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MICROCONTROLLER-BASED METAL AND NON-METAL SORTING AUTOMATIC TRASH CAN COVER

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ABSTRACT

Waste is still a problem that is often faced in the community, the accumulation of waste in the environment must be overcome with good management, because if not it will have a negative impact on all components of life. Waste problems still often arise due to the habits of people who still throw garbage out of place, so that the existingarbage becomes scattered in several places that cause a very pungent odor, even triggering flood disasters. The problem that is difficult to handle is the placement of metal and non-metal waste, if the two wastes are mixed, it is difficult to manage the two types of waste. One solution that can be applied to the trash can is to make a trash can that can separate the location of waste according to its type, namely metal and non-metal. The innovation of a trash can that can detect objects and the cover automatically opens, then the garbage will be sorted into metal and non-metal waste based on a microcontroller aims to provide convenience to everyone who will throw away garbage by automatically separating the types of waste. Using the processing module in the form of arduino nano as the processing center, the sorting module in the form of an inductiv proximity sensor as a metal or non-metal detector, the object detection module in the form of an ultrasonic sensor as a distance detector, the drive module in the form of a servo motor as a garbage cover drive and a metal and non-metal garbage separator bar drive. A healthy environment will encourage people to live healthy and realize a clean environment by creating a sense of "concern" for the importance of environmental cleanliness and body health without waste.

Keywords: *Dustbin, Arduino nano, Inductiv Proximity Sensor, Servo Motor, Ultrasonic Sensor*

1. INTRODUCTION

Waste is still a problem that is often faced in the community environment, the accumulation of waste in the environment must be overcome with good management, because if not it will have a negative impact on all components of life. If the waste cannot be decomposed, it will create more severe environmental pollution. Waste problems still often arise due to the habits of people who still throw garbage out of place, so that the existing garbage becomes scattered in several places which causes a very pungent odor, even triggering flood disasters.

Through data in 2018 taken from the National Waste Management Information System (SIPSN) in the city of Pematangsiantar, there were 228.00 tons / day of daily waste generation. Awareness and lack of public sympathy for the environment, to dispose of and sort waste according to the type of waste is very minimal. The government expects waste to be sorted directly and manually by the community, namely by providing bins in several parts that are easy to find, but public awareness is still lacking about the impact of waste on daily life [1].

The process of waste management in various places has an important role, as well as big cities. However, the existence of waste bins in big cities is not well utilized, especially in the

placement of types of waste, for example, the separation of waste bins based on their type, namely organic and inorganic waste. A problem that is difficult to handle is the placement of metal and non-metal waste. If the two types of waste are mixed, it is difficult to manage the two types of waste. One solution that can be applied to the trash can is to make a trash can that can separate the location of waste according to its type (metal and non-metal). Officers no longer have to sort out metal and non-metal waste before recycling. Garbage collection can be done on full bins so that it can save costs for transportation. With this solution, the number of staff can also be reduced. To increase the space in the bin, the waste in the bin must be of the same type, so that the bin can accommodate more waste. Waste disposal and waste processing are important to reduce the impact of disasters. At this time, waste processing is not maximized, so that waste is mixed and difficult to process. To facilitate the processing of waste according to its type, a trash can is made that can sort metal and non-metal waste automatically.

Figure 1.1 Trash cans in the community

Public indiscipline regarding cleanliness of the environment can create an undesirable presence of waste when linked to factors of cleanliness, health, comfort and beauty. One of the factors that can affect the environment is the problem of waste disposal and management. The lack of participation in hygiene issues in maintaining the environment has received attention from the government [2]. The habit of the community in littering is done by almost all circles, not only the poor, even the highly educated also do it. The state of the environment with a lot of garbage scattered in various places has become a serious problem because according to Law Number 18 of 2008 concerning waste management, states that the problem of waste is a national problem so that its management needs to be carried out in a comprehensive and integrated manner in order to provide economic benefits, be healthy for the community, be safe for the environment, and be able to change people's behavior [3].

A polluted environment makes life unhealthy and uncomfortable because it is in a polluted environment. Residents' understanding of utilizing waste positively is by burning garbage, which certainly has a bad effect on the air around the house becoming polluted. Meanwhile, garbage thrown into the sea and river will greatly disturb the ecosystem of the place. The World Bank report "What a Waste: A Global Review of Solid Waste Management" revealed that the amount of solid waste in the world will continue to increase by 70% from this year to

2025, from 1.3 billion tons per year to 2.2 billion tons per year. In Indonesia, the amount of solid waste produced nationally reaches 151,921 tons per day [3].

The problems that have been described require an innovation with a tool that can separate metals and non-metals automatically, the microcontroller-based metal and non-metal sorting automatic cover trash can model aims to provide convenience to everyone who will dispose of waste by automatically separating types of waste, especially metal and non-metal waste. A healthy environment will encourage people to live healthy and realize a clean environment by creating a sense of "concern" for the importance of environmental cleanliness and body health without waste. Environmental cleanliness is an important concern, where people no longer sort garbage manually such as trash bins that are provided with garbage sorting tools according to their type, this tool will make it easier for cleaning staff to pick up garbage according to its type.

2. RESEARCH METHOD

The tool to be designed is a microcontroller-based metal and non-metal sorting automatic cover trash can. The trash can will detect the object and the cover will automatically open, then the waste will be sorted into metal and non-metal waste. This tool will sort waste automatically with the aim of making it easier for everyone who will throw garbage in the trash can. Using an arduino nano processing module as a processing center, a sorting module in the form of an inductiv proximity sensor as a metal or non-metal detector, an object detection module in the form of an ultrasonic sensor as a distance detector, a drive module in the form of a servo motor as a garbage cover drive and a metal and non-metal garbage separator bar drive. In this research method, a procedure for how the tool works is used which is easy to understand and has simple stages. The flow of the tool development model can be seen in the following flowchart image:

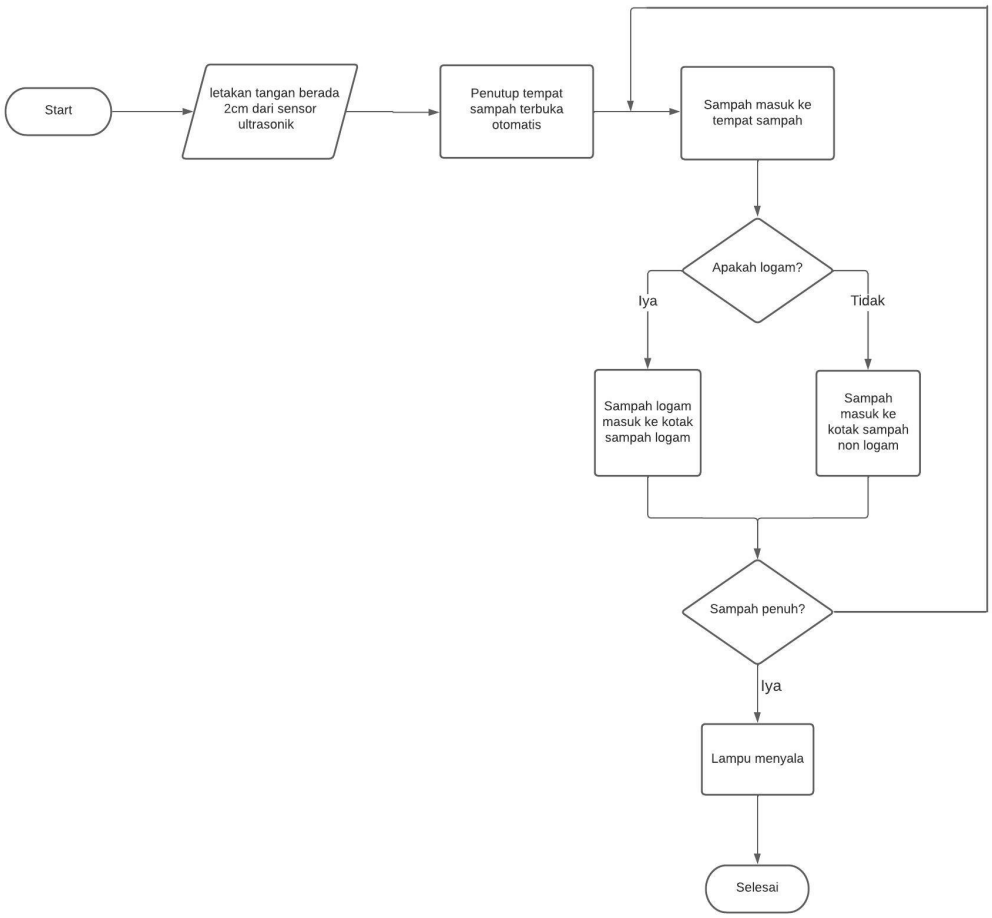

Figure 2.1 Flowchart of How the Microcontroller-Based Metal and Non-Metal Sorting Trash Can Design Tool Works

The survey was conducted to obtain comparison materials between the tools to be designed and existing tools. The first survey was conducted using a journal that had been published in Resolution: Engineering Informatics and Information Engineering Volume 1, No. 6, July 2021 with the title "Use of Microcontroller Systems in Making Automatic Sorting Trash Can Using Arduino Uno". The design in the journal uses the Arduino Uno Microcontroller as a controller for selecting the type of garbage, the proximity sensor functions to detect the presence of objects in the form of metal or non-metal, the servo motor functions as a driver of the automatic trash can opening system, while the HC-SR04 Ultrasonic sensor is useful for detecting people who will approach to throw away garbage. The design by Fauzan Azmi Hasibuan, Solikhun, Zulaini Masruro produced a tool that identifies metal and non-metal waste sorting bins. The circuit diagram can be seen in Figure 2.1

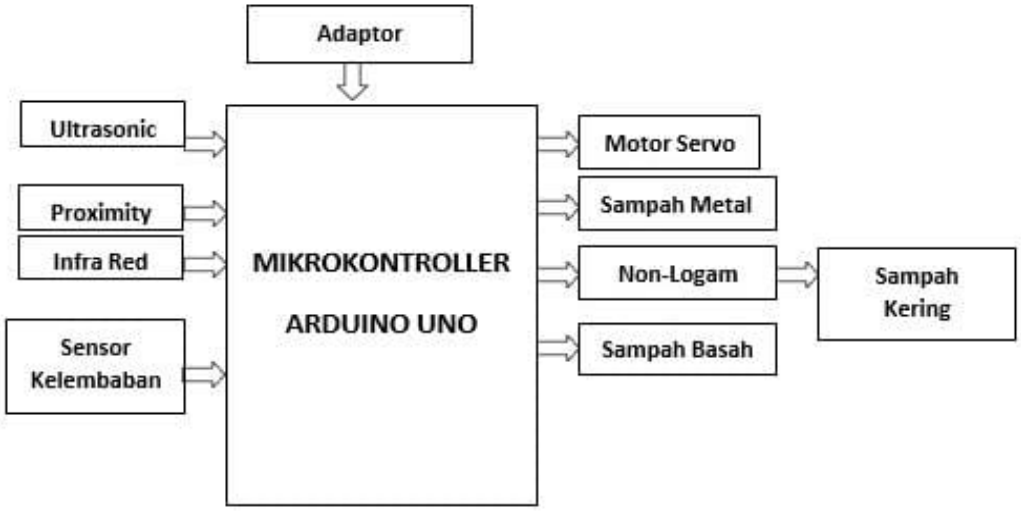

Figure 2.2 Circuit Block Diagram

Source: [1]

The second survey used a journal that was published in the Tesla Journal Volume 19, No.2, October 2017 entitled "Design of Automatic Lid Opening Trash Can and Capacity Indicator" [4]. The design by Arsa Priyo Rahardjo, Suraidi, and Hadian Satria Utama resulted in the design of an automatic trash can lid and can convey a message about protecting the environment, becoming more attractive with the notification of the capacity of the trash can when it is full. This system uses an infrared sensor as a sensor to determine whether the trash capacity is full or not, when the trash can is detected to be full, the sensor will provide information to the microcontroller to turn on the indicator at the cleaning center via radio frequency media. The design block diagram can be seen in Figure 2.2

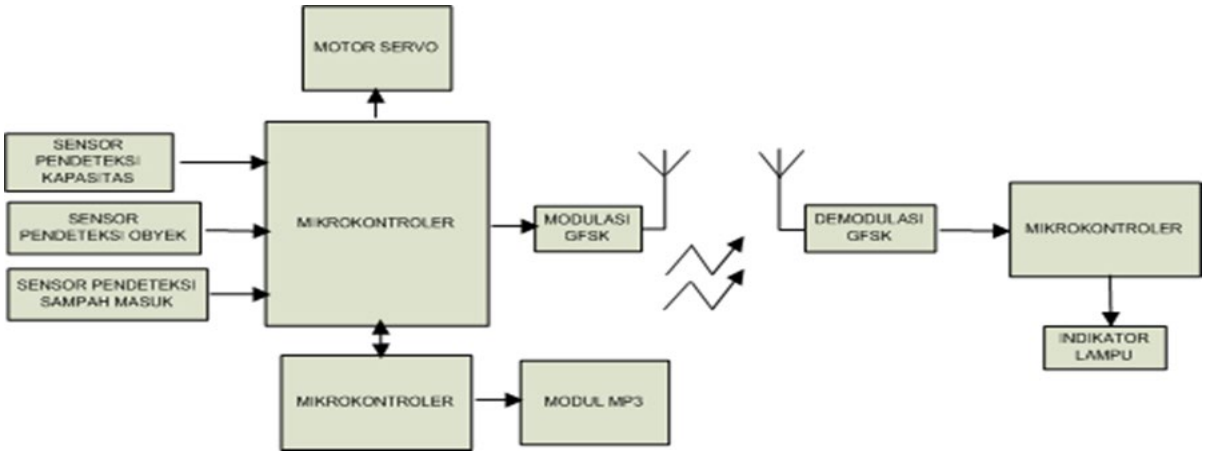

Figure 2.3 Design Block Diagram

Source: [4]

The third survey was also conducted using a publication in the Journal of Informatics Engineering Students (JATI) Volume 6, No. 2, September 2022 with the title "Metal Waste Detection System with Non-Metal Waste for Used Goods Collectors in Bekasi Jati Village" [5]. The tool designed in the journal produces a tool to detect metal and non-metal waste for collectors of used goods using an arduino uno microcontroller as a processing center, inductive proximity sensor as a metal detector, ultrasonic sensor as a distance detector, servo motor as a driver of the metal or non-metal waste separator bar, for wifi connection using esp 8266 as a driving force using a dynamo and speed control using a potentio meter powered by a 9v battery. The design carried out by Dwi Wulan Nabilla and Rully Pramudita produced a tool from a form of system development that is still done manually into an Internet of Things-based system. Illustration of the device design tool can be seen in Figure 2.4

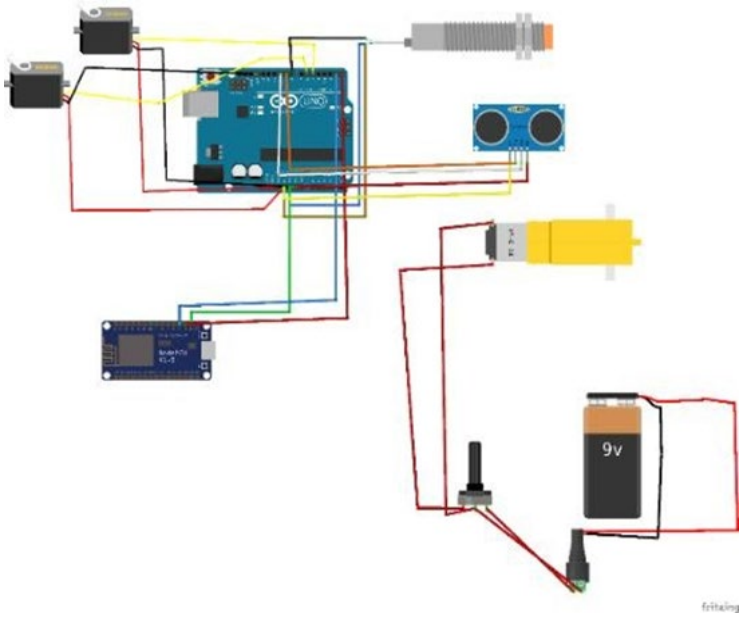

Figure 2.4 Device Design

Source: [6]

3. RESULTS AND DISCUSSIONS

The tool to be designed is an automatic closing trash can and can sort garbage according to its type. This trash can will open automatically when it detects the arrival of people who will throw away garbage, and will sort metal and non-metal waste automatically. This tool uses a processing module, namely Arduino nano as a controller, MG995 servo motor drive module as a means of driving the trash can cover and driving the trash separation bar, HC-SR04 Ultrasonic sensor object detection module to detect objects within 2-450 cm, metal and non-metal waste sorting module inductive proximity sensor.

Table 3.1 Comparison of Tools to be Designed with Survey Results

No.	Parameters	Survey Results			Tools to be designed
		First Survey [1]	Second Survey [4]	Third Survey [5]	
1	Mikrokontroller	Arduino Uno	ATMega328P	Arduino Uno	Arduino Nano
2	Sorting Sensor	inductive proximity sensor	None	inductive proximity sensor	inductive proximity sensor
3	Object Detection	HC-SR04 Ultrasonic sensor	*Passive infrared receiver* (PIR)	*HC-SR04 Ultrasonic sensor*	*HC-SR04 Ultrasonic sensor*
4	Automatic closing	None	Available	None	Available
5	Motor	Servo motor	Servo motor SG5010	Servo motor	Servo motor MG995

The designed tool has the following specifications:
1.Using an Arduino Nano microcontroller processing module with an operating voltage of 5V.
2.Using the MG-995 Servo Motor sorting device drive module with a voltage of 4.8V to 7.2V
3.Using HC-SR04 Ultrasonic Sensor object detection module that can detect objects up to450cm.
4.Using Inductiv Proximity sorting module as metal waste sorting

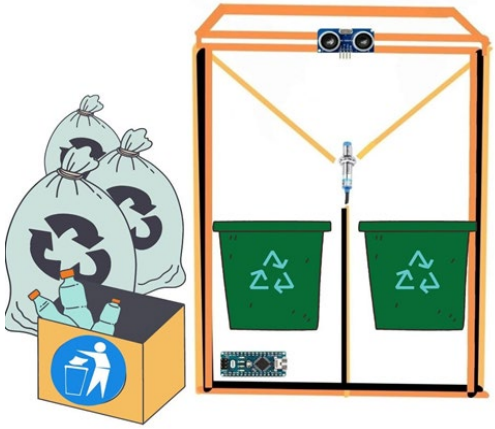

Figure 3.1 Design Sketch of Metal and Non-Metal Sorting Automatic Cover Trash Can

In this automatic trash can cover sorting system is by combining all modules and assembling them into one so that it becomes an automatic trash can cover sorting metal and non-metal. The processing module as the controller of the design tool which contains the work program of the tool, the object detection module as a tool that detects the presence of an object with a distance of 2 to 450cm, the drive module is divided into two namely the trash cover drive module and the sorting tool bar drive module, the sorting module as a tool for sorting waste according to the type of metal and non-metal. The following is a table of tests for each module of the microcontroller-based automatic metal and non-metal sorting trash can design tool.

Tabel 3. 2 Processing Module Testing and Analysis Results

Testing	**Description**	
1	Arduino *on*	Working Tools
2	Arduino *off*	Tools Not Working
3	Arduino *on*	Working Tools
4	Arduino *off*	Tools Not Working
5	Arduino *on*	Working Tools
6	Arduino *off*	Tools Not Working
7	Arduino *on*	Working Tools

Tabel 3. 3 Testing and Analysis of Object Detection Module

Testing	Testing Distance (cm)	Description
1	2 cm	detected
2	4 cm	detected
3	6 cm	detected
4	8 cm	detected
5	10 cm	detected
6	12 cm	detected
7	14 cm	detected
8	16 cm	detected
9	18 cm	detected
10	20 cm	detected
11	21 cm	undetectable

Tabel 3. 4 Test Results and Analysis of the Sorting Cross Drive Module

Testing	Object	Type of Waste	Servo Motor Rotation Direction
1	Milk cans	Metal	180° to the right
2	Scissors	Metal	180° to the right
3	iron hinges	Metal	180° to the right
4	Hekter kertas	Metal	180° to the right
5	Bottle	Non-Metal	90° to the left
6	Paper	Non-Metal	90° to the left
7	Tissue	Non-Metal	90° to the left
8	Plastic	Non-Metal	90° to the left

Tabel 3. 5 Test Results and Analysis of the Metal Sorting Module

Pengujian	Jenis Benda	Kondisi
1	Metal	active
2	Non Metal	not active
3	Metal	active
4	Non Metal	not active
5	Metal	active
6	Non Metal	not active
7	Metal	active

Tabel 3. 6 Testing and Analysis Results of Non-Metal Sorting Module

Pengujian	Jenis Benda	Kondisi
1	Metal	not active
2	Non Metal	active
3	Metal	not active
4	Non Metal	active
5	Metal	not active
6	Non Metal	active
7	Metal	not active

4. CONCLUSIONS AND SUGGESTIONS

Conclusion

From the results of the discussion on the Microcontroller-Based Automatic Metal and Non-Metal Sorting Trash Can Tool Design, conclusions can be drawn:

1. Reducing environmental pollution by utilizing waste according to its type.
2. The application of the Proximity sensor in the use of this tool makes it easier to separate metal and non-metal waste.
3. The trash can cover will open automatically when it detects an object.

Suggestion

In the process of making this tool is still not so perfect, so there are some suggestions that can be added:

1. The distance of the proximity sensor can be increased again in order to detect metal waste more significantly.
2. The next design tool can be added to the garbage press.
3. Using a locking module to lock the garbage when it is full.

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