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Pusat
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Ecosorter

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ABSTRACT

One of the pressing issues faced by communities worldwide is waste management and disposal. In Malaysia, improper garbage disposal has depended heavily on landfills and poses a significant threat to both the environment and public health, leading to a range of interconnected issues. The project aims to assist in tackling the problem of improper garbage disposal by segregating the waste. As well as to emphasise the importance of waste reduction, recycling, and the adoption of sustainable waste management approaches at the local, national, and global scales. Consequently, the Ecosorter, which is equipped with the Arduino Uno platform, has been developed to identify various categories of recyclable materials. It then opens the lid of the appropriate bin to facilitate the user's segregation of their waste into the appropriate bins. According to the Malaysia Investment Development Authority, in 2021, a total of 13.95 million metric tons of municipal solid waste were generated per year in Malaysia, equivalent to 38,207 metric tons generated per day by households and institutions. This showed an increase from previous years, as municipal solid waste amounted to 13.91 million metric tons and 13.88 million metric tons in 2020 and 2019, respectively. In summary, Ecosorter represents an innovative solution capable of addressing the global challenge of improper garbage disposal, offering sustainable alternatives that hold considerable market potential for various stakeholders, including households, environmental departments, and garbage collectors.

Keywords: Arduino Uno; garbage; waste management; environment; disposal.

1. INTRODUCTION

In Malaysia, the improper disposal of waste has become a pressing environmental concern and there is still no best solution to this problem. The global population is expected to produce 3.40 tonnes of solid trash by 2050 (colife.com, 2023). Waste management refers to the collection, removal, processing, and disposal of materials that can be considered waste. Waste materials can be solid, gaseous, liquid, or even dangerous, and they are typically generated by human activities (D. A. Vallero and V. Shulman, 2019).

Waste management is a significant problem in Malaysia as waste output outpaces the country's recycling rate (H. L. Chen et al., 2021). Malaysia generates more than 30,000 tonnes of municipal solid waste (MSW) per day, equivalent to 1.17kg of waste per person. Food waste made up the largest portion of MSW, followed by plastic, paper, mixed organic, wood, and others (H. L. Chen et al., 2021). On the other hand, as one of the world's major importers of plastic waste, together with the increasing urbanisation and population growth rates, Malaysia

too faces problems with the management of waste, in particularly plastic wastes. Additionally, as a biodiversity hotspot with some of the world's most biodiverse coral reefs, plastic waste is also a major concern in Malaysia, threatening both the terrestrial and marine ecosystems (S. Sarkar, 2015). Meanwhile, sources of solid and metal wastes for steel industries may thus be identified as coke oven by product plant, sinter plant, refractory materials plant, blast furnace, basic oxygen furnace, steel melting shop and rolling mill. Dumping solid waste in open space and excavated land not only creates environmental pollution in the form of dusts and leachate but also create huge financial liability due to scarcity of land. Out of total solid wastes generated in the steel plant in our country around 63% are dumped which needs to be recycled or reused to target a zero solid waste as being done in many developed countries (Metal Recycling 101, n.d.).

Based on our findings, the normal trash bin that is normally used only provides a container but cannot segregate the waste material. This issue will hinder the implementation of the recycling program. Our product, Ecosorter, focuses on continuous improvement and additional compartments to provide the best trash bin solution. Firstly, Ecosorter can identify the type of material waste so that the segregation can occur. Secondly, a wheel component is selected to be integrated into the product to improve its portability for use both indoors and outdoors. Thirdly, the Ecosorter is designed in a square shape to make it easy to fit into any place.

The objective of the project is to manage the improper waste disposal by segregating them into four distinct categories which are metal material, non-metal material, dry waste and wet waste. By segregating waste in this manner, the project will be able to facilitate more efficient handling and disposal processes. Furthermore, we also emphasise the significance of waste reduction, recycling, and the implementation of sustainable waste management practice not only at the local level, but also at the national and global scales. In many developing countries, the mismanagement of wastes poses a threat to both the ecosystem and human health. Overall, waste management is an inescapable challenge of our times, whenever waste is produced, it needs to be managed well and with the potential environmental impacts in mind.

2. METHODOLOGY

To address this issue, we must first identify the fundamental cause of the inefficiencies in existing waste management systems. The difficulty is that they do not segregate their trash into the appropriate waste categories. As a result, we propose a product that will improve the waste management system. Thus, we suggest the development of the Ecosorter. It uses the Arduino Uno platform to identify different materials and sort them into their respective bins. The Arduino Uno-based technique has been divided into two parts: garbage detection and trap door opening. As a result, the garbage may be easier to recycle once it arrived at the recycling facility.

2.1. Detection of Different Type of Waste

The use of the Arduino Uno platform to identify and help sort waste thrown by the user into the appropriate bins. By using the Arduino Uno, we can connect a few sensors to help to detect the different materials presented by the user. We use a capacitive sensor to detect non-metallic items, an inductive sensor to detect metallic items, and a humidity sensor to differentiate between wet and dry items. After the waste type is detected, a trap door will as correspondence for the correct waste types.

2.2. Trap Door Opening

There will be four trap doors for each type of waste which are metal, non-metal, wet and dry items. Each trap door will automatically open after a sensor has detected its waste type. When the sensor identifies a particular type, it sends a signal to the Arduino Uno to open the appropriate trap door. The trap door can be opened or closed using a servo motor.

3. RESULTS AND DISCUSSION

First and foremost, Ecosorter are designed as shown in Figure 1. It was designed to be environmentally friendly to minimise resource consumption and promote efficient use of materials. This environmentally friendly product is found to be more durable and long-lasting, consequently reducing the need for frequent replacements. This can lead to less waste being generated over time, as fewer unused products end up in landfills or incinerators. Besides, Ecosorter offers an exceptional quality at an affordable price. They are available for a wider range of consumers, including those with limited budgets, as most of the materials used are readily accessible and obtained from various sources. In addition, Ecosorter can manage waste efficiently with the help of sensors, which powered by Arduino Uno. This innovative product utilizes sensors to detect and categorize different types of waste, hence enabling precise sorting. The Ecosorter functions by gathering data from its sensors, which are strategically positioned to detect various characteristics of incoming waste materials. This data is then transmitted to the Arduino Uno microcontroller, where it undergoes processing to determine the appropriate course of action. Through sophisticated algorithms and predefined parameters, the Arduino Uno accurately analyzes the sensor input and generates precise output commands. Lastly, by using this product, the waste will be well managed according to its type which eventually will help the disposal process much easier. This product will be easy to operate, will require very minimal maintenance, and will be cheap to operate. The product will be powered by a 12-volt battery to ensure that the circuit has enough power to operate all the sensors and the servo motor.

3.1 Schematic Diagram of Ecosorter

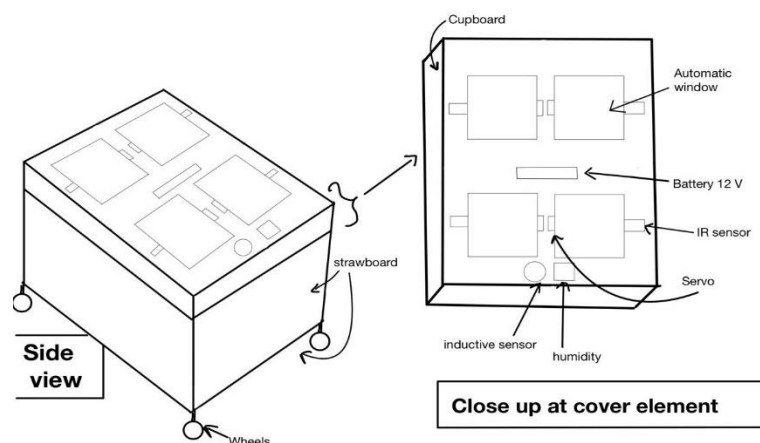


Figure 1. Schematic diagram of Ecosorter

3.2 Ecosorter Expenses

Table 1. Ecosorter expenses

Item	Quantity	Price (RM)
Arduino Uno Kit	1	59.80
Inductive Sensor	1	14.61
IR Sensor	1	7.00
Humidity Sensor	1	2.75
Battery 12V	1	10.00
Strawboard	6	9.60
Total		103.76

Table 1 shows the amount of expenses needed to produce this product which cost approximately RM 103.80.

3.3 Future Improvements

Although, our product has been proven to solve the issues with stated before, we have a few ideas on how we could improve our product to help make it even more effective at waste management. Firstly, we would like to add a conveyer system that would automatically deposit the waste into the correct bin without human intervention. This would greatly improve our product and make it easier for users to recycle. Secondly, we would like to add a method to detect glass and plastic object. This will further improve the waste management system by weeding out the waste into more specific categories. Thirdly, in the future we will add a solar panel to our product. This is to ensure the product could last for months without needed a change of battery.

4. CONCLUSION

All in all, we have observed a significant rise in waste management problems in Malaysia due to the accumulation of waste, especially involving non-biodegradable materials that have been excessively consumed by the citizens without proper segregation. To overcome this issue, we have developed Ecosorter to simplify waste sorting for people and increase opportunities for recycling. Ecosorter aims to enhance efficient waste management to manage the growing volume of mixed waste in Malaysia while also properly segregating them into several categories. In addition, we are also aiming to increase the recycling rate in the country, surpassing even that of first-world countries, as more Malaysians become involved and informed about recycling by using Ecosorter. Additionally, with the assistance of Ecosorter, we set out to educate and raise awareness among younger generations and even older generations, making responsible waste management a societal norm. Our sole aim for Ecosorter is for it to set the benchmark for more remarkable initiatives in waste reduction and making the earth a better place.

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