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Automatic Waste Segregator

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Abstract: In India, the most crucial threat that adds up is the striking amount of waste generated. Around 62 million tons of waste is produced each day of which 45 million of waste is left untreated and disposed unhygienically causing severe health issues and environmental degradation. Ultimate destination of solid waste in India is at disposal. Thus, a practicable answer could be separating the waste at disposal level. The proposed Automatic Waste Segregator system aims to sort the waste into four types namely wet, metal, solid and glass waste. The project deals with the implementation of this system using Arduino microcontroller, to control the entire process with ease and simplicity. The main architecture of the segregator comprises of different prominent stages consisting of IR sensor, inductive proximity sensor, rain drop sensor, photoelectric sensor and the segregation bins. Each of the waste is detected by the respective sensor and discarded into the bins assigned to it wherein the waste can be taken for further processing.

Keywords: Photoelectric Proximity Sensor, Rain Drop Sensor, Inductive Proximity Sensor, L293D Motor Driver;

I. Introduction

In India about 60 million tonnes of waste is being generated every year. Ten million tons of garbage is generated in metropolitan cities. According to centre of science and environment, innovative disposal and recycling methods must be introduced instead of landfill sites. Thus, a cost-effective system called "Automatic waste segregator" is proposed for proper management of waste. Automatic waste segregator categorizes the waste as wet, solid, metallic or glass. [1]

As the world moves towards a more digitalized future, it is directly proportional to increase in urbanization and industrialization. This is the main cause of generation of large amount of waste. As per the report published by World Bank, approximately 1.3 billion tons of municipal waste is generated every year and it is expected to rise to approximately 2.2 billion tons per year by 2025. [2] Due to this, waste lies littered in the surrounding, dumped on open lands and this becomes major problem for various types of disease-causing bacteria and viruses which is why waste management is of vital importance.

Segregation makes it possible to reuse and recycle the waste effectively. So, the waste management becomes an important concern for the health and well-being of the society. Presently, the waste segregation is

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done manually by installing different bins for collecting different type of waste such as wet, dry and metal etc [3]. But this method has lot of discrepancy; one is being the unawareness of most people towards waste management. Due to lack of proper segregation methods, a large amount of untreated waste is dumped as landfills. So, the idea is to make a garbage segregator which can identify the type of waste and put them in different bins accordingly and automatically [4]. Implementation of the project at household level will reduce the expenditure on waste disposal, manual effort required for waste segregation and the waste could be easily being recycled, reused and reduced. The economic value of the waste generated is not realized unless it is recycled completely.

Several advancements in technology have also allowed the reuse of waste to be processed into useful entities such as [6]

- Waste-to-Energy, where the waste can be used to generate synthetic gas (syngas) made up of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam.
- Waste-to-Fuel, where the waste can be utilized to generate bio fuels.

When the waste is segregated into basic streams such as wet, dry and metallic, the waste has a higher potential of recovery, and consequently, recycled and reused. The wet waste fraction is often converted into compost or methane gas, or both. Compost can replace the demand for chemical fertilizers, and biogas can be used as a source of energy. The metallic waste could be reused or recycled. [7]

II. Methodology

Figure 1 shows the block diagram of the automatic waste segregator system. Arduino uno is used as the main controller. A cylindrical pathway is provided into which the object is dropped. Two IR sensors are placed along the cylindrical path. One at the beginning end and the other at the tail end. IR sensors are used to mark the presence of the object that falls into the system. Two rain drop sensors, one inductive proximity sensor and a photoelectric proximity sensor are placed on a flap. Rain drop sensors is used to identify wet waste, inductive proximity sensor to identify metal waste and photoelectric proximity sensor to differentiate between solid and transparent objects.

The object is fallen on the flap on which the sensors are placed. If the object is wet, the two rain drop sensors give an output value and if the value is below 700, the object is confirmed to be wet. If the object is a metallic substance, the inductive proximity sensor gives an output value. If the output value of the inductive proximity sensor is above 500, the metallic property of the object is confirmed. If the object is neither wet nor metallic, then the photoelectric proximity sensor checks for the transparency of the object. The photoelectric sensor gives two values namely black and white. If the black output value is less than 20 and white output value is greater than 600, the object is detected to be transparent and hence categorized as glass. Else, the object is categorized as solid waste.

Bins are placed below the flap on a rotator. A stepper motor drives the rotator on which the bins are placed. The stepper motor is controlled by the stepper motor drive. Once the type of the waste is detected, the stepper motor rotates by the respective angle that is set for each type of waste. Here, the step count is given as 50. For the wet type detection, the step count does not change. Thus, the position at which the wet bin is placed is considered as initial position. For the metal type detection, the step count is multiplied by 2. To discard the metal waste, the rotator rotates by 90□ and the metal bin is positioned under the flap. Similarly, for solid and glass waste, the step count is multiplied by 3 and 4 respectively and the rotator rotates by 180□ and 270□ respectively. This way the bin corresponding to the type of waste is positioned below the flap. The bin will move back to the initial position once the waste fall into the respective bins, and the flap closes.

The flap is driven by a DC motor that is controlled by IC L293D motor driver. Once the corresponding bin is placed under the flap, the flap opens and the waste is discarded. After a delay period, the flap will be closed.

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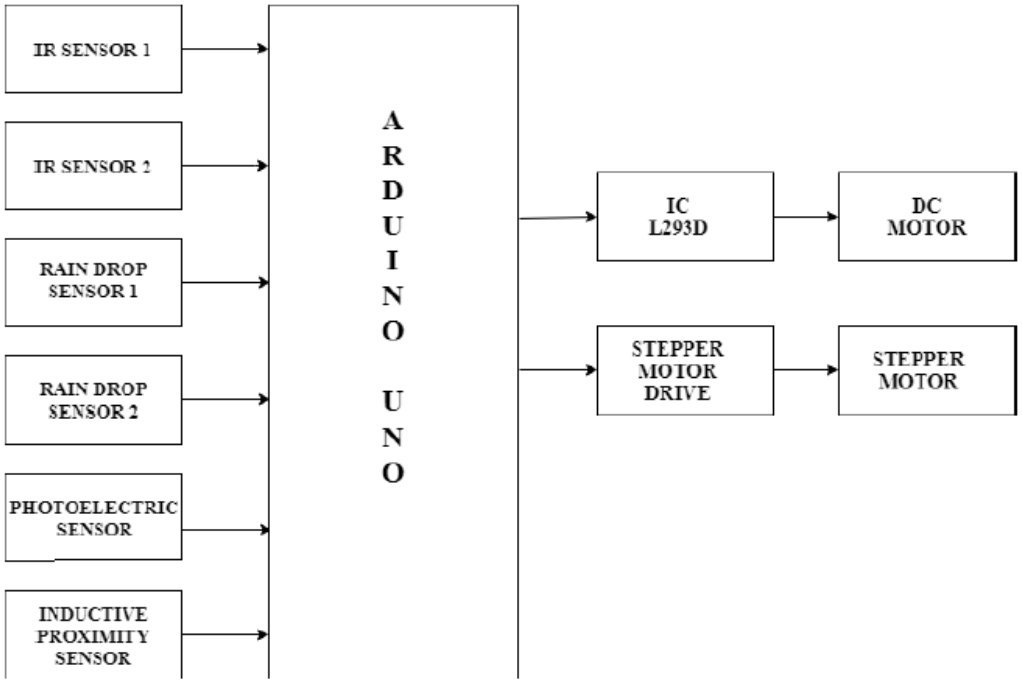

Figure 1. Block Diagram

III. Implementation

The design procedure can be broken down into two stages mainly, Hardware implementation and Software implementation.

A. Software Requirements

Figure 2. Flowchart of the Proposed System

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The methodology described in section II is represented in the form of flowchart in Figure 2.

B. Hardware Implementation

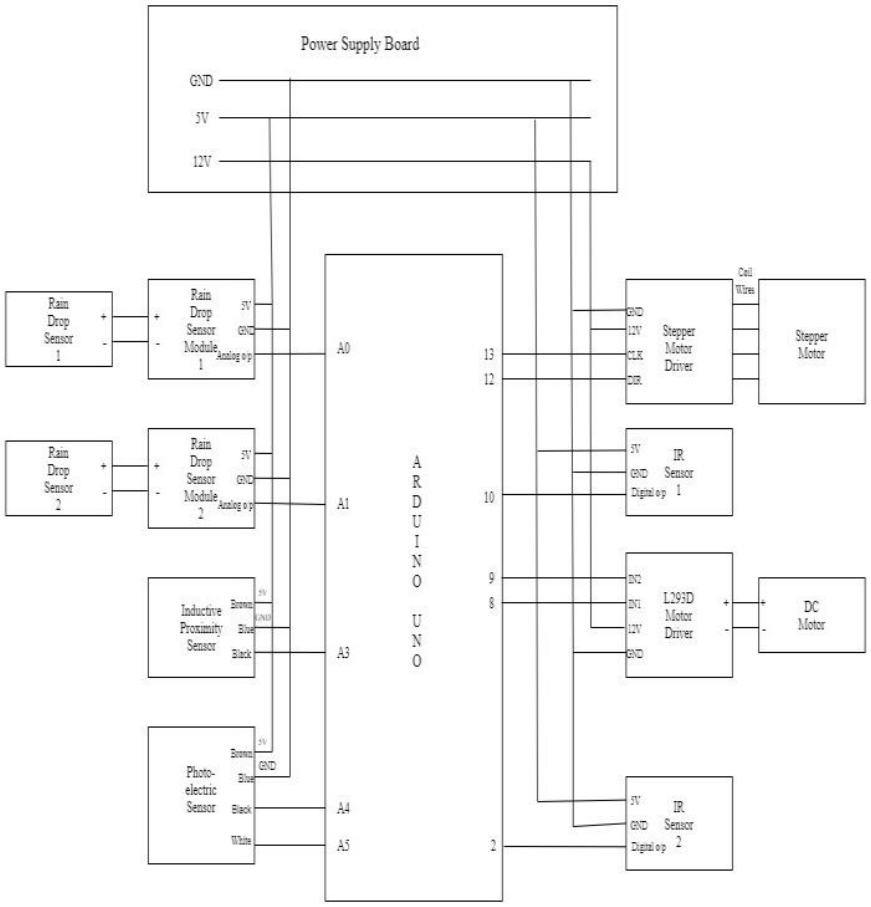

Figure 3. Circuit Diagram of the Proposed System

The circuit diagram of the proposed system is as shown in Figure 3. It consists of Arduino UNO board [10], power supply board. Different sensors act as input and output sensors to Arduino UNO [11]. Rain drop sensors, inductive proximity sensor, photoelectric proximity sensor, IR sensors [12] are input sensors. Rain drop sensor module is used to control rain drop sensor. Stepper motor driver and DC motor driver are output drivers. These motor driven are used to drive stepper motor [16] and DC motor respectively. The power supply connection of different sensors is also shown in the figure. A0, A1, A3, A4 and A5 are the analog input pins of the Arduino board to which the analog output pins of wet sensors, inductive proximity sensor and photoelectric sensor are connected. The digital output pins of IR sensor 1 and 2 are connected to digital input pin 10 and 2 respectively. Digital pin 8 and 9 are input to L293D motor driver [17]. Similarly, pin no. 12 and 13 are input to stepper motor driver.

IV. Result and Analysis

The proposed method is a solution to the current waste management problem which will effectively segregate metal, glass, wet and solid.

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a. Wet Waste

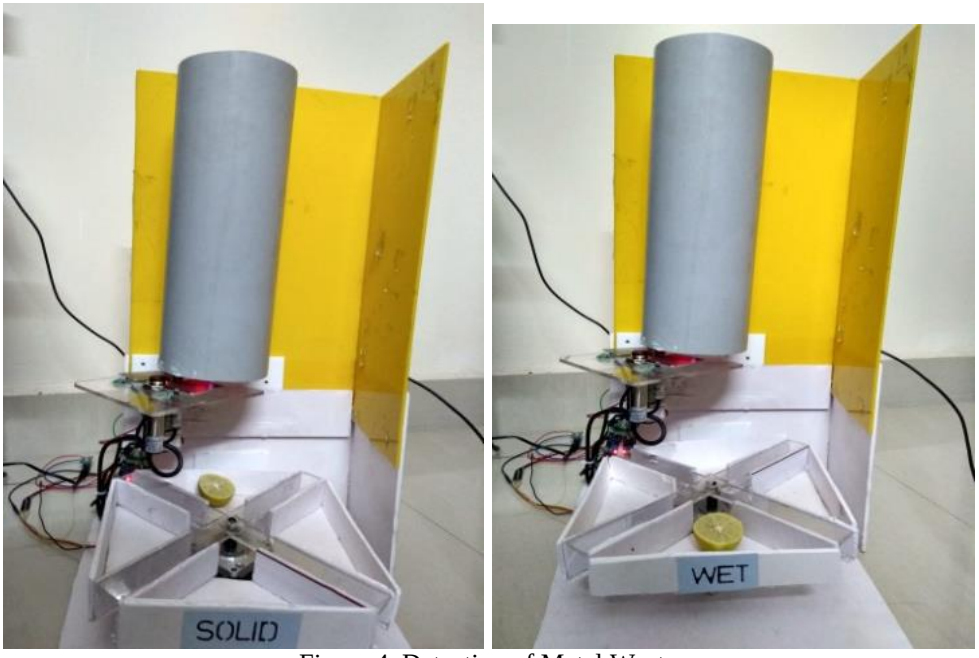

Figure 4. Detection of Metal Waste

Once the object is detected, if it is a wet waste, the value of each rain drop sensor [14] is displayed. The reading of either of the rain drop sensor (ws1 or ws2) should be less than 700 for wet waste. As the value of ws1 or ws2 is lesser than 700, the object is detected as wet waste. Then the flap opens, the waste drops into the wet bin which is placed in the initial position. Then the flap closes. The Figure 4 shows the images of detection of wet waste.

b. Metal Waste

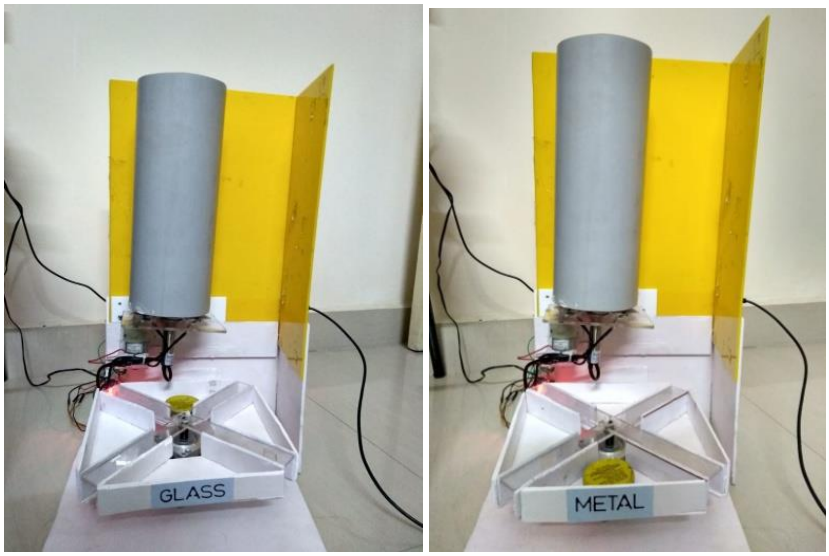

Figure 5. Detection of Metal Waste

If the object is detected as metal, the reading of inductive proximity sensor [13] is displayed. The reading of inductive proximity sensor should be more then 500. Then the flap opens and the object drops into the respective bin. The flap closes and the bin moves back to the initial position. The Figure 5 shows the images of segregation of metal waste.

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c. Glass Waste

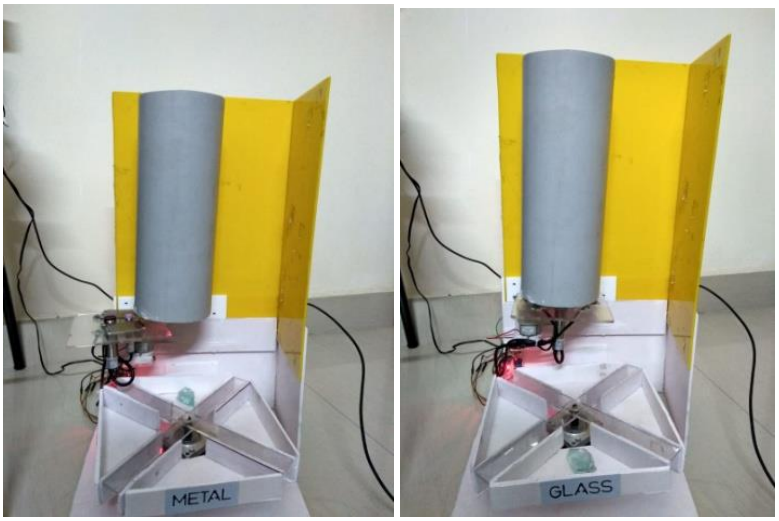

Figure 6. Detection of Glass Waste

The system checks whether the object detected is wet or metal. If the object is neither wet nor metal, then the system analyses for transparent or non-transparent material. If the back light sensed by the photoelectric sensor [15] is less than 20, then the object inputted is transparent material. The flap opens and the waste drop into the respective bin. The flap closes. The bins move back to the initial position. The analog readings of black and white light sensed by the photoelectric sensor are displayed. The Figure 6 shows the images of segregation.

d. Solid Waste

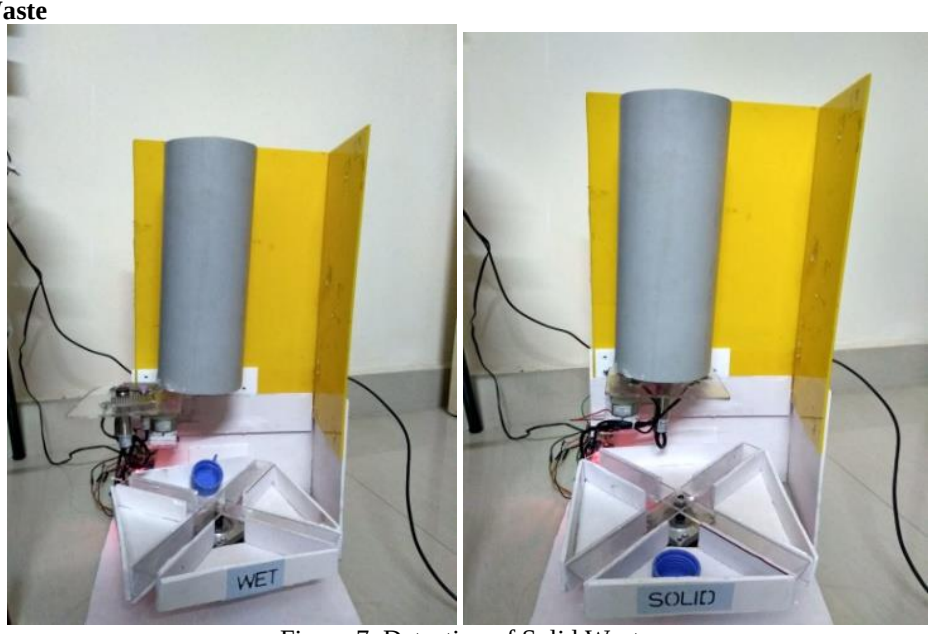

Figure 7. Detection of Solid Waste

The system checks whether the object detected is wet or metal. If the object is neither wet nor metal, then the system analyses for transparent or non-transparent material. If the back light sensed by the photoelectric sensor is more than 20, then the object inputted is non-transparent material. The flap opens and the waste drops into the respective bin. The flap closes. The bins move back to the initial position. The analog readings of black and white light sensed by the photoelectric sensor are displayed. The Figure 7 shows the images of segregation of solid waste.

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V. Conclusion

An efficient waste management system is the need of the hour. The proposed method is a solution to the current waste management problem that segregates metal, glass, wet and solid. The Automatic Waste Segregation system (AWS) effectively employs inductive proximity sensor to identify metallic items, rain drop sensor to identify wet objects, and photoelectric sensor to differentiate between solid and glass waste. Implementation of this system at a local level like societies, educational institutes, etc. can reduce the burden on the local authorities. The automatic waste segregator is one small step towards building an efficient and economic waste collection system with a minimum amount of human intervention and also no hazard to human life. Segregating all these wastes at a domestic level will also be time-saving.

Every project always has a scope for improvement. Using a robotic arm will make the process of segregation easier when different types of waste are dumped together. Also, more sensors can be used to segregate bio-degradable and non-bio-degradable waste, recyclable waste, e-waste, and medical waste. A recycling system can be included to the present system which recycles each kind of waste using respective methods and also the level of bins can be monitored using proximity sensors and GSM module in the case of segregating waste at a larger scale.

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