Smart Sensor Can

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Abstract- Today, one of the issues that most cities and towns are facing is the deterioration of the environment's cleanliness due to poor garbage management, this is a result of improper garbage collection management. Due to this poor management, the trash is dispersed across the neighborhood, which leads to unhealthy social conditions. Thus, to overcome this problem the Smart Sensor Can is developed. This system is basically a microcontroller-based system where we use sensors like Ultrasonic sensor and raindrop sensor, Arduino UNO, Servo motor LCD display, GSM module, Electromagnet. The Ultrasonic sensor is used to felicitate identification of any user near the bin and on sensing the user the lid of the bin opens with the help of servo motor and waits for the user to put the trash. Based on the type of waste being disposed, they are segregated into dry and wet waste using raindrop sensor, which is wiped after each user throws the trash. Further the dry and metal waste is segregated using Electromagnet. An Ultrasonic sensor is fixed inside the sensor can to check the level of the bin and is displayed on the LCD display and sends alert message to the in- charge person regarding dispose of the waste via GSM module. In this paper, a detailed study of smart sensor can is given. The paper briefs about the different sensors used, use of recent technologies, its working and its benefits to the society.

Indexed Terms- Arduino, Smart dustbin, Ultrasonic sensor, Raindrop sensor, Servo motor, GSM module, LCD display, Electromagnet, MOSFET Control Module, Buck Converter, Power adapter.

I. INTRODUCTION

The population of India is rapidly growing every year, and with the same pace, the waste production is also escalating. Every year, Indian cities produce 62 million tonnes of municipal solid waste (MSW). About 43 million metric tonnes of material are collected (i.e., about 70%), of which 11.9 million metric tonnes (i.e., about 20%) are processed. Around 31 million tonnes of the waste are deposited in landfills. Following the collection of this waste, the garbage must be manually sorted separated, which takes a lot of labour and puts plenty of lives in danger.

Authorities believe that India is following an inaccurate system of waste disposal and management. It is frequently observed that there are overloaded trash cans or dustbins in our city, whether they are located in public spaces or private buildings. It makes the area unsightly and unclean for others, and it also smells bad. So, what are dustbins basically, Dustbins are containers that are used to store trash on a temporary basis. They are often used in homes, offices, and other public places to collect the waste. In some places, littering is a serious offense, and hence public trash cans are the only way to dispose of waste. Once the smart sensor can be put to use, up to 80% less manual segregation would be required, requiring less labour, emissions, fuel, and road congestion. It is a fast-growing society where science and technology see Rapid growth and time have become the most valuable things.

In India, the idea of a smart city is still relatively new. Even though it has drawn a lot of attention in recent years as our current Prime Minister proposed creating 100 smart cities across India. There are several duties that must be carried out in light of the oncoming spread of smart cities. The prime need for a smart lifestyle begins with cleanliness, and cleanliness begins with the dustbin.

II. ANALYSIS

A. Software Components
1. Arduino IDE software

B. Hardware Components
1. Arduino UNO
2. Ultrasonic sensor
3. Servo motor
4. Buck Convertor
5. Servo motor Driver
6. Electromagnet
7. MOSFET Control Module
8. Raindrop sensor
9. 20x4 LCD display
10. SIM800C GSM module
11. Power adapter
12. Dustbin

III. PROPOSED PROTOTYPE

A. Methadology

A thoughtfully created idea to answer to the social problem regarding waste disposal is the "Smart Sensor Can". Here we are using multiple sensors like ultrasonic sensor, raindrop sensor to performs various operations.

Firstly, we use an Arduino IDE software for programming, where we dump all the code that is necessary for the proposed system. An Ultrasonic sensor is fixed in front of the bin which senses the persons arrival towards the bin and waits for few moments and then gives command to the servo motor to open the bin's lid. Later when the person drops the waste, the rain drop/moisture sensor segregates the waste based on wet or dry waste and is deposited into their respective compartments.

A MOSFEET drives an electro-magnet in the dry waste compartment that further separates the dry waste from the metal waste. Even when it is a metal waste, the electromagnet rotates the waste first in the direction of the dry compartment and then in the direction of the metal compartment and after this, the electromagnet is turned off, and then the metal falls into its respective compartment.

Each compartment has a dedicated ultrasonic sensor for level detection. When the bin is full, an alert is displayed on the LCD regarding the disposal of the waste, and an SMS is sent to the intended phone number. The buck converter converts a 12-V supply into 6V, which powers the MOSFET and the servo

motor driver. The Arduino communicates with the servo motor driver and LCD through the I2C communication protocol and used UART communication protocol to communicate with the GSM module.

This brings a drastic change in terms of cleanliness and also brings betterment in the human being. Since it is a sensor-based bin, it will be easy to access for any age group and our aim is also to make it affordable so that a large number of people can take use of it.
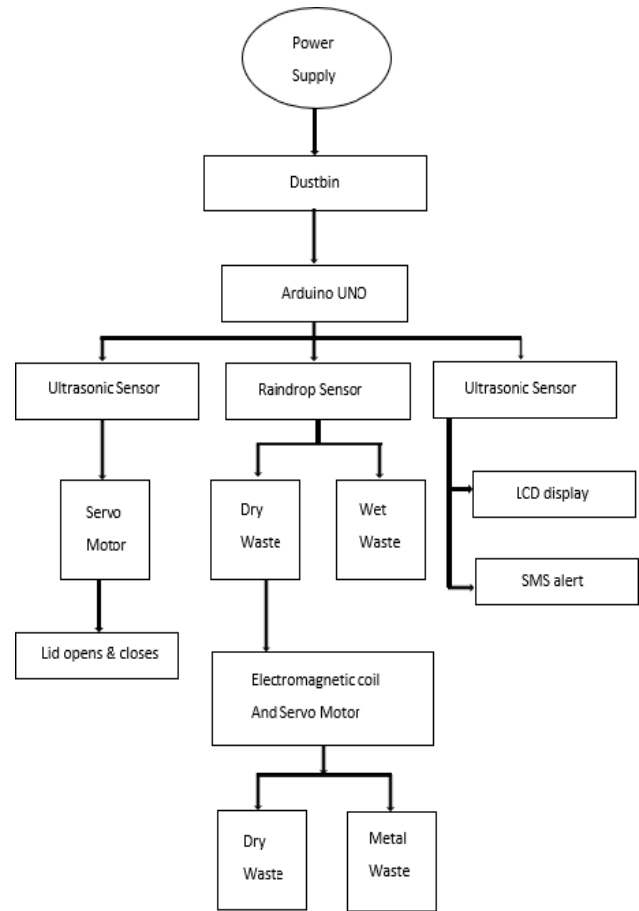

Figure 1: General operating flow chart of smart sensor can

B. Schematic
Schematics of the components used in the project are given as follows:

The servo motor driver is powered up using a 12V power source, which is stepped down to 6V using a Buck Converter. The PWM pins 0, 1, 2, and 3 of the

servo motor drivers are connected to the PWM pins of four separate servo motors, which are used for sorting different types of waste (dry, wet, and metal), wiping raindrop sensors, and opening and closing of lid, as shown in Figure 2.
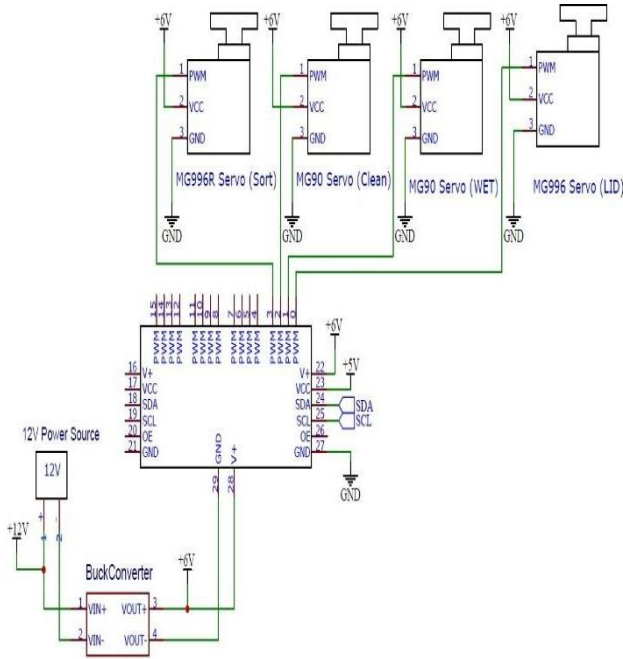

Figure 2: Servo motors and buck convertor connected to driver

The pin D2 and D3 of Arduino is connected to transmitter and receiver pins of GSM module (SIM800C). Using AT+CMGF command, it sends the SMS in text mode to the mobile phone. MOSFET module has 5 pins of which pin 3 and 5 are grounded. D12 pin of Arduino UNO is connected to pin 4 (PWM pin) and it receives switch ON and OFF commands to operate the electromagnet. Pin 1 and 2 are connected to electromagnet which in turn is given to 12V power supply shown in Figure 3.
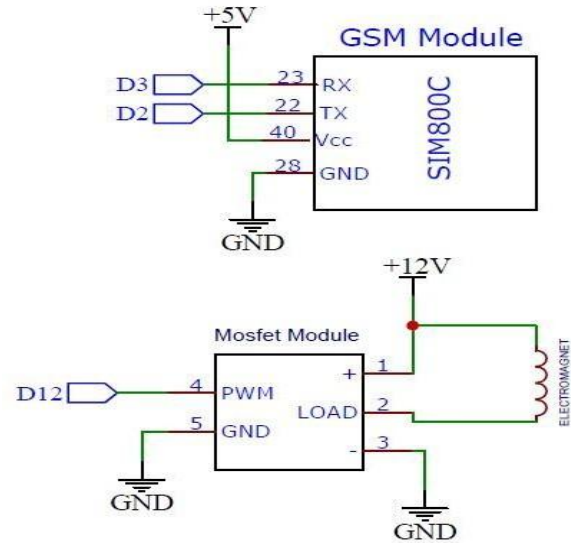

Figure 3: GSM and MOSFET module

The SCL and SDA pins of LCD are connected to A4 and A5 pins of Arduino UNO through which the intended commands will be displayed as seen in Figure 4. Analog signals are sent from Arduino UNO to A0 pin of the raindrop sensor. The positive and negative terminal are given to nickel coated plate for the detection of moisture.
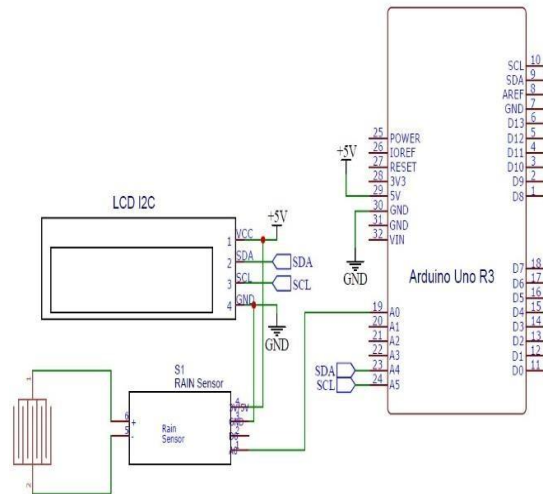

Figure 4: LCD and raindrop sensor connected to Arduino Uno R3

Figure 5 shows the schematic of various ultrasonic sensors. Digital pins of Arduino UNO are connected to Trigger and Echo pins of the ultrasonic sensors (HC-SR04) to detect the person's arrival and level of waste in each compartment.
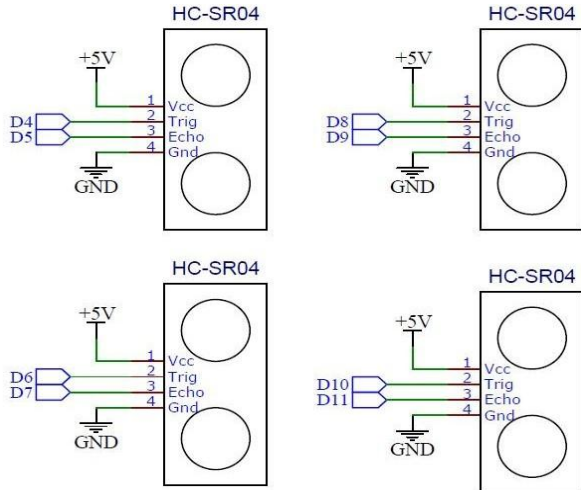
Figure 5: Ultrasonic sensors

IV. ADVANTAGES

Smart Sensor trash cans are considerably superior to traditional trash cans and have numerous advantages, which are stated below:

1. They contribute to a cleaner, safer, and more sanitary environment, as well as increased operating efficiency.
2. They lower management expenses, resource use, and roadside pollution. Furthermore, they reduce the amount of manpower required to conduct rubbish collection.
3. Smart bins are good for the environment. Smart bins reduce carbon dioxide and other gas emissions by minimizing the need for collection visits.
4. Recycling rates are increased by smart bins. Smart bins take up less room than regular recycling bins.
5. Smart bins take up less space on the sidewalk than regular recycling bins, decreasing clutter and making it easier for people to move through the city.
6. Using smart garbage collection containers and systems equipped with fill level sensors saves time and money. Because smart transport vehicles only go to full containers or bins. It can save up to 30% on infrastructural, operating, and maintenance costs.

V. RESULT

A. Detecting persons arrival:

Initially, the lid of the bin is closed. An ultrasonic sensor which is attached in front of the can that detects the persons arrival towards the bin, since the ultrasonic wave which is being emitted through the trigger pin is being obstructed, these waves are reflected back and is received by the echo pin which sends a signal to the servo motor attached near the lid and the lid of the smart sensor can opens as shown in the Figure 6,

Figure 6: Detection of person

B. Segregation of waste:

As the person throws the waste, it is firstly segregated into wet and dry waste which is done using a raindrop sensor, where a connection is created between the nickel strips of the raindrop sensor if the moisture content is present and the waste is disposed to the wet compartment else it is disposed to dry or metal compartment as shown in the Figure 7, here a wet cloth is used to demonstrate a wet waste.
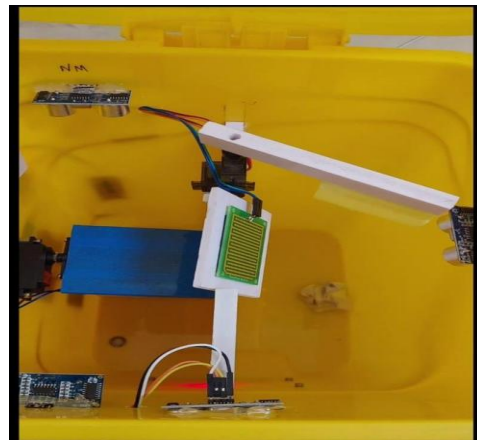

Figure 7: Wet waste detected

If the waste is not having any moisture content in it then the raindrop sensor is tilted such that the waste is made to fall on the plate, where an electromagnetic coil is attached that magnetize the surface and hold the waste content if it is metal waste. Later based on dry or metal content, the waste is disposed into their respective compartment shown in the Figure 8,
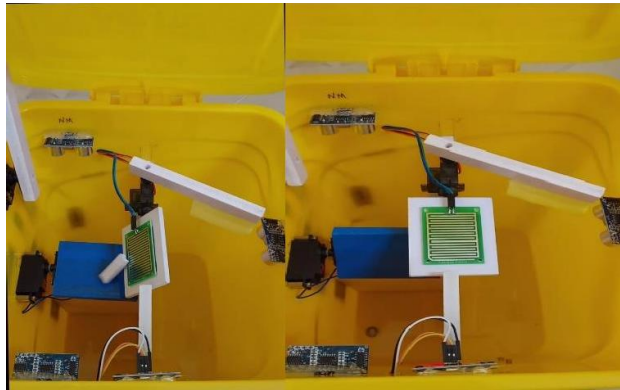

Figure 8: Segregation of dry & metal waste

C. Alert systems:

As soon as the bin is full two ways of alert system is done one by displaying the level of the bin through LCD display and secondly by sending an alert SMS to the in-charge person via a GSM module as shown in the Figure 9,
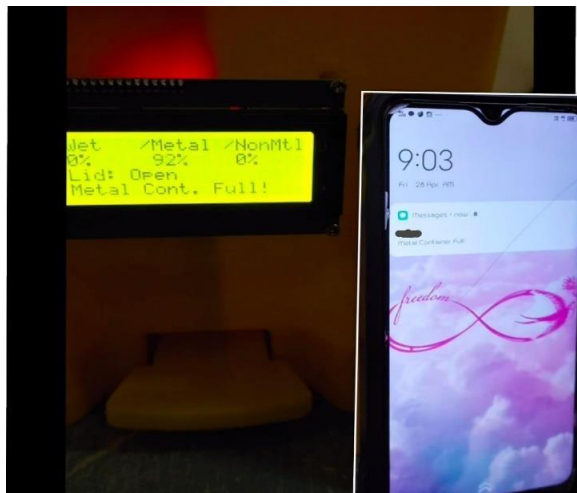

Figure 9: Alert message on LCD display & to mobile phone through SMS

Upon using the ultrasonic sensor property, the level of each compartment of the smart sensor can is detected and is made to display on the LCD display and also an SMS is sent regarding the fullness of the

waste to the concerned person so that they come & cleans the bin.

The below Table 1 represents the Test-cases.

Test No.	Condition	Result
1	Lid operation	The lid opens and closes smoothly and securely.
2	Garbage sorting	The dustbin sensors sort different types of waste, such as wet, dry, and metal.
3	Alert test	The dustbin displays the alert message in the LCD and sends Message regarding the fulfillment of the bin to the Intended person.

Table 1: Test-Cases

CONCLUSION

Waste management is a major concern in most of the countries in the world. If waste is not managed properly, it will have an impact on the health and the environment around us. Despite the fact that there have been many excellent smart bins, they still have some drawbacks. To overcome that, the design of "smart sensor cans" has been made. In this system, different sensors are used to segregate waste based on its nature (dry, wet, or metal). In each compartment, an ultrasonic sensor is placed, and an LCD is used to display the amount of garbage in each compartment. An SMS alert message is sent to the concerned person or authority to assign a person to empty the bin within a specific time frame. This has a significant impact on cleanliness and also helps people. Being a sensor-based can, it will be simple for individuals of any age to reach, and the goal is to make it reasonably priced so that many people may use it.

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