JOURNAL OF INFORMATION, KNOWLEDGE AND RESEARCH IN ELECTRONICS AND COMMUNICATION ENGINEERING
ISSN: 0975 – 6779| NOV 16 TO OCT 17 | VOLUME – 04, ISSUE – 02

Automated Waste Segregator

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ABSTRACT:

One of the main concerns with our environment has been solid waste management which in addition to disturbing the balance of environment also has adverse effect on health of the society. Effective waste management is one of the major problems of the present era. The segregation, handling, transportation and disposal of waste are to be properly managed so as to minimize the risk to the environment. The economical value of waste is best realized when it segregated. The traditional way of manually segregating the waste utilizes more human effort, time and cost. This work proposes An Economic Automated Waste Segregator (AWS) which is cheap and easy to use solution for a segregation system at households, so that it can be sent directly for processing. It is designed to sort the refuse into metallic waste, wetwaste, drywaste, plastic waste.

KEYWORDS: *Automation, Economic, waste segregation, inductive sensing, metal detection.*

1. INTRODUCTION

We design a paper on **"AUTOMATED WASTE SEGREGATOR**". The rising population of India poses serious threats with regard to the availability of living space, utilization of natural resources and raw materials, education and employment. But another serious peril that follows is the escalating amount of waste generated each minute by an individual. Every city is grappling with the menace of ever increasing waste. An astounding 0.1 million tons of waste is generated each day in our country. Sadly, only 5% of this colossal amount of waste is recycled. In India, the collection, transportation and disposal of MSW are unscientific and chaotic. Uncontrolled dumping of waste on outskirts of towns and cities has created overflowing landfills which are not only impossible to reclaim because of the haphazard manner of dumping but also has serious environmental implications. One possible solution for this problem could be segregating the waste at the disposal level itself. When the waste is segregated into basics streams such as wet, dry, metallic, plastic, the waste has 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 demand for chemical fertilizers, and biogas can be used as a source of energy. The metallic waste could be reused or recycled.

Even though there are large scale industrial waste segregators present, it is always much better to segregate the waste at the source itself. The benefits of doing so are that a higher quality of material is retained for recycling which means that more value could be recovered from the waste [3]. The occupational hazard for waste workers is reduced. Also, the segregated waste could be directly sent it to the segregation plant then to the recycling plant.

Currently there is no system of segregation of dry, wet, plastic and metallic waste at household level. J.S.Bajaj[4:12] has recommended that a last cost most appropriate technological option for safe management should be developed the purpose of this project is the realization of compact, low cost and user friendly segregation system for urban household to streamline the waste management process.

A. Technical Background

The mixed waste is sorted based on the following methods at the industrial level[5]. Large items are removed by manual sorting. Then the refuse is sorted based on its size by using large rotating drums which smaller then the diameter of the holes will be to drop through, but large particles will remain in the drum.

For metallic objects electromagnets or eddy current based separators can be used. Near infrared scanners are used to differentiate between various types of plastics based on the ability of the materials to reflect light. X-rays can also be used to segregate materials based on their density.

B.Proposed Solution

Waste is pushed through a flap into the proposed system. An IR proximity sensor detects this and starts the entire system. Waste then falls on the metal detection system. This system is used to detect metallic waste. After this the object falls into the capacitive sensing module. This module distinguishes between wet and dry waste. After this the object falls into LDR+LASER for sensing plastic waste. After the identification of waste, a circular base which holds containers for dry. Wet and metallic waste is rotated. The collapsible flap is lowered once the container corresponding to the type of garbage is positioned under it. The waste falls into the container and the flap is raised. The waste in the containers now can be collected separately and sent for further processing.

C.Organization of the paper

The paper is organized as follows: section III encompasses the design methodology of the AWS, which has a detailed description of each implementation of each block. Section IV contains the results of experiments performed to show the performance of the various blocks of the AWS. Section V has the concluding remarks of the project.

2. RELATED WORKS

M.K. Pushpa [1] describes paper about microcontroller based automatic waste segregator. The proposed system uses an inductive proximity sensor to detect metal waste and blower mechanism to segregate between wet and dry wastes. A simple 8051 microcontroller forms the heart of the system. It controls the working and timing of the entire sub sections.

Subhasini Dwivedi [2] proposes a solid waste treatment plant for separating plastic, glass bottles and metal cans from solid waste material. The system uses different capacitive, proximity sensors to detect each object which is moving on a conveyer belt and segregate into different bins with the help of hydraulic cylinder flaps. The entire system is controlled by a programmable logic controller.

S.M.Dudhal [3] describes paper deals with waste segregation using programmable logic controller. The system is developed for separating out metal from waste materials. The system consists of an automatic feed system trough which waste fed into a conveyor belt, sensors and a robotic arm to which an electromagnet is attached will extract the metal from the waste and will deposit it into a bin.

Ruveena Singh [4] describes about a smart waste sorting which automatically segregate waste into two categories namely degradable and biodegradable wastes. The proposed system consists of lid, on which the waste material is placed. There is a sensor which transmits the signals and that signal received by the microcontroller, depending on the signal is received the lid of system works and put the waste into corresponding bin.

3.IMPLEMENTATION

Figure 1 shows a block diagram of the AWS. The main goal of the project is to design and develop a sorting system that sorts and waste automatically into four categories namely metal waste, wet waste, dry waste and glass waste. An upper enclosure waste does not fall out of the sensing area. Inside the enclosure is an infrared (IR) proximity sensor module. When the waste is dumped in by pushing the flap, the IR proximity sensor module gets activated and brings the micro controller LPC2138 out of low power mode. The system starts when the waste is pushed through a flap into the inclined plane having the inductive proximity sensor. The object slides over the incline to fall on the inductance coil which is used to sense any metal object. If the object is metallic a change in parallel resonant impedance of the metal detection system is observed. If the object is not a metal it continues and drops into the capacitive sensing module. In capacitive sensing the property used for segregation of waste is the relative dielectric constant. Once a dielectric is introduced between plates of the capacitor the capacitance increases. Wet has a higher relative dielectric constant than that of the dry waste because of moisture, oil and fat, content present in kitchen waste. For detecting a glass waste here we are used LDR+LASER sensing module. The light dependent resistors which changes resistance according to light intensity. Normally the resistance of photo resistor decreases with increasing intensity of light falling on it. A laser diode is an electrically pumped semiconductor laser in which the active medium is

formed by a p-n junction of a semiconductor diode similar to that found in a light-emitting diode. The laser diode is the most common type of laser produced. The two dc geared motor are used in our project. The dc motor works on 12v. To drive a dc motor, we need a dc motor driver called L293D. This dc motor driver is capable of driving 2 dc motors at a time. In order to protect the dc motor from a back EMF generated by the dc motor while changing the direction of rotation, the dc motor driver have an internal protection suit.

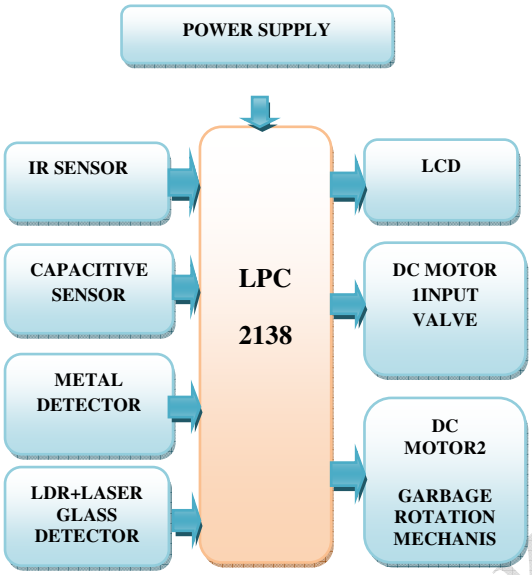

Fig. 1 Block Diagram of proposed system

A. *Entry system and initialization*

The waste is dumped into the AWS by pushing it through a flap. This flap comes in the proximity of the IR proximity sensor which marks the entry of the waste. The sensor sends an interrupt to the microcontroller which comes out of the low power mode. It then initializes the sensor modules. The initialization of all modules ensures that any dynamic changes in the environment do not affect the sensing.

B. *Metal Detection System*

The object moves over the incline and falls on the inductive coil [1][4]. The inductive coil is a part of a parallel inductance and capacitance (LC) circuit. This measures the parallel resonance impedance of a parallel LC circuit and returns data as a proximity value. This data changes whenever another metallic object is introduced in the vicinity of the coil.

When an alternating current is passed through a coil it generates a magnetic field [7]. When a metallic object is introduced in the vicinity of the coil, eddy currents are induced on its surface. The eddy currents are a function of the distance, size, surface area and composition of the target. This generates a magnetic field which opposes the original magnetic field which is generated by the coil. The inductive coupling between the coil and the object creates a mutual inductance effect on the coil which decreases the parallel resonant impedance of the circuit which in turn is reflected by an increase in the proximity count value. Magnetic fields do not affect the metal detection system. It can detect any conducting material irrespective of its magnetic properties. The waste continues down the incline towards the capacitive sensing module.

C. *capacitive sensing module*

Two pairs of copper cladded electrodes of size 10*7 cm are placed along the walls of the structure which are inclined to each other at an angle of 60°. This arrangement is made to ensure that waste of all sizes can be sensed. The area between each pair of plates increases as it moves away from the apex of the structure. The sensitivity of the plate decreases with its increase in area, hence smaller plates would accurately sense objects of smaller size. Even though the sensitivity of the larger plate is decreased, it is designed to detect larger objects which will yield a change sufficient to be identified. The property used for segregation of waste is the relative dielectric constant. Once a dielectric is introduced between the plates the resistance value between the plate's changes and subsequently a voltage change is detected. Wet waste has a higher relative dielectric constant than that of dry waste because of the moisture, oil and fat, content present in kitchen waste. If the change in the voltage is greater than threshold then the type of garbage is inferred as dry waste, else it is wet waste. Thus, the type of waste is identified as either wet or dry. The waste continues down the incline towards the glass sensing module.

D. *Glass sensing module*

For the sensing of glass type waste the LASER+LDR are used. The LASER light is place at one end and other end the LDR is placed. The glass type waste is placed in between these two laser and LDR. The light is passing through laser light Photo resistors or Light *Dependent Resistors* (LDR) which change resistance according to light intensity. Normally the resistance of Photo resistor (LDR) decreases with increasing intensity of light falling on it. Photomultiplier tubes containing a photocathode which emits electrons when illuminated, the electrons are then amplified by a chain of dynodes. From the output of LDR we can decide the waste is glass type or not.

E. *Segregation module*

To achieve the segregation, two dc geared motors [5] are used. The containers are placed on a circular base which is mounted on the axle of a servo motor. The circular base rotates as the axle of the servo motor rotates. If the container corresponding to the type of garbage is not under the flap then the motor is rotated clockwise or anticlockwise. The servo motor is given four different positions or angles for the four types of wastes detected. The motor thus always comes to the required position according to the signal obtained. The default bin at the circular base is the dry bin. To avoid overshooting of the container due to the momentum of the base, the servo motor is rotated at lower speeds by using pulse width modulation (PWM) which is generated from the microcontroller's timer. Once the required container is positioned under the flap, a second servo motor lowers the collapsible flap by rotating the motor clockwise by 180° it then waits for 2 seconds to ensure that the waste falls down and finally raises the flap back to the initial position by rotating the motor anti clockwise by going back. PWM is used to rotate the motor. Thus the segregation is completed.

4. CONCLUSION

Automatic Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. The system can segregate only one type of waste at a time with an assigned priority for metal, wet, dry and glass waste. The experiment has been conducted for wet, dry, glass and metallic wastes. It is found that the change of capacitive count value is greater for wet waste and very less for dry waste. Other objects like glass and wood have intermediate relative dielectric constant and thus are detected as dry waste. Experimental result shows that the waste has been successfully segregated into glass, metallic, wet and dry using the Automatic Waste Segregator.

5. RESULTS

The project has been tested for different categories of waste namely wet, dry and metal. Wet waste means organic wastes such as vegetable peel, garden wastes etc, dry waste include paper wastes, plastic bottles etc, and metallic waste include safety pins, foil paper etc. glass waste include frame glass, glass bottles etc.

Table 1. The result of waste segregation

Wastes	Type of waste detected
Foil paper	Metallic waste
Banana peel	Wet waste
Lemon	Wet waste
Potato	Wet waste
Poly bag	Dry waste
Paper	Dry waste
Keys	Metallic waste

Table 2. Rotation of circular base according to Detected waste

Wastes	Angle (in degrees)	Movement of bin
Dry	45	Default
Metallic	45	Anti clockwise
Wet	135	Clockwise
Glass	135	Anticlockwise

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