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INTELLIGENT DEBRIS MANAGEMENT SYSTEM

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Abstract

Globally there has been rapid growth in the amount of waste generated due to industrialization, urbanization and continuous economic growth. The disposal, segregation, recycling of solid waste and improper management of these wastes is the need of the hour and improper management of these wastes is hazardous to human health and is causing an imbalance in the ecological system. There is a rapid increase in capacity and categories of solid waste as a result of urbanization, constant economic growth, and industrialization. According to the Global Waste Management Market Report-2007, it is calculated that the total amount of urban waste generated globally has gone up to 2.02 billion tones, which represents 7% of the annual increase since 2003."Wastes are not always waste if it is segregated as it was". To properly manage the waste it has to be handled, segregated, transported and disposed so as to reduce the risks to the public lives and sustainable environment. The economic value of waste can be gained only when it is segregated. This project proposes an automation of waste material segregation. This method is an easy and simple solution for separation of three types of wastes: metallic, degradable and non-biodegradable waste.

Background Study

This section highlights the previous work references used to arrive at this proposed idea.

[1].Automatic garbage separating robot using Image Processing Technique.

The robot detects the object by the distance sensor and collects the garbage automatically by sensing using camera by the image processing technique using MATLAB, the robot can be able to segregate the garbage into degradable and non-degradable waste. Embedded c programming used for the arm and gripper movement by the PIC micro-controller and the separation of garbage is done by the image processing technique of size, color and texture.

[2].Stand-alone Frequency based Automated Trash bin and Segregator of plastic bottles and tin cans.

It is an automated trash bin that distinguishes plastic bottles and tin cans regardless of the object's position

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of drop. The system used a piezoelectric microphone for input signal acquisition and a comparator for noise elimination. Instead of resonant frequency, the system relied on the average frequency response of the object as it hits the platform. The decision process is done by the microcontroller Arduino. The platform used is made of galvanized iron connected to a DC motor that physically segregates the objects. This study will help the community on waste recovery and aims to make recycling more convenient.

[3].Automation of plastic, metal and glass wastematerials segregation using Arduino in scrap industry.

This paper proposes an Automation of Waste material Segregation in scrap industry. This method is easy and simple solution of segregation of three types of wastes glass, metal and plastic. It is designed to sort the trash into metallic waste, plastic waste and glass waste ready to be proces separately for the next process of operation. The Method uses inductive sensors for metallic items, and capacitive sensors to distinguish bio-degradable and non-bio-degradable waste. Experimental results show that the segregation of waste into metallic, plastic and glass waste has been successfully implemented using the Automation of material segregation (AMS) method.

Introduction

In India, with more and more people migrating to the cities, the amount of waste being generated is also increasing at a higher pace and waste management is likely to become a critical issue in the upcoming years.

Most commonly, thewaste is disposed in unscientific and irregularly manner in low lying, open dumps and on the outskirts of the cities. Most of the landfills lack a proper management and monitoring, nor do they use any inert materials to cover the waste. This results in ground and surface water contamination due to surface runoffs and lack of covering; air pollution caused by burning the waste, which releases toxic gases, pungent odor and ends up effecting the health of the people due to mosquitoes and scavenging animals.

Not just the waste management system but also the people involved in this work especially Rag pickers(who play a vital but,an unrecognized role in recycling of the urban solid waste)are constantly exposed to the dangers of accidents, injuries and diseases through contact to harmful materials and poisonous materials as the scourge with bare hands and bare feet.

The economic value of the waste is not truly obtained unless it is segregated and recycled properly. A lot of waste-energy technologies used to produce energy recover materials and free lands which would otherwise be used for dumping the garbage. Sustainable and economically viable waste management must ensure maximum resource extraction combined with safe disposal through engineered waste-energy technologies.

Technical Background

In India, the waste landfills are dumped so much so that the garbage becomes visible and then one has to cringe by its stench. Smoke rises steadily from these areas as the decomposing materials generate highly combustible methane gas. Though rules passed in 2006 have made it mandatory to treat the dump yards, only 10% of the waste has been treated and

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used viably .Many cities across India have set up large waste to energy plants, which can treat 300MT of waste to compost in one day. There are also plastic shredding machines for below 40 microns. This project mainly aims at segregating the waste at the home level; separating the litter found on the road side and then taking it to the dump areas as three types of sorted wastes: Metallic, Bio-degradable and Recyclable. This sort of segregation at the smaller level increases the efficiency of the waste that is been converted, reduces pollution, saves many workers from injuries and health hazards and also adds on to the economic value.

Proposed Idea

The waste is first detected by the ultrasonic sensor, which has been programmed to sense objects in 12cm distance. Once the object is sensed the automated arm picks up the object and drops it into the intelligent bin.

The main segregation takes places in the bin. It consists 2 sections: one with an inductive sensor to detect metallic waste and the other with a capacitive sensor to distinguish between the non-biodegradable and bio-degradable waste.

Block Diagram

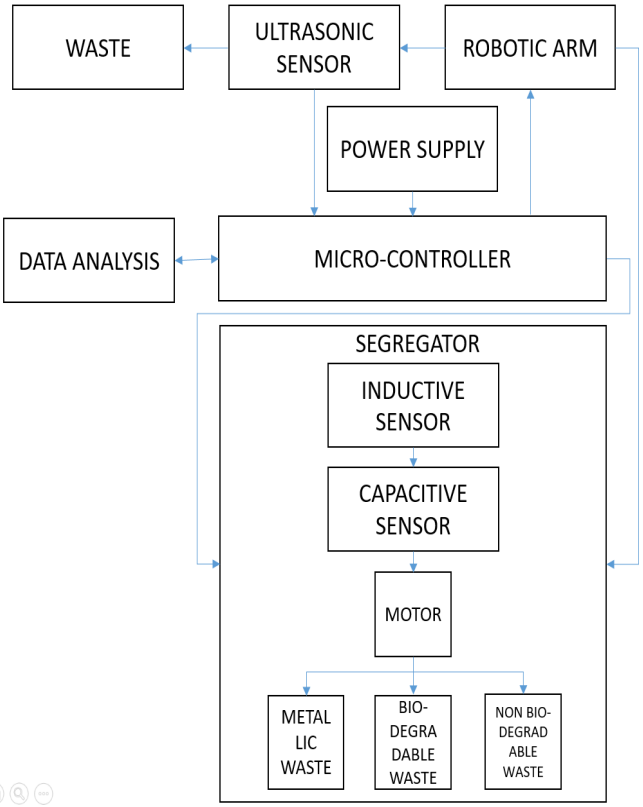

Fig.1.1

Fig.1.1 shows the block diagram of the Intelligent waste Segregator.

Collection and Initialization

The object is sensed by the HC-SR04 Ultrasonic sensor which is programmed by interfacing with the ATMEGA 328p microcontroller. The sensor continuously sends readings to the microcontroller which then converts it into its equivalent distance data and verifies if the detected object is lesser than or equal to given distance. If the sensor readings are equal to the programmed readings then the object is picked up by the automated arm.

Automated Arm

The Arm is made of three MG995 servo motors and the gripper is made of one SG90 servo motor. The servo

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motor is basically controlled by the pulse width modulated pins of the microcontroller. There is a minimum pulse, a maximum pulse, and a repetition rate. A servo motor can usually only turn 90° in either direction for a total of 180° movement. The MG995 can rotate up to a maximum angle of 120° and the SG90 can rotate to maximum angle of 180°.The pulses sent to the motor determines position of the shaft and based on the time programmed for each pulse sent via the microcontroller; the rotor will turn to the desired position. The servo motor expects a pulse every 20 milliseconds (ms) and based on the T_{on} the direction and the angle of rotation is determined.

After the sensor values matches the given distance the micro-controller instructs the arm to pick up the object and the arm initializes the process.

Inductive Sensing Module

After the object detection part, the arm drops the waste in the segregator bin. The bin starts the segregation process by sorting out the metallic waste with the help of the inductive sensor. The inductive sensor is a Colpitts oscillator circuit. This circuit uses a capacitive voltage divider network as its feedback source.The two capacitors, C1 and C2 are placed across a single common inductor, L.The inductor used in this circuit is a copper coil with Diameter= 4.5cm, Number of Turns=35, which results in a total inductance of 200mH. The emitter terminal of the transistor is connected to the junction of the two capacitors, C1 and C2 which are connected in series and act as a simple voltage divider. When the power supply is firstly applied, capacitors C1 and C2 charge up and then discharge through the coil L. The oscillations across the capacitors are applied to the base-emitter junction and appear amplified at the collector output. Resistors, R1 and R2 provide the usual stabilizing DC bias for the transistor in the normal manner while the additional capacitors act as DC-blocking bypass capacitors. The amount of feedback is determined by the ratio of C1 and C2. These two capacitances are generally "ganged" together to provide a constant amount of feedback so that as one is adjusted the other automatically follows. The frequency of oscillations for a Colpitts oscillator is determined by the resonant frequency of the LC tank circuit and is given as:

$$f_{r=\frac{1}{2\pi\sqrt{LC}}} \qquad (1)$$

Where C_T is the capacitance of C1 and C2 connected in series and is given as:

$$\frac{1}{C_T} = \frac{1}{C1} + \frac{1}{C2} \qquad (2)$$

$$C_T = \frac{C1*C2}{C1+C2} \qquad (3)$$

The configuration of the transistor amplifier is of a *CE* type with the output signal 180^o out of phase with regards to the input signal. The additional 180^ophase shift require for oscillation is achieved by the fact that the two capacitors are connected together in series but in parallel with the inductive coil resulting in overall phase shift of the circuit being zero or 360^o.Hence the oscillations are sustained.

When a metallic object is dropped in the bin, it interferes with the magnetic flux produced by the coil and adds to the inductance of the Colpittscircuit. Thus the resonant frequency of the oscillations varies. These frequency variations indicate that the object dropped is metallic.

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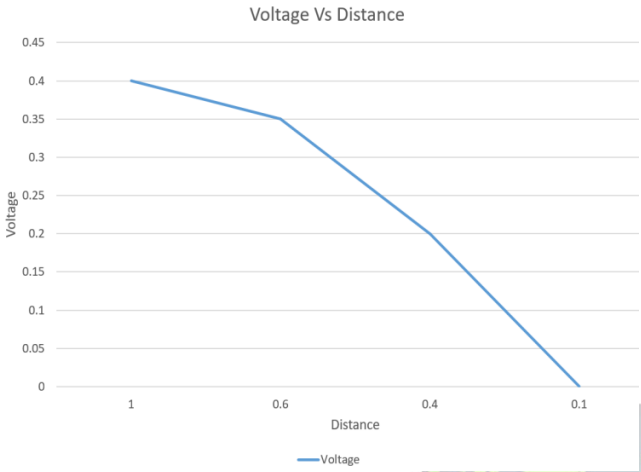

Fig.1.2

Fig.1.2 represents voltage v/s distance graph.

Capacitive Sensing Module

If the object is not detected as metal, it is dropped down to the next section where it is separated as biodegradable or recyclable waste.

This section of the bin uses a capacitive sensor. It consists of an electrode which acts as one of the plates of the capacitor. The second plate is shown by two objects: one is the environment of the sensor electrode which forms parasitic capacitor C_0 and the other is a conductive object like bio-degradable waste which forms touch capacitor C_T. The sensor electrode is connected to a measurement circuit and the capacitance is in calculated by the microcontroller in regular intervals. If a conductive object is placed near the electrode, the output capacitance will increase which indicates the object as a bio-degradable waste.

If the waste is not detected in the above two sections, it is automatically dropped down to the final part of the bin which is labeled as non-biodegradable waste.

Future work

The future work of this project is to extend the waste segregation to detect and separate plastic waste from non-biodegradable waste. As plastic is the major contributor of environment degradation. And plastic waste prevent the percolation of water and thereby prevent the rise in ground water level.

Conclusion

The issue of debris management is something that is of most important at the same time highly ignored. Wastes are not always waste if it is segregated as it was. To properly manage the waste it has to be handled, segregated, transported and disposed so as to reduce the risks to the public lives and have a sustainable environment. So we came up with this project titled "**INTELLIGENT DEBRIS MANAGEMENT SYSTEM**".We firmly believe that this project will be a small initiative towards a clean and green India.

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