



SORTING MECHANISM FOR EFFICIENT WASTE MANAGEMENT

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Abstract- Sudden increase in the amount and types of harmful waste is due to population, economic growth, technology development, industrialization and urbanization, are becoming a major problem. Unrestrained dumping of waste on outer edge of towns and cities has produced abundant landfills. It also causes serious ecological implication in terms of ground water pollution and contribution to Global warming. The segregation, management, transport and disposal of solid waste should be treated correctly to reduce the threats to the public and the environment. The cost-effective value of waste is realized when it is segregated. This paper proposes a system which segregates the waste into three categories such as metal, dry and wet. Thus the system separates the waste at the disposal stage itself. This system uses the inductive proximity sensor to find metal waste and moisture sensor to distinguish between dry and wet waste. The IR sensor is also used to identify the presence of waste. This project uses PIC16F877 microcontroller, to control the entire process with ease and simplicity.

Key words: IR sensor, PIC 16F877A, inductive proximity sensor, moisture sensor.

I. INTRODUCTION

In recent years, the waste disposal has become a major cause for concern in the nation. India generates approximately 133760 tonnes of municipal solid waste per day, of that 91152 tonnes are collected and 25884 tonnes are treated. Suitably engineered waste disposal protects human health and conserves input environmental resources such as ground water, surface water, soil fertility and air quality. The usual method to treat the waste is open dumping at the landfill sites. This method is very dangerous to human being and other species in the world. The landfills of many cities are overflowing and there is no space for new waste. An efficient management system is a need to make a better planet for future generation to live in. When the waste is segregated such as dry, wet, and metal, it has a privileged possible of revival and accordingly, recycled and reused. For example, the kitchen waste is

converted into fertilizers which reduce the chemical fertilizers. This project proposes a Waste Segregator which is an economical, easy to use as a key for a segregation system at household level. When this system is implemented in household level, the segregated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant. So the main objective of the project is just identifying the type of waste and putting them into the corresponding bins such as dry, wet and metal so that the waste can be easily recycled. This system also reduces the occupational risk of waste workers. This system uses a PIC microcontroller to control all the sensors and motors.

II. SYSTEM REQUIREMENTS

The system in this paper consists of PIC 16F877A, IR sensor, inductive proximity sensor, moisture sensor, DC geared motors, LCD display.

A PIC 16F877A microcontroller forms the heart of the system. It controls the working and timing of all the associate sections so as to sort the waste into the three primary categories.

An elucidation of the working of the microcontroller based waste segregator is illustrated below with a block diagram as shown in Fig 1.

1.Power supply:

In this project, circuits, sensors & motors are used, which require +12V & +5V (DC) supply. To fulfill this requirement, we have used the power supply which provides regulated +12V & +5V (DC). Transformer with 15V and 1A are used to down convert the AC up to 15V.

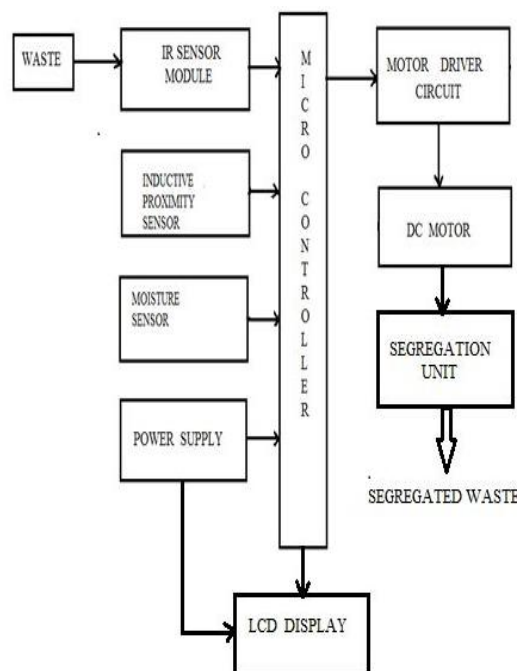


Figure 1: Block diagram

For conversion of AC into DC, Bridge type rectifier is used. It is made up of 4 diodes (1N4007) which is tied to the secondary of the transformer.

The purpose of the regulator is to maintain a constant voltage. For positive voltage output use LM78XX, XX indicates the value of output voltage and 78 indicates positive output.

The output of the rectifier is pulsating DC. This pulsating DC is converted into pure DC using a filter. A filter capacitor was necessary to minimize the ripple voltage and bring the output voltage closer to a steady value.

2. PIC 16F877A microcontroller:

The PIC microcontroller 16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as much possible because it uses FLASH memory technology. It has a total number of 40 pins and there are 33pins for input and output. It also has many applications in digital electronics circuits. The sensors and motors are interfaced to the microcontroller. According to the output of sensors, it generates control signals to drive desired motors.

3. IR sensor:

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. The emitter is an IR LED and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. IR transmitter emits some radiation, which is reflected back to the IR receiver whenever an object comes in contact with that radiation. The waste is dumped into the waste segregator, the IR sensor becomes active, it sends a corresponding signal to a controller which in turn activates the other sensors.

4. Inductive proximity sensor:

The Inductive Proximity Sensor (IPS) is a solid state device that generates an output signal when metal objects are either inside or entering into its sensing area from any direction. It consists of an oscillator, a ferrite core with coil, a detector circuit, an output circuit, housing, and a cable or connector. The oscillator generates a sine wave of a fixed frequency. This signal is used to drive the coil. The coil in conjunction with ferrite core induces an electromagnetic field.

When the field lines are interrupted by a metal object, the oscillator voltage is reduced, proportional to the size & distance of the object from the coil. The reduction in the oscillator voltage is caused by eddy currents induced in the metal interrupting the field lines. This reduction in voltage of the oscillator is detected by the detecting circuit. Thus the metal object is identified by the sensor.

5. Moisture sensor:

Moisture sensors typically refer to sensors that estimate volumetric water content. It measures the volumetric content indirectly by using some other property of the object such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. One common type of soil moisture sensors in commercial use is a Frequency domain sensor such as a capacitive sensor. Another sensor, the neutron moisture gauge, utilizes the moderator properties of water for neutron.

6. DC geared motor:

A machine that converts d. c. power into mechanical power is known as DC motor. A geared DC motor is made by attaching a gear assembly to an ordinary DC motor. This will increase the torque by decreasing the speed of the motor. The speed of the motor is counted in terms of RPM, rotations of shaft per minute. The speed can be reduced to any desired RPM by using the correct combination of gears. Each precision geared motor sports a 6mm diameter shaft that protrudes from them and it operates up to 12V.

7. Drivers and display unit:

L293D is a typical motor driver or motor driver IC which allows the DC motor to drive on either direction. It is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It can control two DC motors with a single L293D IC. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction.

After receiving the input signal from the motor driver, microcontroller produces the corresponding output for the motor. 16x2 Liquid Crystal Display is used as a display unit.

8.L293D:

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III. WORKING

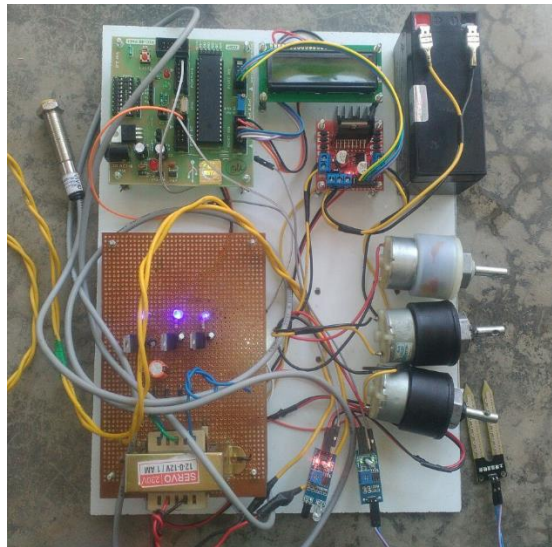


Figure 2: Hardware setup

The presence of waste is identified by the IR sensor. After identifying the type of waste, metal sensing section starts with a flap opening through which garbage goes into the assembly. The inductive proximity sensor is used to identify the metal waste. The metal to be segregated comes in contact with the inductive oscillator circuit mounted in a metal sensing section which monitors high frequency current loss in the circuit. The output signal is defined by changes in supply current. According to the presence or absence of a close metallic object, the output is high or low, but this variation in the output signal is independent of supply voltage. If the metal object is in vicinity of searching coil, then supply current will flow more and vice versa. It is based on detecting the distance of the sensor.

From the output signal of the metal detector section, the waste is distinguished as metallic or nonmetallic using the controller. At the end of this section, there is a MOTOR1 (M1) installed, which rotates in clockwise direction and waste falls down in the default bin named as 'METALLIC'. If identified waste is made up of nonmetallic components, then the second section starts playing its role, i.e. moisture sensor unit gets activated to identify the nature of waste.

The moisture sensor senses volumetric water content in waste and material is classified as wet and dry. After categorization of dry waste, MOTOR3 (M3) rotates in a clockwise direction by 120° and 'DRY' bin. As the collection process of dry waste gets completed, MOTOR3 (M3) revolves in counter clockwise direction by 120° to bring default bin (Metallic) bin under outlet flap. For accumulation of wet waste, MOTOR3 (M3) whirls in clockwise direction by 240° and waste get agglomerated in 'WET' bin. In completing the segregation process M3 rotates 240° in counter clockwise direction and the default bin comes under outlet flap. These two sensors interface with the PIC microcontroller. So the output of the sensors fed to the controller. The microcontroller sends the command to the DC motors. Two DC motors are connected through L293D IC which controls the motor simultaneously.

The two DC motors are used to control the flap mechanism. The third motor is used to control the circular base which contains three bins.

IV. RESULT

The following project shows the categorization of different types of waste using this project:

Table 1: Result of the segregator

Waste to be segregated	Type of waste	Angle of rotation from default bin	Result
Staple pin	Metal	0°	metallic
Paper	Dry	120°	dry
Banana peel	Wet	240°	wet
Coin	Metal	0°	metallic
Wet cloth	Wet	240°	wet

V. FUTURE WORK

This project has been made using a PIC controller and sensors such as metal, moisture and IR. The moisture sensor is not so efficient, therefore we can make use capacitive plates to detect the wet and dry waste. Also the project can be done by using Arduino, MSP 430 or any other high end microcontroller. The project can further be implemented in industries on a bigger scale in order to make the correct choices for disposal of hazardous wastes and other types of harmless waste. With a designate primacy for metal, dry and wet waste, the system can isolate only one sort of waste at a time. Henceforth, advances can be made to separate the assorted type of waste by utilization of buffer spaces.

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