*need*broker*message.*Broker*responsible for distributing messages to interested clients based on message topics. The following are the features of the MQTT protocol:

1. *Publish/subscribe message pattern*which provides message distribution from one to many and*decoupling*application.
2. *Messaging transport*Which*agnostic*with the contents of*payload*.
3. Using TCP/IP as the basic network connectivity.
4. There are three*Level of Quality of Service*(Qos) in delivering messages:
   a. “At most once”, where messages are delivered with the best effort of the TCP/IP network.Message loss or duplication may occur.
   b. “At least once”, it can be ensured that the message is delivered even though duplication is possiblehappen.
   c. “Exactly once”, where the message is guaranteed to arrive exactly once.

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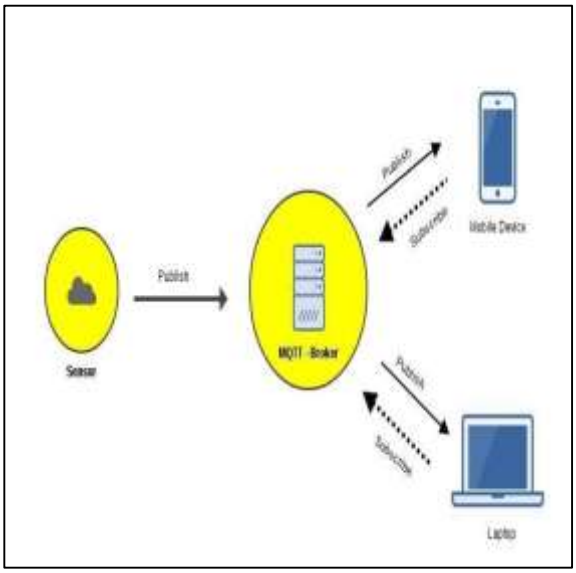

Figure 2.6 MQTT architecture [14].

METHODOLOGY

Implementation Plan

As for the research implementation plan*Smart Trash Can*IoT based, in Figure 3.1.

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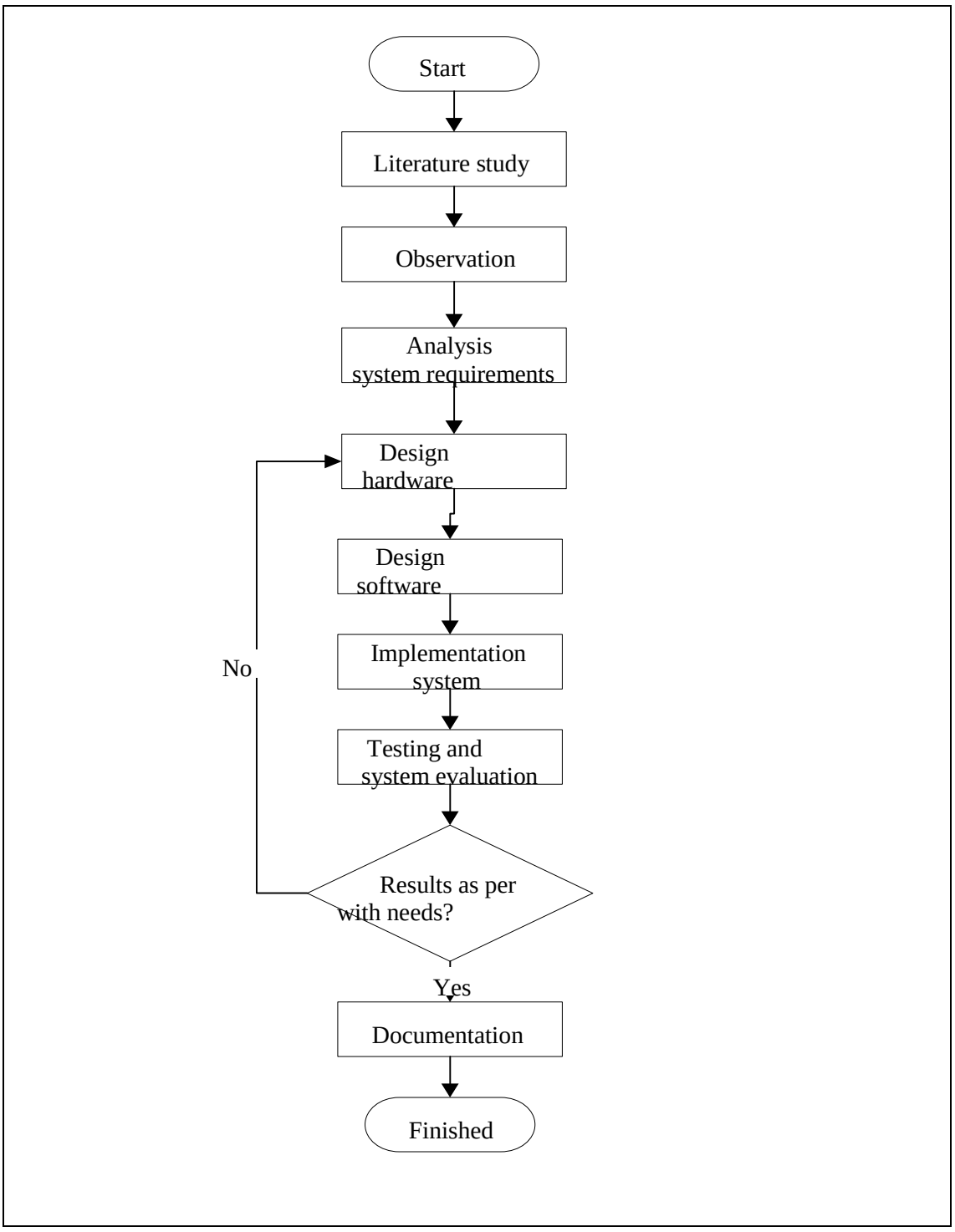

3 Figure 1 Flow diagram of research stages.

Figure 3.1 shows the flow of the system research implementation plan.*Smart Trash Can*IoT Based for Residential Waste Officers. The explanation for each process in Figure 3.1 is as follows:

1. Literature study

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In the literature study stage, studies and reviews are conducted on previously conducted research and other research related to the research to be conducted. This review is conducted to find out the results of previously conducted research, so that it can be used as a reference for the research to be conducted.

2. Observation
   At the observation stage, researchers go directly to the field to obtain information related to the problem.
3. System requirements analysis
   At the system requirements analysis stage, an analysis of the system requirements is carried out.*Smart Trash Can*IoT Based for Residential Waste Officers to be built, such as analyzing what devices are needed in the design and construction process of the system.
4. Hardware design
   At the hardware design stage, the entire system hardware circuit is designed in the form of the architecture and electronic circuit of the system*Smart Trash Can*IoT Based For Residential Waste Officers.
5. Software design
   At the software design stage, it will be related to the software-based system.*web*as a medium*monitoring*and the MQTT architecture design of the system.
6. Implementation
   At the implementation stage, the system devices are prepared*Smart Trash Can*IoT Based for Residential Waste Officers and the implementation of the MQTT protocol and the creation of an IoT-based system*web*in other words, this stage is the stage of building a complete system.
7. System testing and evaluation
   In the system testing and evaluation stage, testing is carried out on the system that has been built and evaluating the test results. If the system is running according to needs, it will proceed to the next stage, but if the system has not run according to needs, a review will be carried out on the hardware design.
8. Documentation
   At the documentation stage, a report will be made of the results of previously carried out activities.

System Analysis And Design

Problem Analysis

Garbage is the waste output from all human activities. Every day humans produce garbage, both organic and inorganic garbage which has various shapes and types, it is not surprising that this problem. also found in many residential areas. Household waste is one of the problems that is still faced by all cities in Indonesia, this problem arises in urban areas due to the limited yard space owned by city residents, so they cannot manage their own household waste.

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Based on these problems, the city sanitation service team manages it by designing and building a lot-based Smart Transh can and transporting and storing waste in stages from the waste source to the TPS/containers provided.

Based on the assessment results of the sanitation service team, the volume of waste produced every day in the city is 1126m3, where the largest contributor is household waste, which is 425m3/day, the rest consists of market waste, commercial waste, public facilities, roadside sludge, industrial areas and others.

System design

Design the interface

The following is a series of interface page designs on the IoT-based Smart Trash Can system for Residential Waste Officers which has two actors, namely residential waste officers and housing residents.

a. Login Page

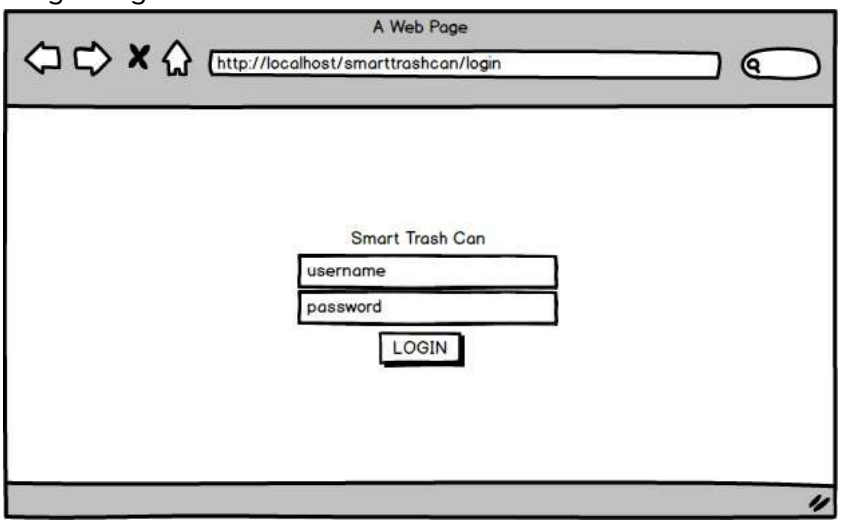

Figure 3.7 Login page.

Figure 3.7 shows the login page that will be used as a gateway to access the main page of the system by entering a username and password.

b. Home Page

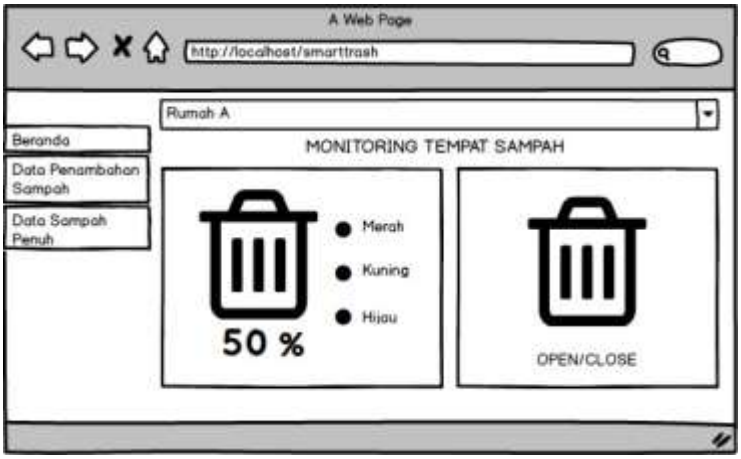

Figure 3.8 Home page.

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Figure 3.8 shows the homepage that will be displayed after the housing waste officer has logged in. This page will display a combo box to select a house as well as information on the weight of the trash can in real time and notifications regarding the condition of the trash can lid/opening. This page also displays 3 categories of trash weight conditions using color. Green means the trash can contains trash from 0%-30% of the trash can capacity. Yellow means the trash can contains 31%-70% of the trash can capacity. Red means the trash can contains 71%-100% of the trash can capacity.

c. Waste Addition Data Page

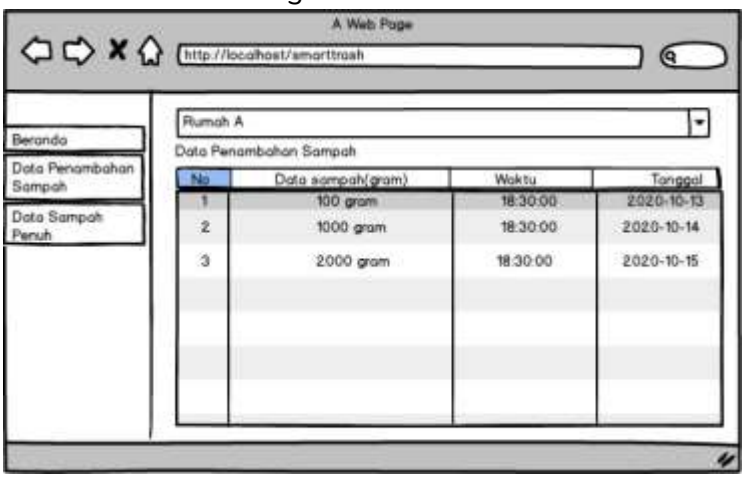

Figure 3.9 Waste addition data page.

Figure 3.9 shows the data page of waste addition recording presented in table form. Data is displayed in the form of waste addition and total waste in grams and the date and time of waste addition.

d. Trash Data Page Full

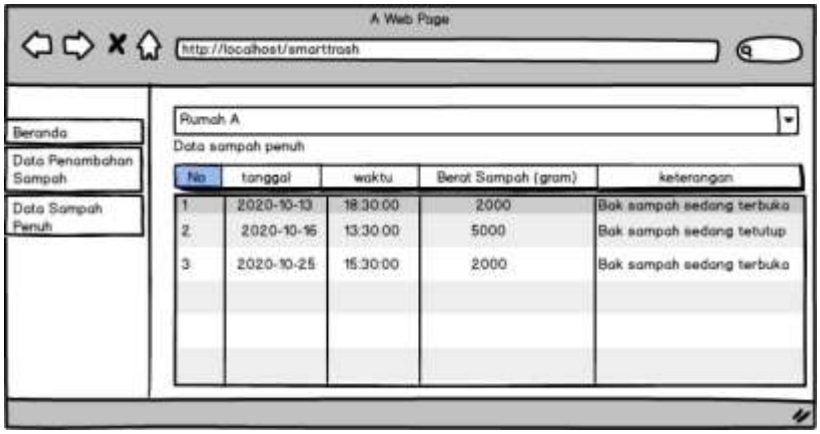

Figure 3. 10 Full trash data page.

Figure 3.10 is a page of full trash data. This page displays a table of full trash bin times that displays the date, time and weight of the trash when it is full, and displays information about whether the trash bin is closed or open.

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Flowchart design

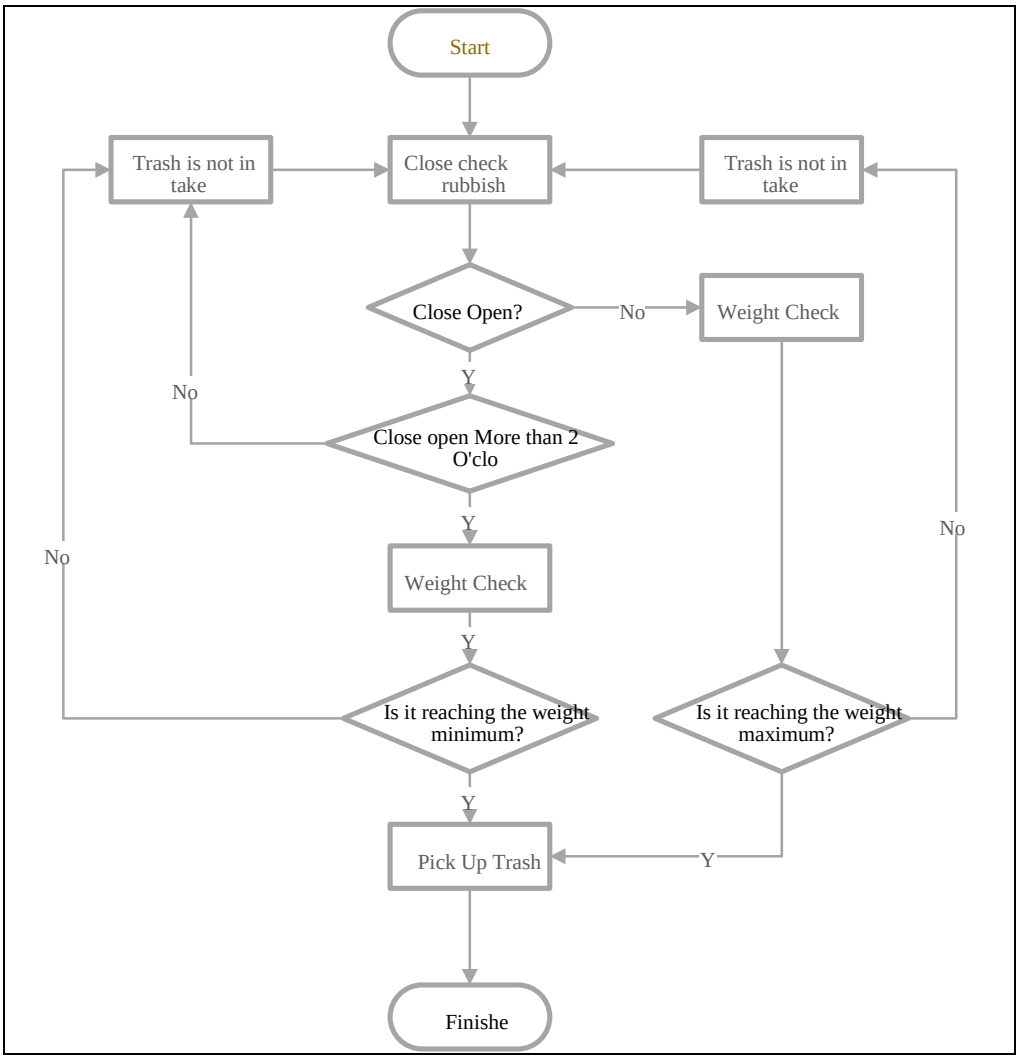

Figure 3. 4 *Flow chart*System Workflow

In Figure 3.4 is*flow chart*system workflow from*Smart Trash Can*IoT Based For Residential Waste Officers. Starting from checking the trash can lid, then reading the trash can lid value if it is open then a check is carried out towards the open lid for more than 2 hours, if not then a weight check is carried out towards checking the maximum weight value, then a check is carried out for the open lid for more than 2 hours,If "yes" then a weight check is carried out towards checking the minimum weight value, if "no" then the waste is not collected. If one of thethe minimum and maximum weight values have reached the limit then a warning will appear for garbage collection. Where, for the minimum weight value of the trash can is 2 kilograms and the maximum value is 5 kilograms.

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RESULTS ANDDISCUSSION

System Realization

In this chapter, we will discuss the results of the research conducted, namely"System Realization*Smart Trash Can*IoT Based For Residential Waste Officers". The realization of this system has been made according to the design described in the previous chapter. Then, this chapter will also discuss the results of the system that has been made based on the existing design, conducting testing of the entire system and evaluating the running system.

Hardware Assembling Realization

Realization of hardware arrangement of the System*Smart Trash Can*IoT Based for Residential Waste Officers refers to the hardware design contained in the previous chapter. The realization of the hardware that has been made can be seen below.

Figure 4.1 Realization*WeMos*D1 R2 and HX711 Module.

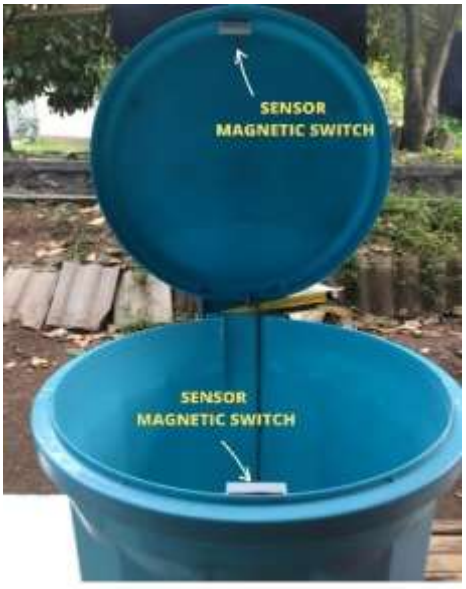

Figure 4.3 Realizati the sensor *magnetic switch*

At the realization stage, the hardware has been designed according to the design made in the previous chapter. In Figure 4.1 there is a Wemos D1 (R2) and the HX711 Module which is placed behind the trash can which is connected by a cable.*jumper*. Then in Figure 4.2 there is a weight sensor that has been assembled with acrylic which is placed in a trash can. In Figure 4.3 there is a sensor*magnetic switch*which is attached to the trash can lid. The function of each of these tools is:

1. WeMos D1 (R2), used as the microcontroller of the system*Smart Trash Can*which will receive data on each sensor. Where this microcontroller has provided an ESP8766 module that can be connected to*wifi*.
2. HX711 module, used as a reader of weight sensors. Where the module is*conversion*mark*analog*to value*digital*on weight sensor
3. Weight sensor, used to detect the weight of the waste that is entered.
4. Sensor*magnetic switch*, used as a trash can open/close detection.

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Sensor Testing*Magnetic Switch*

Sensor testing*magnetic switch*is a test carried out in the realization of system development*Smart Trash Can*IoT-based for residential cleaners who place sensors on both sides of the trash can lid, to obtain system value results in the form of conditions, whether the trash can is closed or open.

Figure 13 Sensor testing*magnetic switch*.

The following are the results of the sensor testing.*magnetic switch*with several conditions that correspond to the input values which can be seen in Table 4.2.

Table 4.2 Magnetic switch sensor test results.

Input	Condition
0	Closed
1	Open

From the test results obtained, it can be seen that the value*input*is 0, then the condition of the trash can will be closed, whereas if the value ...*input*1 then the trash can condition will be open.

Web System Testing Results

In the web testing process*Smart Trash Can*This is done by testing methods*black box*. This test is done to see the results of the functions or features in the web. The following are the results of the functional testing of the web system that has been carried out.

Function Testing *Login*

Feature testing*login*This is done to test whether the function running in the process*login*has been running well and correctly. As for more details about the testing process*login*The system can be seen in Table 4.3.

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Table 4.3 Testing the login function.

No	Test Scenario	Expected results	Test Results	Conclusion
1	Form *username* And *password* filled with incorrect data	Process *login* failed and will display back page *login*	In accordance	Valid
2	Form *username* And *password* filled with correct data	Process *login* successful and will enter the system that will display dashboard page	In accordance	Valid

Based on Table 4.3 it can be seen that for all process tests *login* produce valid conclusions, namely the entire process *login* it's working properly.

Testing *Logout.*

Feature testing *logout* This is done to test whether the function running in the process *logout* This has been running well and correctly. As for more details about the testing process *logout* on the system can be seen in Table 4.4.

Table 4.4 Logout process verification.

No	Test Scenario	Expected results	Test Results	Conclusion
1	Clicking the button *logout* on the system	Process *logout* successful and display page *login*	In accordance	Valid

Based on Table 4.4 it can be seen that for process testing *logout* produce a valid conclusion, namely that it is running as it should.

Home Listing Feature Testing

This home listing feature testing is done to test whether the function is running in the process *logout* This has been running well and correctly. As for more details about the process testing on the system can be seen in Table 4.5.

Table 4.5 Home listing feature testing.

No	Test Scenario	Expected results	Test Results	Conclusion
1	Selecting a home list	Displaying data accordingly the selected house	In accordance	Valid

Based on Table 4.5, it can be seen that testing the process of selecting a list of houses resulted in a valid conclusion, namely that it was running as it should.

Testing *Monitoring* Rubbish bin

Testing on features *monitoring Smart Trash Can* This is done to test whether the function in the process *monitoring* This has been running well and correctly. This test is done by displaying data on the weight of the waste and the status of the waste cover. For more details about this test, see Table 4.6.

Table 4.6 Monitoring of waste bins.

No	Test Scenario	Expected results	Test Results	Conclusion
1	Putting the trash load on *Smart Trash Can*	Displays waste weight in percentage form	In accordance	Valid

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No	Test Scenario	Expected results	Test Results	Conclusion
2	Does not add to the burden on*Smart Trash Can*	Not showing waste weight in percentage form.	In accordance	Valid
3	Open the trash can lid*Smart Trash Can*	Display trash lid status Open	In accordance	Valid
4	Close the trash lid*Smart Trash Can*	Displays trash lid status Closed	In accordance	Valid

Based on Table 4.6, it can be seen that for all tests in the monitoring process, data has been displayed in the form of numbers and graphs from each sensor accordingly. So the process in this test has run properly.

Trash full Alert / Notification Function Testing

Testing on the full trash Warning / Notification feature is carried out to test whether the full trash Warning / Notification function is running properly and correctly. This test is carried out by adding a load of 2kg and 5kg of trash. For more details about this test, see Table 4.7.

Table 4.7 Full warning test.

No	Test Scenario	Expected results	Test Results	Conclusion
1	Adds 2kg load and waste cover open for 2 hours	Display full alert on homepage	In accordance	Valid
2	Add a load of 2kg and keep the trash lid closed	Not showing full warning on homepage	In accordance	Valid
3	Add a 5kg load and keep the trash lid closed	Display full alert on homepage	In accordance	Valid
4	Add a load of less than 5kg and keep the trash lid closed	Not showing full warning on homepage	In accordance	Valid

Based on Table 4.7, it is a table of full garbage warning test scenarios with the following scenario explanation:

a. The first test scenario, a test was carried out by adding a load of 2 kg where the trash lid was open for 2 hours which had previously been adjusted to*flow chart*, where the expected results are displayed on*website*displays a full trash warning on the homepage, then the appropriate results are obtained, then the conclusion for the first test can be said*valid.*
b. The second test scenario, a test was carried out by adding a load of 2 kg where the trash lid was closed, where the expected results were displayed on the display.*website*does not display a full trash warning on the homepage, then the appropriate results are obtained, then the conclusion for the first test can be said*valid.*
c. The third test scenario, a test was carried out by adding a load of 5 kg where the trash lid was closed, where the expected results were displayed on the display.*website*displays a full trash warning on the homepage, then the appropriate results are obtained, then the conclusion for the first test can be said*valid.*
d. The fourth test scenario, a test was carried out by adding a load of 5 kg where the trash lid was closed, where the expected results were displayed on the display.*website*does not display a full trash warning on the homepage, then the appropriate results are obtained, then the conclusion for the first test can be said*valid.*

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From all the tests conducted in the above scenario, the notification/warning function can display warnings on the homepage accordingly. So the process in this test has run properly.

Testing the Function of the Data Table Addition of Trash

Testing on the data table function feature of adding waste is done to test whether the function in the data addition process has run well and correctly. For more details about this test, see Table 4.8.

Table 4.8 Testing of waste addition table.

No	Test Scenario	Expected results	Test Results	Conclusion
1	There is a waste value stored	Function to display data in the form of a table according to the stored values	In accordance	Valid
2	No values stored	Function does not display data in table	In accordance	Valid

Based on Table 4.8, it can be seen that for all tests in the waste addition table, data has been displayed in the form of a waste processing data table. So the process in this test has been running properly.

Full Garbage Data Table Function Testing

Testing on the full garbage data table feature is done to test whether the full garbage data table function is running properly and correctly. For more details about this test, see Table 4.9.

Table 4.9 Full trash table test.

No	Test Scenario	Expected results	Test Results	Conclusion
1	There is a full trash warning stored	Function displays full trash data in the form of a full garbage data table	In accordance	Valid
2	No full alerts are saved	Function does not display full data in table	In accordance	Valid

Based on Table 4.9, it can be seen that the test can display data in tabular form. So the process in this test has run properly.

Overall System Function Test Results

To get the test results, there needs to be a test scenario on the system device that is made to find out whether the system can run well or not. Testing on this system is carried out according to the scenario in Table 4.10, namely by testing the system using different loads. To be able to see the results of testing the overall system function, it can be seen as follows:

Table 4. 10 Test scenarios.

Test Scenario	Waste Weight > 5kg?	Waste Weight > 2kg?	Close Open ?	Take Out Trash/No Take	
				Expectations	Reality
1	*True*	*True*	*True*	Pick Up Trash	Pick Up Trash
2	*False*	*True*	*True*	Pick Up Trash	Pick Up Trash

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Test Scenario	Waste Weight > 5kg?	Waste Weight > 2kg?	Close Open ?	Take Out Trash/No Take	
				Expectations	Reality
3	*False*	*False*	*True*	No Take	No Take
4	*False*	*False*	*False*	No Take	No Take
5	*True*	*True*	*False*	Pick Up Trash	Pick Up Trash

Table 4.10 is a table of test scenarios.*website Smart Trash Can*IoT based for garbage officers in housing, this scenario is used as a reference to test how the system functions properly. For more details as follows:

1. The first test scenario, for the first scenario a test was carried out by giving a load of more than 5 kg and the load was also more than 2 kg on the trash can with the trash lid open, so the result was that the garbage officer could pick up the trash.
2. The second test scenario, for the second scenario, a trial was used with a waste load of less than 5 kg and the load was more than 2 kg with the condition that the waste lid was open, the result of which was that the waste officer was able to collect the waste.
3. The third test scenario, the third scenario uses testing with a load of no more than 5 kg and the load is less than 2 kg with the trash lid open, so the result is that the garbage officer has not been able to collect the trash.
4. The fourth test scenario, for the fourth scenario, a load of no more than 5 kg is used and the load is no more than 2 kg with the trash lid closed, so the result is that the garbage officer has not been able to collect the trash.
5. The fifth test scenario, for the fifth scenario, a test was carried out by giving a load of more than 5 kg and the load was also more than 2 kg on the trash can with the trash lid closed, so the result was that the garbage officer could pick up the trash.

Based on the test scenario carried out in Table 4.10, it can be concluded that the scenario carried out has run as it should. This can be proven in Table 4.11 and Table 4.12 which are the results of data that has been stored in the database in the system.*website.*The following are the data results from testing on the system:

Table 4.11 Waste Addition Data.

No	Id	Weight (grams)	Time	Date
1	4	226	21:45:03	2020-11-03
2	5	140	21:45:38	2020-11-03
3	6	2567	21:48:31	2020-11-03
4	7	2215	21:48:36	2020-11-03
5	8	2507	21:51:27	2020-11-03
6	9	1785	21:51:43	2020-11-03
7	10	811	21:51:54	2020-11-03
8	11	347	22:16:57	2020-11-03
9	12	548	22:17:23	2020-11-03
10	13	353	22:17:27	2020-11-03
11	14	1308	22:17:47	2020-11-03
12	15	2695	22:17:52	2020-11-03

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No	Id	Weight (grams)	Time	Date
13	82	542	00:21:05	2020-11-04
14	83	4495	00:21:10	2020-11-04
15	84	3136	00:21:15	2020-11-04
16	85	2193	00:22:13	2020-11-04
17	86	3223	00:22:18	2020-11-04
18	87	2647	00:22:48	2020-11-04
19	88	5554	00:22:56	2020-11-04
20	89	5604	00:22:57	2020-11-04

Table 4.11 is a table that shows the results of adding waste to the system.*smart trash can*IoT-based for residential waste officers, for the first column, namely the id column, is the id for each new data addition that comes in, then for the second column is a column that shows the weight of the amount of each additional waste that comes in, so for each additional waste the system will record each weight value that is not included in the full category in grams. Furthermore, for the time column, it is a column that records the time the weight value of the waste enters the system, so for each additional waste the system will record the time. Similar to time, the date column contains data in the form of the date, month and year when the waste data is added, so every time waste data is added, the system will record the date the data was added.

CONCLUSION

Based on the research that has been conducted, the conclusions that can be drawn from this research are as follows: Electronic circuit*Smart Trash Can*The one that was created can monitor the trash bin by displaying the weight of the trash and the status of the trash lid. System*web*which was built has been able to do*monitoring*by displaying additional waste data and full waste data from each sensor which is displayed in table form. Data communication using the MQTT protocol has been running well, withusing "broker.hivemq.com" as an online brokerwhich is*open source*. The system that was built was tested using 5 test scenarios to find out whether the system was running well or not, and it was concluded that the tools and systems were working well. The results of the MOS testing that has been carried out can be obtained a value of 4.58 on a scale of 5 which shows that the system that was built is included in the good category. If further research is conducted on this study, the following suggestions can be considered: For further development, it is hoped that different or larger variations of trash bins will be used. It is hoped that in the future the system can be built based on*mobile*so that waste notifications can be accessed more quickly by waste officers. It is hoped that this system can be developed into a system that can differentiate between organic and non-organic waste.

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