

# Line Follower Based Smart Moving Dustbin for Smart Cities

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## Abstract:

The growing industrial revolution and inventions lead to advancement in technology and emergence of smart cities which creates a need for smart solid waste management. Moving Smart dustbin is a new idea that can manage the wastes in the smart cities. In this, the ordinary dustbin is made smart by using sensor systems. The obstacles are find using Ultrasonic sensor, load sensor is used to measure the weight of the garbage, smell sensor is used to detect the unpleasant odor, level of the dustbin can be detect using Infrared sensor and this sensor helps the dustbin to move in the predefined path. The status of the dustbin is updated using Liquid Crystal Display for the users. As soon as the level detector is high, the dustbin will automatically move in the predefined path to reach the main garbage area with the help of line follower robot and empties the dustbin by dumping the waste in garbage area. In this moving smart dustbin, Strain Gauge load cell is used, which converts strain into the electrical signal. The power generated from the wastes are given to the sensors, which are used in the smart dustbin. This system is designed based on IOT, so the messages regarding dustbin will be sent to the corporation. The dustbins related data are supervised by the developed website. The prototype obtained seems to be attractive and by using the solar panel for charging the battery we could save a lot of power and automate the city. But there are lots of issues in designing a smart technology and in future we may go for Bluetooth or Zigbee modules for movement.

**Keywords —Infrared Sensors, Liquid Crystal Display (LCD), Smell Sensors, Strain Gauge load cells, Line Follower Robot, Internet of Things (IoT).**

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## I. INTRODUCTION

Dustbin is a most common and essentially used in all the places. If the garbage gets filled, we can remove the wastes in the dustbin. Here we have pointed out a new proposed model, which keeps moving in the crowded area to give access to the people who want to dispose something. Moving smart bin can be connected along with a microcontroller which is build with Arduino Uno board that is interconnected along with LCD and IR sensor.

An Echo sonic system is positioned at the pinnacle of the waste bin that allows you to come across the presence of obstacle approaching closer to the dustbin and stops it and while the impediment moves it starts the movement of the bin. Arduino will be programmed and it gets intimation, if the waste bin is filled, the closing peak from the terminal height given to IR sensor could be displayed. When the trash arrives at the limit level the dustbin naturally moves to the main location for disposal.

If the wastes are not managed properly then this bring about air and soil contamination. They adversely affect human well being.

41% of the air contamination in Guwahati, a city in Assam, is caused due to the accumulation of trashes, which is found in the essential review made in Guwahati.

The air contamination which normally leads to diverse breathing issues like bronchial asthma etc. Mosquitos reproduction and *Musca domestica* (Houseflies)reproduction happen mostly in trash which are a significant reason for different sicknesses like intestinal sickness, malaria, chikungunya etc.

It is the reason for cerebral pain, sick sensation and increment in the feeling of anxiety. A place with worse sanitary condition and rotten condition could never have been a sound spot to survival. There are around millions of individuals as of now experiencing breathing illness for which disgusting and odor sniffing of trash is also a critical factor.

Practically 90% of the constant obstructive pneumonic malady happens in high and low earning nations brought about by noxious. In excess of 3 million individuals passed on of chronic obstructive pulmonary diseases in 2005. Inappropriate administration of trash is recognized to be specific significant reasons for twenty two human sicknesses causing unexpected earlier death each year.

Therefore, the implementation of this moving smart waste bin can save us longer period thereby stopping the big of epidemic to a high-quality volume and promising an easy environment within the metropolis.

## II LITERATURE SURVEY

To get data on the latest research, the literature surveyed some different papers.

The authors Anuja Apte, Saurabh Dugdhe, Sajuli Jire and Pooja Shelar used Radio Frequency Identification Detection and sensors which work on Wi-Fi to design dustbins in Efficient Waste Collection System [2]. One of the major drawbacks in this paper are that the frame work can be utilized only in the limited areas. The gas detector which is used in the dustbin, to detect the presence of CO in the bin, it is not possible to consider the essence of the air in the bins.

The paper Smart Recycle Bin [3] by authors Aeslina Abdul Kadir, Mohd MohdRazali Tomari, Mohamad Hairol Jabbar, Helmy Abd Wahab have proposed the new method that Rewards users by using a waste detection system for weight based measurement points and the type of waste placed in bin. Main issue in this method, is recognizing the kind of the trash isn't yet find and left illusive. Moreover, nothing is executed to neglect issue of the assortment of trash.

In Smart and Wireless Waste Management [1] by authors ShubhamThakker, R.Narayanamoorthi identified the type of plastic using the NIR spectroscopy. The alienated dissipate a MSW (municipal solid waste) system may be put in a vulnerable location. By using a dissenter substance which can be mix right into a homogeneous substance. The whole procedure is rehashed each hour.

## III. PROPOSED SYSTEM

Here we use a completely automated dustbin, which once filled will start moving in a predefined path and reaches the main garbage collection area so thereby reducing human labor and it also generates its own power to charge the battery through Solar Panels.

Strain Gauge load cell is used to convert strain (force) to the electrical signal. The power generated by load cell is given to the sensors which are used in smart moving dustbin, so it reduces the requirement of battery.

### 3.1 BLOCK DIAGRAM

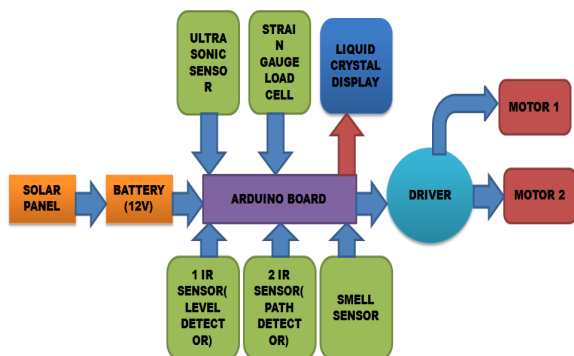


Fig 1. Block Diagram of Moving Smart Dustbin

### 3.2 WORKING AND IMPLEMENTATION

The first process in implementing a moving smart dustbin is to connect the Liquid Crystal Display(LCD) to the Arduino and verify whether it's working properly. The next step is to connect the Ultrasonic Sensor to the previous setup and calibrate the distance using the sound waves. The echo pin is used to generate the sound waves, and it's an input and the trig pin acts as a receiver and it's an output.

$$\text{Distance} = (0.034 * \text{duration}) / 2$$

(0.034 = Sound velocity in micrometer/second, Duration = time require for the sound waves to transmit and return)

Next connect the dustbin level detector i.e. IR sensor to the above setup and if the sensor is low we get an output "moving..." on LCD else we get an output "Dustbin is full" on LCD. This step is followed by interfacing 2 IR sensors along with two DC motors to the Arduino Board through H-Bridge, then we give a condition to the ultrasonic sensor that is, it detects a distance < 50 then stop the line follower in the track by making the motors low, otherwise the robot follows a line following mechanism.

In the bottom of the bin the load cell is placed. Whenever the trashes are dumped in the dustbin some force will be applied on the load

sensor, then this strain gauge load cell converts the force into the electrical signals in two stages.

These generated power is given to the sensor systems which are used in the smart dustbin through the Arduino Board. So, it reduces the usage of battery by the sensor systems.

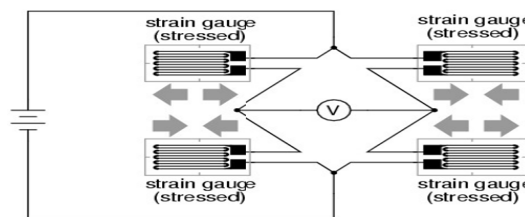


Fig 2. Strain Gauge load cell with Wheatstone Bridge

A Wheatstone Bridge arrangement which are used to connect an four strain gauge elements .It determine the electric signal in the strain gauge load cell.

The Smell sensor is placed inside the dustbin, which detects the unpleasant odor that is produced in the dustbin by the trashes.

If the dustbin level detector or the smell detector and deviation sensor is high then the dustbin will automatically move to the detected common garbage area and the motor will be in OFF state until trashes are removed from the dustbin and starts' moving after a push button is pressed.

If the dustbin level detector or smell detector is high and the deviation sensor is low then the dustbin will move in the normal line follower track until the deviation sensor gets high. The DC motor will be run by a 12V battery and the battery will be energized by sunlight through Solar panel.

This entire system is implemented using IOT, so the regular updates regarding the performance of the smart dustbin will be continuously send to the corporation. If any one of the sensors is damaged or the dustbin is not working properly or if there is any problem in the dustbin, the message will be sent to the corporation.

The corporation member has to send someone to rectify the faults in the smart dustbin. Finally, we

can design the frame and place the dustbin in it and implement the entire working module in this prototype successfully.

#### IV. HARDWARE REQUIREMENT

The hardware requirements for the implementation of moving smart dustbin are as follows.

##### 4.1 ULTRASONIC SENSOR

As the tag shows, ultrasonic sensors generate ultrasonic waves by utilizing this wave it calculates the distance. The head of the sensor radiates a sound signal and gets the signal return from the spot. Ultrasonic transducers estimate the time between the transmission and reception and also measure the distance to the objective. This is like how radar measures the time taken by the radio waves to hitting a target and return. The ultrasonic sensor works on the principle of SONAR.

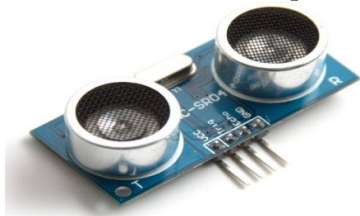


Fig. 3. Ultrasonic sensor

##### 4.2 INFRARED SENSOR

An infrared sensor is an electronic appliance that is employed to ping something on its environment. It transmits radiation and receives separate infrared emission. Infrared sensors are also equipped for allocating the warmth being produced by an item and acknowledge the progress.

The IR sensor's output is in the digital form. It can notice 38 kHz Infrared signal and output is low that is zero voltage or they do not notice and its output is high that is five voltage.

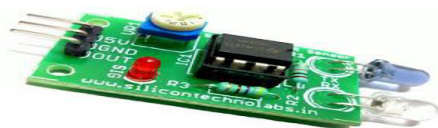


Fig 4. IR Sensor

The frequency range of Infrared radiation is 300 GHz to 400 THz and wavelength ranges between 780 nm to 1mm.

##### 4.3 SMELL SENSOR

The smell sensor is also called as bioelectric nose. It can detect some specific smell molecules which respond along with receptor protein. The sensor arrays which are incorporated along with electronic noses that can react to volatile compounds. If the sensors sense any smell, the signal generates and response may go to the digital value.



Fig 5. Smell sensor

An instrument used to identify and quantify smell dilution is Olfactometer. Olfactometers are utilized related to human subjects in lab settings, frequently in statistical surveying, to measure and qualify human olfaction. Olfactometers are utilized to measure the smell identification limit of things.

##### 4.4 LOAD SENSOR

A load cell is an equipment, which converts the one source of energy into another, so it is also a type of transducer. Load cells are also called as strain transducers, it converts the electromotive force into an observable electrical power. The amount of the electrical power generated is proportional to the pressure to the load cell.

The three basic types of load cells are based on output signal: pneumatic, hydraulic, and strain gauge. Here we use only the strain gauge load cell. This form of load cell is more precise and less expensive.

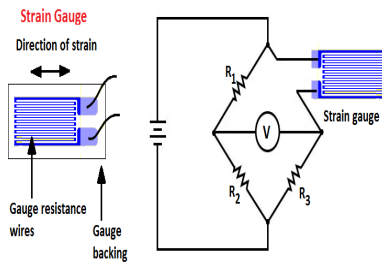


Fig 6. Strain gauge load sensor

A Wheatstone Bridge arrangements which is used to connected four strain gauge elements. It measure the electric signal in the strain gauge load cell. It provides energy efficient and give an large amount of power supply to other devices.

#### 4.5 DC MOTOR



Fig 7. DC Motor

The conversion of electrical power into a mechanical power is done using DC motor. The working of DC motor is depend on the principle that the mechanical force is experienced, when a current carrying conductor is placed in a magnetic field. The speed of an DC motor can be control by either reducing the strength of the current or by varying the voltage level. It works under the principle of Fleming's left hand rule.

#### 4.6 ARDUINO BOARD

Arduino board is the best board, which is used in electronics and coding. It is flexible to use in both hardware and software. It is used in various applications such as 3D printing, embedded surrounding, IOT systems etc. It is a microcontroller board based on ATMEGA328. There are fourteen binary input/output pins in that six pins are used for analog inputs. The Arduino board consists of 16MHZ crystal oscillator, USB connection, power jack, program memory, data memory.



Fig 8. Arduino Board

The data is capacity the data memory and the code is stored in the flashed program memory. In our project the Arduino plays a major role in controlling the system.

#### V. CONCLUSION

One of the major challenging issue in our society is waste management. If the wastes are not disposed or cleaned properly, then this will lead to many deceases and spoil the green atmosphere. We have designed a moving smart dustbin which is more durable and affordable and also reduces the maintenance issues. This smart dustbin is designed using the sensor systems and implemented in IOT. So the entire process is automated. This Smart moving Dustbin helps to achieve lot towards pure and healthy atmosphere in building a smart city.

In India this technology is new, so before implementing this system on a wide scale, the sufficient alertness should create between the public. Otherwise, sensitive apparatuses such as sensors could be disabled because of rough user behaviours. Here we use a line following mechanism with IR sensors which are difficult to calibrate, so a different path tracking protocol with wireless modules can be used for increasing its performance.



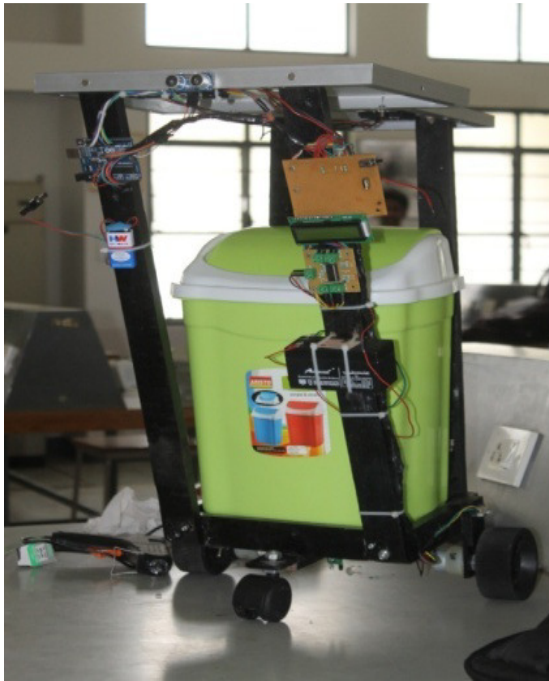


Fig 9. Moving Smart Dustbin

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