

# AUTOMATIC WASTE SEGREGATOR BIN USING ROBOTIC ARM

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**Abstract** - This research aims to design an automatic segregator bin which can segregate the waste at source that helps in reducing the time taken for processing, and the segregation work done for large amounts of waste in the later stages. It includes different partitions for collection of different waste using sensors, with a LCD display which updates the status of the bin. The bin uses a robotic arm for picking and placing of waste, also defines the path to be taken after waste detection around the bin. This robot can be useful at places like offices, apartments, shopping malls, parks etc. This system will be useful in making waste management in smart cities automated.

**Keywords**—micro-controllers, IR sensors, moisture sensor, metal sensor, ultrasonic sensor, DC motors, motor driver, robotic arm.

## I. INTRODUCTION

As we know the technology has shown immense growth in the past few years which has led to immense production, there is a massive amount of waste generated everyday due to this[1]. Heaps of generated waste, growing even faster than the rate of urbanization have had a major impact on the environment. The garbage needs to be monitored at all times.

Based on estimates, the world cities generated 1.3 billion tonnes of waste annually with Asia accountable for 1 million tonnes per day[2]. With current urbanization and population growth rate, the global waste generation is estimated to rise to 2.2 billion tonnes by 2025. More than fifty percent of world's population does not have access to regular collection of trash which have caused troubles at a crisis level[3].

The government of India has brought in about many policies, acts, mission and programs as such for the establishment of the clean society such as Swachh Bharat Abhiyan which is a cleanliness campaign run by the government of India[3]. This was a massive move taken up by the government for the welfare and betterment of the society. This situation calls for an efficient system that can sort waste at the initial stage, thus making waste management more effective and systematic. This paper thus deals with an Automatic waste segregator bin

with a robotic arm, that categorizes the waste in a more systematic manner and will also make the process easier.

There are huge amounts of waste dumped on the roads without being segregated in India. Most of the reusable and recyclable waste goes to the dump yards as there is no proper segregation. All these waste are mixed and it takes a lot of time to segregate such huge amounts of waste everyday. There is 62 million tonnes of solid municipal waste generated while only 43 million tonnes is collected per annum[10]. Only 11 million tonnes of the collected waste are treated and further processed while the remaining is dumped onto landfill sites. This poor management system cannot be driven for long. To increase the amount of waste treated and make it reusable, the waste must be segregated before being collected so that it can be directly treated. For example, wet waste can be converted into compost and plastics can be recycled. This reduces the time needed to segregate after accumulating the waste.

An introduction and working principle to the proposed system is given in section I and II of the paper. A view of the model can be seen in Fig1 section II. The implementation and result of the model is explained in section III and IV. Section V and VI gives the flowchart and conclusion based on the same. This is the organization of the paper [1].

## II. WORKING PRINCIPLE

The basic components used are arm7, IR sensor, rain sensor, metal sensor, GSM, LCD display, Ultrasonic sensor, DC motor and robotic arm[4]. Based on the reception of the intensity by the IR receiver, the output of IR sensor is defined. DC motor is used to convert electrical power into mechanical power. Motor driver acts as a driving force for the rotation of DC motor.

In the block diagram of waste collector, the bin will move with the help of a dc motor which in turn will be run with the help of a micro-controller. The robotic arm detects its path with the help of an IR sensor. The micro controller also controls the robotic arm mechanism. The bin moves when the obstacle is detected by using IR sensor. IR sensor is used for any obstacle

detection and it also helps in detecting the path. Micro-controller is used to control the robot. Micro-controller will help in moving the robot to the place where waste is sensed using IR sensor. Micro controller also helps in controlling the movement of robotic arm. The bin uses 200rpm DC motors for the purpose of movement from one place to another. 60rpm and 150rpm DC motors are used for the movement of robotic arm. It uses 3.5rpm DC motors for bin rotation and flipper movement We use a driver for dc motors and the power supply is 12V. In this research, we use the robotic arm to pick the waste and place it in the bin which will later undergo segregation using sensors.

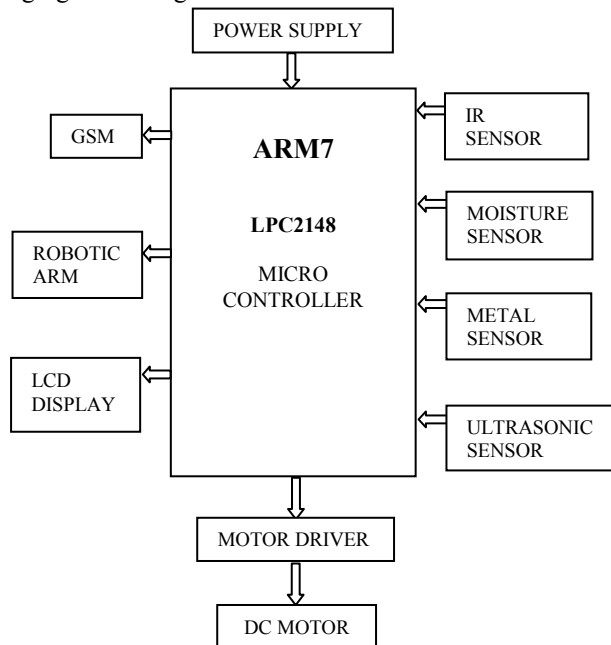


Fig.1. Block Diagram

### III. IMPLEMENTATION

**LPC2148:** It is a 32 bit micro controller based on RISC architecture[4]. LPC2148 micro controller belongs to ARM7 family manufactured by Philips. It consists of many inbuilt peripherals, which makes it more efficient[9]. Due to its tiny size and low power consumption, it is widely used in many applications [5]. This micro controller is programmed by downloading the code by using Keil mVision software for implementation.



Fig.2. LPC2148 micro-controller

**DC MOTOR:** It is a 60rpm center shaft dc motor which is of high quality. This paper has used DC motor for the bin movement (rotation of the bin for dumping waste and path movement when an obstacle is detected), the sliding movement of the flipper to place the waste in the partition, picking and placing of waste using robotic arm when waste is sensed around. When the waste is dry, the bin does not rotate and waste is dumped in initial position. If wet or metal waste, it is rotated in clockwise or anticlockwise by a delay and goes back to its position after the waste is dumped in the bin.

**IR SENSOR:** It is an obstacle detector that consists of an infrared transmitter and a receiver[4]. This is used for the obstacle detection for robotic arm. It senses if waste is dumped at the mouth of the bin and the sensors operate if an obstacle is detected. It is also placed at the bottom of the bin to sense obstacles around, if any.



Fig. 3. IR SENSOR

**MOISTURE SENSOR:** This sensor is used to detect wet materials or wastes containing moisture elements. It is given with a 5V supply. When there is a wet material on the induction plate, the led turns on and the output is low. It works with a negative logic. It is used to detect wet waste in this bin segregator.

**METAL SENSOR:** It is used to detect the metal based on relay, i.e. if any metal waste is placed near to metal detector, the relay is turned on. It uses 12V power supply. We use this sensor to detect metal waste inside the bin. If the waste is neither metal nor wet, it is detected as dry waste.

**L293 MOTOR DRIVER:** The L293 is a dual H-bridge integrated circuit. L293 can be used for simultaneous, bidirectional (clockwise and anticlockwise) control of two motors. Current provided by micro controllers is of the order of 5mA and that required by a motor is of the range of 250-500mA. Hence we require a driver to drive DC motors. We use two motor drivers for bidirectional rotation of four motors.

**GSM MODULE SIM300:** The SIM300 is a triband GSM solution in a compact plug in module. The SIM300 gives GSM 900 /1800 /1900MHz performance for voice, SMS, Data etc, in form of small factor and consumes lower power. These features of SIM300 make it ideal for virtually unlimited applications. When the bin is full, the ultrasonic sensor is sensed and using SIM300 it sends SMS to the number given in the code.

**ULTRASONIC SENSOR:** It is used to measure the distance of an object from itself using sound waves. This sensor is used to detect if the bin is full by giving the minimum distance in the code written for it. If the bin is full, we use GSM module to send the message.

**AC ADAPTER:** It is an external power supply that changes household electric current from mains voltage (either 120 or 230 volts AC) to low voltage suitable for consumer electronics. AC adapters are used with electrical devices that require power. Here, in our project power is supplied to ARM7 micro-controller with the help of this adapter.

**ROBOTIC ARM:** It is a type of mechanical arm which is usually programmable similar to a human arm. The robot arm uses motion sensors to make sure it moves in the right direction and space. The computer controls the motion of robot by rotating the individual stepper motors which are connected to each joint. Either rotational motion or translational displacement takes place.

#### IV. RESULTS AND DISCUSSION

The results of this research model displayed in Fig.4 are discussed here. The hardware components are connected properly. A SIM card is inserted in the provided slot of GSM module[6]. This model has been tested for household wastes which are generated in every home today and the results are obtained[7].

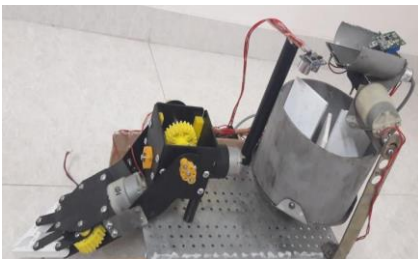


Fig .4. Smart Bin

The power is supplied to the circuit through an adapter. The status of the bin is displayed on LCD. Initially the LCD displays “SMART SEGREGATION OF WASTE” as shown in the Fig.5.



Fig.5. Initial message display

When the IR sensor of the robotic arm senses an obstacle, it displays “PICK AND PLACE” and places the waste on the top of bin allocated for detection of waste using sensors as shown in fig.6.



Fig.6. display for robotic arm

Once the waste is dumped, the sensors sense the waste and display the status on LCD. The bin is rotated depending on the type of waste and the waste is dumped. The LCD displays are shown in Fig.7, Fig.8, Fig.9.



Fig.7. display when metal is detected



Fig.9. display when metal and moisture not detected

The circuit connections are made as shown in the below Fig.10. The code is dumped onto the micro controller. The connections are soldered to avoid breakage of connections.

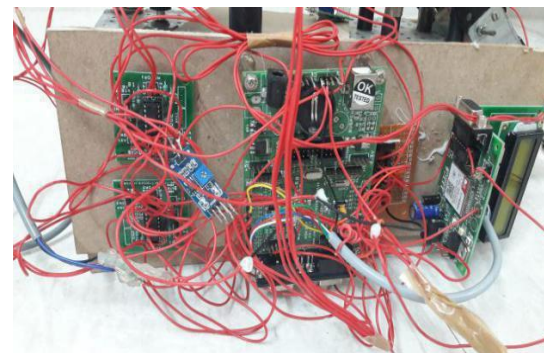


Fig.10. Circuit connections

This paper has been proposed by taking the environmental aspects into picture and the future scope implementation. It supports in maintaining an ever green environment[6].The following are few advantages of this smart bin:

- 1.It is cost effective and efficient waste management system because it improves the performance of our current waste system by making it easier for disposal and processing as segregated waste arrives directly from the bin.
- 2.It reduces the time required for processing of waste in current waste management system as the current system does

not segregate waste before collection of waste at all places. All these collected waste are finally dumped at dump yards.

3.The waste can be collected separately and used for producing energy.

4.It can be made compact and more efficient by adding a crusher to increase the volume of waste that can be accumulated inside the bin.

## V. FLOWCHART

The flow of procedure for implementation and detection of the segregation of bin used in this research model is explained with the help of a flow diagram. This flow is given in the flowchart below in the fig.11[6].

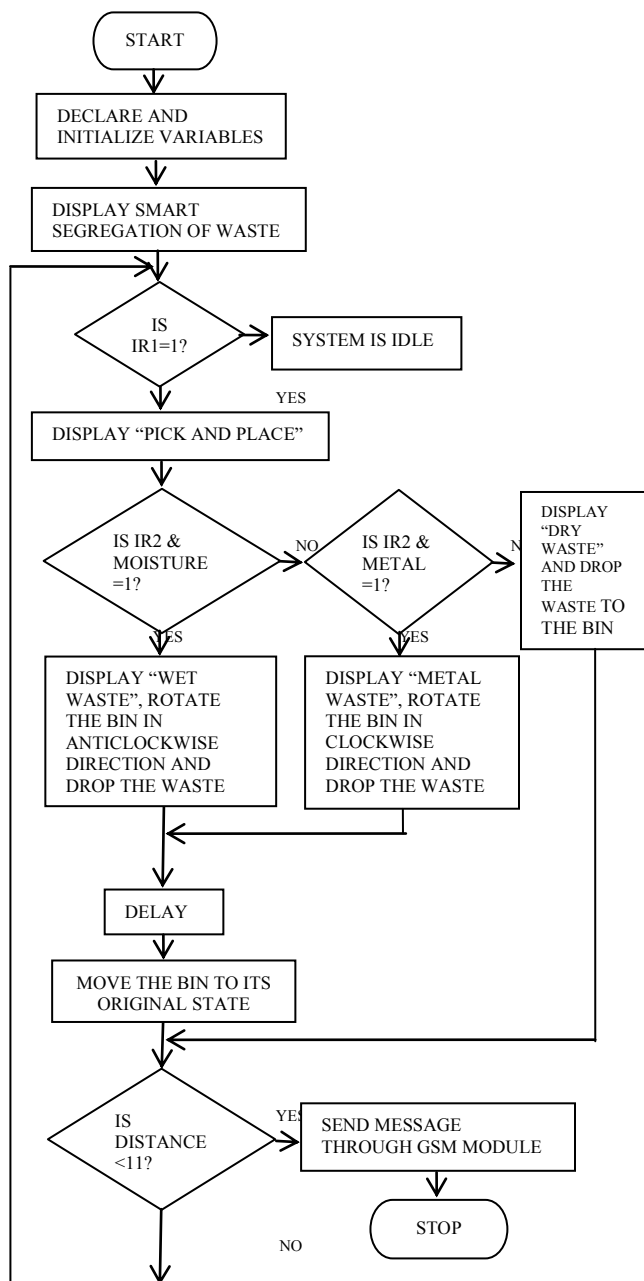


Fig.10. Flow of segregation and detection

## VI. CONCLUSION

Automatic Waste Segregator Bin using Robotic Arm performs the segregation into metal, dry and wet waste. The waste around the bin is detected and robotic arm is used to place the waste in the bin. This system is more innovative as it includes an automated system and a robotic arm, making it a more effective and efficient system. It is more reliable and effective compared to the present waste management system as it excludes the human work to segregate waste to a great extent. Mistakes while segregation can be avoided.

This research takes a step forward in contributing towards the cleanliness of our society, thereby supporting the idea “SWACHH BHARAT ABHIYAN” proposed by our humble Prime Minister. As “SWACHH BHARAT” concentrates of keeping the country clean, this bin could help us get a better statistics value for the country’s waste management.

It can be made more advanced and efficient by using a crusher and artificial intelligence in the future. It can include an automatic sensing mouth opener and also an automatic movement towards the disposal area when the bin is full for future scope.

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