

Smart Dustbin-Wet and Dry(Metal) Waste Segregator with Alert System

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Abstract—Continuous urbanization and industrialization has led to increase in volume and type of waste generated. It is estimated that in 2006 the total amount of municipal solid waste generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003 (Global Waste Management Market Report 2007). This poses a problem for local and national governments to ensure sustainable and effective waste management. Technology always helps mankind in making life easier. In public places, proper disposal of waste is not being followed which causes overflow of waste in dustbins that has become a threat to the environment. Segregation, management, transport and disposal of waste plays an important role to minimize the risk to the public and environment. The economic value of waste is best realized when it is segregated. Currently there is no such system of segregation of dry, wet and metallic wastes at a household level. This paper is an innovative way to revolutionize the waste management system using sensors. Segregation is achieved using respective automated sensors and the level of dustbins are monitored simultaneously. Presently there's no such system for segregation of dry and wet wastes at domestic level or social unit level. This paper proposes an automated sensor based waste management and segregation system. It is designed to sort the refuse into 2 categories: wet and dry (metal).

Keywords— segregation, automation, management, embedded system technology, dustbin, automated sensors.

I. INTRODUCTION

In recent times, garbage disposal has become a huge cause for concern in the world. A voluminous amount of waste that is generated is disposed by means which have an adverse effect on the environment [1:11]. Waste Management includes arranging, financing, development and operation of facilities for the gathering, transportation, reusing and last disposal of the waste. The common method of disposal of the waste is by unplanned and uncontrolled open dumping at the landfill sites. This method is injurious to human health, plant and animal life. This harmful method of waste disposal can generate liquid leachate which contaminate surface and ground waters can harbor disease vectors which spread

harmful diseases and can degrade aesthetic value of the natural environment and it is an unavailing use of land resources [4:4].

In India, rag pickers play an important role in the recycling of urban solid waste. Rag pickers and conservancy staff have higher morbidity due to skin infections and respiratory problems. The segregation of the wastes are diminished as it depends on the rag pickers. One possible solution for this problem could be segregating the waste at the disposal level itself [2]. When the waste is segregated into basic streams such as wet, dry [2]. Currently there is no such system of segregation of dry, wet and metallic wastes at a household level [3]. The economic value of the waste generated is not realised unless it is recycled completely.

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 either compost or methane gas, or both. Compost can replace the demand for chemical fertilisers, 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.

This paper proposes an Automated Waste Segregator (AWS) which is a cheap, 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, wet waste and dry waste [3].

II. LITERATURE SURVEY

The garbage management in cities should be effectively and efficiently implemented. Most smart dustbin techniques so far only used IR sensors, Ultrasonic sensors and RFID tags and only concentrated on waste management. This section discusses about the existing approaches in the field of smart waste management.

Insung Hong et.al [5] has suggested that replacing SGS(Smart Garbage Sensor) instead of RFID garbage collecting system helps to improve their energy efficiency up to 16% and can reduce the food waste reduction .Inside

the SGS they have installed SGBs (Smart Garbage Bins) to control the energy efficiency of the system.

In another framework, the paper proposed to design an electronic machine, which allows you to offer a way to abnormal waste disposal gadget. The designed gadget uses biosensor sensor, weight sensor and height sensor to locate overflow of the waste within the dust bin and the quantity of pollution caused by unwanted toxic gases from the bin. It included a GSM module to alert municipality about the overflow of the waste [6].

Fachmin Folianto et.al [7] has suggested that it uses mesh network. It is used to produce data and deliver it to the mesh network. Whenever the bins are filled they need to be cleaned. The bin collector gives the route to collect the bins.

Vikrant Bhor et.al [9] has suggested that when the system ensures that the garbage bins are fully filled up to their maximum it must be cleaned using IR sensor, GSM mode and microcontroller. When it is not filled it must be reported to the higher authority of a particular contractor. It concludes that it has a clean environment and it decreases the total number of trips the garbage collector vehicle rounds.

As per the statistics and study, garbage bins needs separate sections and various indication facility so that respective authorities can monitor the bins effectively. Solid waste management facility in India is very poor. There is no organized efforts and processing plan to segregation. It leads to a lot of human efforts. This concept reduces the problems of current waste management problems to a lot extent.

III. PROPOSED SYSTEM

Segregation is the initiative to complete waste management. Studies show that majority of the population in urban and rural areas don't segregate wastes being a reason that they notice it inconvenient. Management or assortment of waste is secondary. There are effective systems of waste management for smart alert system for garbage clearance by giving an alert signal to the municipality for fast assortment of garbage in trash bin with correct verification based on level of garbage filling. Here we propose a project that makes use of different sensors and actuators to manage the waste in a locality and also segregate it in the initial stages itself. The main components that will be used for implementation is as listed below and as shown in the block diagram (figure 1) below.

A. Arduino Uno microcontroller

A simple Arduino Uno microcontroller forms the heart of the system [2]. The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet) [9]. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button[9][10].

B. IR sensor

This is used to detect whether there is any kind of waste present in the dustbin. IR Sensor works using a particular light sensor to detect a single light wavelength in the Infra-Red (IR) spectrum. By using an LED which produces light at the same wavelength as what the sensor is expects, the intensity of the received light is recorded. When waste is put near the IR sensor, it means waste is present and it is ready for segregation. The light from the LED reflects from the object and into the light sensor. A huge change in the intensity is created, which denotes that an object is present. This sensor gives a logical 1 output which denotes that there is a presence of an object and logical 0 output in the absence of the object. This is fed as input to the microcontroller.

C. Moisture sensor

The Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In wet waste, dielectric permittivity is a function of the water content [11]. The sensor creates a voltage corresponding to the dielectric permittivity, and hence the water content of the waste [11]. Thus it helps to differentiate between wet waste and dry waste. [12] IR sensor for level detection- An IR sensor will detect the presence of waste and detects the level of waste. This detects the level and communicates to the microcontroller if the level crosses a particular threshold.

D. Gear motor

Gear motors are mainly used to reduce speed in a series of gears, which in turn creates more torque. This is accomplished by an integrated series of gears or a gear box being attached to the main motor rotor and shaft via a second reduction shaft. The second shaft is then connected to the series of gears or gearbox to create what is known as a series of reduction gears. Generally speaking, the longer the train of reduction gears, the lower the output of the end, or final, gear will be [13]. This motor is attached to the primary dustbin and it helps in clockwise and anticlockwise movements of the bin.

E. Motor Driver

Motor drivers act as current amplifiers, this higher current signal is used to drive the motor. This is used to provide bidirectional drive voltage from 5V to 36V. It has a high noise immunity and provides protection against high temperature. The gear motor needs 12V supply but the maximum voltage at which Arduino uno works is 5V. Thus to meet the required 12V, L293D is used.

F. Inductive Proximity Sensor

Inductive proximity sensors are used for non-contact detection of metallic objects. Their operating principle is based on a coil and oscillator that creates an electromagnetic field in the close surroundings of the sensing surface. The presence of a metallic object (actuator) in the operating area causes a dampening of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit that

changes the output of the sensor. The operating distance of the sensor depends on the actuator's shape and size and is strictly linked to the nature of the material

Table 1: Look up table for the rotation of the base control motor

Type of Waste	Status of bin	Direction of Rotation of motor
Dry	Dry	No rotation
Dry	Wet	Clockwise
Dry	Metal	Anticlockwise
Wet	Dry	Anticlockwise
Wet	Wet	No rotation
Wet	Metal	Clockwise
Metal	Dry	Clockwise
Metal	Wet	Anticlockwise
Metal	Metal	No Rotation

Table 2: Proximity count values for different metal objects

Metallic Object	Metal	Dimensions (cm)	Change in count
Foil	Aluminium	1.7	804
Plates	Copper	2*3	797
Staple Pins	Stainless Steel	5*1	775
Paper clips	Iron	3*2	648

G. GSM

GSM stands for Global System for Mobile Communications. A GSM Modem is a device that modulates and demodulates the GSM signals. The modem used is SIMCOM SIM300. As soon as the IR sensor for level detects that the dust bin is full, it sends a message to the local waste management department or municipality indicating that the bin is full and the garbage needs to be collected. As we have explained earlier, the proposed system is divided into two categories. The figure 2 as shown below represents the flowchart of waste management process. We have declared a variable ir which represents IR sensor output. If ir variable is found to be high, it indicates that the dustbin is full and initiates the GSM to send a message to the municipal groups. If it is low, then no action is taken.

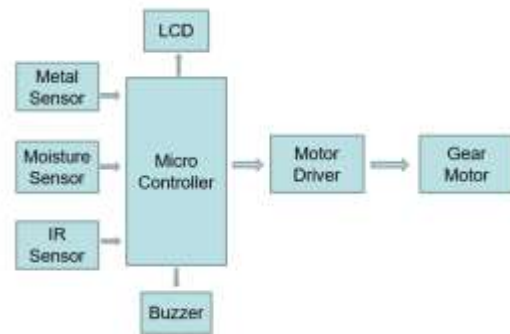


Figure 1. Block diagram of the setup

IV. Conclusion

Automated Waste Segregator has been successfully implemented for the segregation of waste into metallic, dry and wet waste at a domestic level. However, it cannot segregate ceramic into dry waste because of its higher relative dielectric constant as compared to other dry wastes. Noise can be eliminated in the sensing module to increase accuracy and overall efficiency. This system has its own limitations. It can segregate only one type of waste at a time with an assigned priority for metal, wet and dry waste. Thus, improvements can be made to segregate mixed type of waste by the use of buffer spaces. Since, the time for sensing metal objects is low the entire sensing module can be placed along a single platform where the object is stable to ensure better results.

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