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Robust and Automatic Waste Segregator

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Abstract—In past years, the human population living in urban areas has been increasing. This has created large quantities of waste. Since civic authorities tend to overlook this major concern, the untreated waste causes pollution in our environment and creates unhygienic conditions for the citizens. If this waste is treated properly then it becomes useful for us. Proper handling of this situation by our method, can lead to cleaner surroundings for the citizens, efficient treatment of the waste and it can also be financially profitable for the authorities. Our method proposes segregation of waste into various categories based on its property. We accomplish this by using a system made of multiple sensors embedded with a micro-controller which can classify various types of materials. The system segregates waste into dry, wet, metallic and non metallic categories. This leads to better processing of each category separately, which is a more efficient method. The segregated waste can be reused, recycled or used in landfills depending on its category. Also our system monitors the fill level of waste in the dustbins so that it can be collected on time by the concerned authorities. This method leads to better utilisation of waste.

Keywords—Sensor technology, waste segregation system, metal waste segregation, automated waste segregation, residual waste, recyclable waste, wet waste, dry waste, moisture sensor, ultrasonic sensor, inductive proximity sensor etc.

I. INTRODUCTION

There has been a significant increase in Municipal Solid Waste (MSW) generation in the last few decades. Due to rapid urbanization and uncontrolled growth rate of population municipal solid waste management has become acute problem in India. The environmental problem arising from unscientific and indiscriminate disposal of municipal garbage is a real menace for the whole society. As per the previous data in India per capital waste generation had increased by 1.3 percent annually with urban population increasing between 3-3.5 percent per annum. Yearly increase in waste generation is around 5 percent. In India the municipal agencies spend 5-25 percent of their budget on SWM. Unfortunately, high capital investment in the solid waste management sector does not necessarily lead to improvements in the quality of service. Untreated/raw open dumping of municipal solid waste is common picture in India which may cost several environmental and public health problems. Landfills are also becoming increasingly expensive because of the rising costs of construction and operation. Incineration, which can greatly reduce the amount of incoming municipal solid waste, produces ash which contains hazardous materials including heavy metals and organic compounds such as dioxins. Recycling and Recovery (treatment/processing) plays a large and crucial role in solid waste management.

Rest of the paper is organized as follows, Section I contains the introduction of our project concept, Section II contains the related work done by people on the topic, Section III contains the methodology used by us, Section IV contains the results and discussion, section V contains the conclusion and future scope of project, Section VI contains the acknowledgement, Section VII contains the references to the various research paper we referred to.

II. RELATED WORK

[1]A microcontroller based embedded system was designed, which uses DC motor for conveyor belt and segregates wastes into two categories dry and wet waste using simple techniques. Here the biodegradable waste and recyclable waste goes into one section, hence the segregation doesn't serve the purpose and better methods could be implemented.

[2] A green bin model to segregate household waste into dry and wet waste. Five different bins are arranged in a circular way in order to segregate metal/glass waste, paper/plastic, food waste, bio waste, inert material. The waste collected module is moved to over the bins to empty waste accordingly in each bin. This system is not compact and is not economical and also has some constraints for its proper working such as multiple rotative iterations that consumes unnecessary power.

[3]A technique is designed to segregate wet and dry, metallic and non-metallic and degradable &non-degradable waste objects using machine learning and image processing. They are using sensors for first two categories but to segregate degradable & non-degradable material, the waste is been captured by a camera and the image which has been captured is been compared with the dataset images and segregated accordingly. The use of cameras increases the cost of the project and the datasheet used should be flexible and strong enough to detect every degradable & non-degradable waste.

[4] A model where it distinguishes plastic bottles and tin cans using the sound resonant frequency produced when it

hits platform which is made of galvanized iron. This technology only segregates the plastic bottles and tin cans and recycles them.

[5] A Recycle-bot was designed which uses image processing technique to distinguish waste into recyclable and non-recyclable material. ZigBee is also used. This system is complex and communication between modules is necessary to work efficiently.

[6]The wastes are been segregated as metallic waste and non-metallic wastes with the help of metal sensor. And in some papers they simply use magnets to segregate metallic and non-metallic, but they didn't get accurate results. In some other paper they only detect the wet and dry waste with the help of moisture sensors and segregate accordingly. And also odour sensor is used to segregate degradable wastes which make foul smell. The notable dispute in waste architecture is that trash bins by the side of open loopholes become avalanched far ahead on time in advance of the beginning of following cleanliness action. It leads to various threats such as foul odour in the region which is also the root reason for spread of a variety of diseases.

[7] An Arduino based smart garbage monitoring system is developed to monitor the garbage through the city. The instant depth of the litter bin is senses by using HC-SR04 ultrasonic sensor. This HCSR04 ultrasonic sensor is interfaced to microcontroller which is mounted on Arduino UNO board.
As soon as the dustbin is filled by the garbage the ultrasonic sensor measure the distance in the dustbin using frequency of sound wave & it will warn the level of garbage. In the proposed system, there are three threshold levels: If the garbage is filled up to 10% then the green led is glow, if the garbage level is up to 75% then yellow LED glow, the red led is glow if the garbage is filled by greater than 10m and up to 100%, the buzzer starts to buzzing the alarming sound and alerts the user so that filled bin is replaced with another bare rubbish bin.

III. METHODOLOGY

We are primarily using sensors which according to the property of the material of the waste separate it into different categories. The main objective is to segregate the waste so that it can be given proper treatment and make it industry or domestic usable. 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 either 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 can be reused or recycled.

- INDUCTIVE PROXIMITY SENSOR: To separate metals from the waste.
- MOISTURE SENSOR: To separate the organic waste into wet and dry parts.
- ULTRASONIC SENSOR: To detect the presence of waste on conveyer belt.

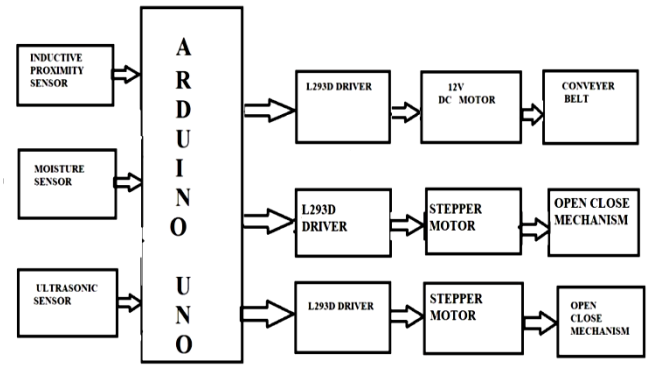


Figure 1: Block diagram of proposed system

The output of these sensors is connected to appropriate segregation mechanisms which are activated when the input from the respective sensor is high and the corresponding type of waste is segregated. The segregation mechanism includes a simple flap which rotated by a stepper motor to a certain degree on activation so that the incoming waste is directed to the respective bin. This method is simple and cost effective. We have also detected the fill level of the respective bins with the help of ultrasonic sensor which will help resolve the problem of unhygienic condition due to the over filling of dustbins.

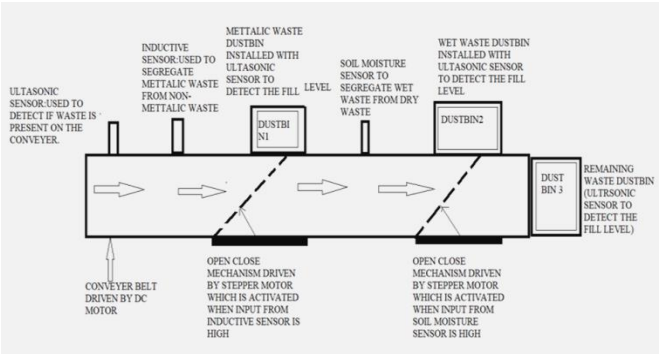


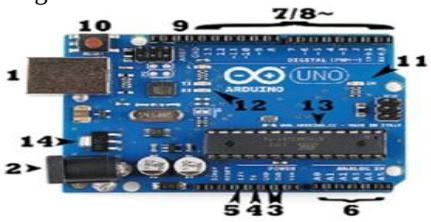
Figure 2: Structural diagram of proposed system

Components Used:

1. Arduino Uno:

The Arduino Uno is a popularly used open-source micro-controller board that runs on ATmega 328P micro-controller. This board contains a set of digital and analog I/O data pins that are used to interface this board with other electronic components. Arduino Uno consists of 14 digital pins and 6 analog pins. This board can be programmed with the help of Arduino IDE (Integrated Development

Environment) that supports embedded C, its back-end is constructed using JAVA.

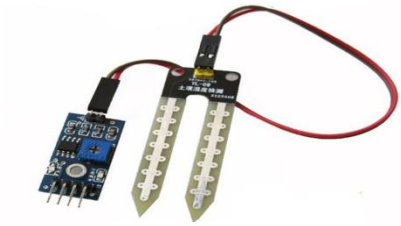


2. Metal Sensor:

An Inductive Proximity Sensor is a non-contact electronic proximity sensor used for the detection of metals. Sensing range of this sensor completely depends upon the metal being detected. Their working principle is based on a coil and an oscillator that generates an electromagnetic field in the surrounding of the sensing range. Presence of any metallic substance in the sensing range causes dampening of oscillation amplitude. Rise and fall of amplitudes is detected by a threshold circuit that causes a corresponding change in the output of the sensor. If a metal contains some percentage of ferrous, the sensing range is longer, while non-ferrous metals like copper reduce the sensing range by 60 percent.

3. Moisture Sensor:

This sensor is used to measure the moisture content in a given material. These sensors use the volumetric water content indirectly by making use of some other properties like electrical resistance, dielectric constant. In general cases, the sensor generates a voltage proportional to the dielectric permittivity and therefore measures the moisture content of a material.



4. Ultrasonic Sensor:

As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves.The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.

IV. RESULTS AND DISCUSSION

In our system, the ultrasonic sensor detects the presence of any object i.e. waste material on the conveyer belt. Upon detection by the ultrasonic sensor, the conveyer belt starts moving. The moisture sensor detects the presence of wet or dry waste and the moisture percentage of the object is displayed on the LCD display. The wet waste is removed by the swing door mechanism. The dry waste proceeds to metal and non-metal segregation by the inductive proximity sensor. Here the metallic waste is shifted to its dustbin by the swing doors. The remaining waste, which does not belong to previous categories is then moved to the last dustbin. In each dustbin there is an ultrasonic sensor which monitors the fill level.

The sensors that are used in our method are working as intended and by adjusting our system we are able to optimize the detection and segregation rate. Hence we have achieved a high rate of correct detections of objects. The summary of sensors and their uses is given:

Table 1: Sensors and their uses

Sensors	Application
Moisture sensor	Wet waste detection
Inductive proximity sensor	Metallic waste detection
Ultrasonic sensor	Waste object detection and dustbin fill level measurement

V. CONCLUSION AND FUTURE SCOPE

In this paper we have presented how waste can be segregated using various sensors that are embedded to a micro-controller without much human intervention. The proposed method ensures that the input waste will be segregated into different categories. After segregation each category of waste can be treated separately with higher efficiency.

The limitation of our method is that it is challenging to segregate waste that is clumped together from different categories. To overcome this challenge the input waste has to be pre-processed physically.

The scope for the future work is that our system can be either scaled up for industrial usage or it can be scaled down for a household level use. Also additional categories of waste can be segregated as needed.

VI. ACKNOWLEDGEMENT

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