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## SMART WASTE BIN: The Future of Garbage Collection Management System

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### Abstract:

The Government of India have recently introduced a new campaign named “SWACHH BHARAT” aiming to make our country neat and clean. Today, with the speedy growth of the population and economical expansion, one of the nastiest environmental problems are utilization of garbage bin properly and it’s management system. There are lots of garbage bin in cities and streets but it has been observed that most of the garbage’s are in and around the dustbin. One of the big reasons behind that when a person throws the waste outside the dustbin, the next coming person also follows the same tradition and this thing will continue. For this reason, the waste pile up and near the waste bin leads to environmental pollution and also can bring into the health threats. Another issue is that dustbin in public places are not cleaned at the right time.

We approach this problem with a different way and it is the main intention of our work. We want to implement Automatic lid On Off operation with an audio awareness message; so that when a person want to throw the garbage’s in the dustbin then the probability of depositing the garbage within the bin may get increased. Nobody’s tendency is to throw the garbage outer part of the basket if we can ensure the cleanliness around the waste bin. Apart from that if the bin cover closes automatically after deposit, then we can restrict the smell to spread outside and also the animals cannot throw the waste outside the bins and proper collection of waste has become a sensational issue now. In order to overcome this problem we are implementing a new system “smart waste bin for garbage collection management system using solar power”, which can have high role in the social cleanliness. Thus, the presented solution may achieve smart garbage collection management system, which can make more hygienic and cleanly Indian cities.

**Keyword:** Arduino Uno, Servo motor, SD card Module, Solar Panel, Ultrasonic Sensor.

### 1. Introduction:

Due to rapid increase in population growth, urbanization and public unawareness the developing countries are facing problem towards dealing with the waste management. It plays a significant role to ensure a clean and healthy world and to protect the environment at the present scenario. Overflow of waste bins as well as garbage spill out in public places, resulting in pollution in the nearby places. It also increases a diseases as well as huge number of bacteria and insects, mosquitoes breed on it. [1].

Now- a- days the proper garbage collection management is one of the major challenges which are seemed in the cities and other places. At present stage most of the dustbin in public places does not have any lid on top. So after filling it becomes dirtier and the wastes will spread to the nearby area. So the people will have a pessimistic thought and they are reluctant to go near the dustbin to put the garbage’s inside it. Hence, we are proposing a new scheme which may play a lead role in the social pollution maintenance. Our scheme is consisting of automated electronically assisted garbage bin with whole power is coming from the renewable solar energy. The smart waste bin will sense the position of human and automatically

opens the lid and an audio message will be played to attract the attention of people to put the waste inside the bin. This scheme automatically closes the lid when the person leaves the area. This proposed scheme is totally working in solar energy and it requires a voltage regulator as it is highly fluctuating in nature. The power is operated the required hardware of the system which is generated by solar photovoltaic cell.



**Figure1: Overflowing Garbage**

We often see that the dustbins are being overflowed in open areas as well as the garbage spills out which results in pollution and also increases the number of diseases. Many solutions have been proposed for the collection of garbage but these are not becoming so much successful due to many criteria, such as a control unit has been placed in the dustbin in every public area. But veracity is in all places the trash bins are overloading and spilling over so the area is becoming jumbled and also it will be prone to diseases.

This proposed work aims to develop a working prototype scheme that has features like automatic lid mechanism and garbage level sensing. Our proposed work has been broadly classified into two parts: (i) Electronically Assisted Waste Bin (ii) Sensing the Garbage Level.

This paper is considered as follows. Section 1 provides the Introduction. Section 2 giving the description of Literature Survey. Section 3 describes the Problem Statement. Section 4 Proposed Work. Section 5 presents the Technological Description and Section 6 provides Results and Section 7 Concluded the paper.

## **2. Literature Review:**

There are few works that have been reported in this field. The literature reviews of some of the papers are given below. In the paper [2] the authors have made use of an ultrasonic sensor in order to measure the level of water inside a tank. The sensor was mounted internally on the top surface of the tank. The ultrasonic sensor normally consists of a transmitter and a receiver. The receiver is used to receive the reflected high frequency sound waves emitted by the transmitter. In order to measure the distance travelled by the sound waves and level of the liquid in the tank, travel time of the waves was determined. The ultrasonic sensor was controlled by a 32-bit microcontroller. A software code was used to interface the ultrasonic sensor with the microcontroller. Microcontroller sends a signal through software code, to the ultrasonic sensor which in turn begins to emit the HFSW. The software code simultaneously runs a timer until the HFSW are received back by the receiver. After receiving the waves, the sensor sends a signal to microcontroller and the time recorded by the timer was counted which was used to determine the distance travelled by the waves. The level of the liquid was calculated by subtracting this distance from the total distance and it can be transmitted to the server via GSM module.

Another work [3] has explained the significance and need of an IoT garbage monitoring system. This scheme consists of AVR family micro controller with Wi-Fi Modem and it is powered by 12V transformer. It monitors the waste bins and also indicates the garbage level via a webpage to the user. The webpage highlights the collected garbage in particular colour and gives a graphical view of the bin. Thus it provides a graphical image of the bin via an IoT Gecko web development platform and helps to keep the city clean by informing about the garbage levels. The AVR microcontroller used was a modified Harvard architecture machine manufactured by Atmel in which program and data are stored separately in physical memory system that appear in different address spaces. So this IoT garbage monitoring system contributes towards clean and hygienic environment.

Another paper [4] has summarized the different techniques used to recycle the garbage. For unhygienic conditions people face different problems regarding to health. Such a situation was controlled by providing

unique ID to garbage bin and based on the ID number an SMS is send to the server if bin is filled.

The paper [5] is based on effectiveness of automatic street lighting system based on low cost microcontroller controlling LED. There system is based on automatic lighting levels control and light sensor, rain sensor for street lighting. Operate like ON or OFF accordingly during night and heavy raining or bad weather.

The paper [6] has proposed a system in which a prototype of waste bin monitoring system was managed using wireless sensor network. The system architecture uses zigbee and GSM communication technology along with a set of carefully chosen sensors to monitor the status of waste bins in real time. The system was consisting of three tier structure comprising of a lower, middle and upper tier. The lower tier measure and transmit bin status to the next tier, the middle tier stores and transmit bin information to control station and the upper tier stores as well as analyze the data for further use. In order to collect the bin parameter, an energy efficient sensing algorithm is also used in the first tier operation.

Paper [7] described a system developed mainly to concentrate on eradicating the issues like cleanliness, environmental instability, disorder, harm or discomfort to the ecosystem. The smart trash used by them has two sensors namely IR and Gas sensor. IR sensor was used mainly to sense the level of trash inside bin and the gas sensor was used to sense toxic gases. When the trash filled up, the RFID placed inside the bin will give information regarding overflow of trash from the bin to the corporation office.

All the specified works have inspired us to proceed and furthermore cover the unexplored spaces which have not been discovered before. Automatic lid opening and the dynamic mobility of the dustbin with the help of solar power are the two distinctive features that are incorporated in this work.

### 3. Problem Statement:

We see many times the dustbins which are in bad conditions. Waste in dustbin all flooded and additionally it spilled out the trashes from the dustbin. People throws garbage on that dustbin which already been overflowed. Sometimes due to this wastages terrible smell created, toxic, unhygienic gases are also produces due to dirty dustbins. It is very bad impression for the city and also it supports to the air pollution and due to this some harmful diseases easily spreadable.

#### Disadvantages of the existing system:

1. Timely the dustbins are not cleaned.
2. It is unhygienic for the environment.
3. It is dangerous for the health of human being for the creation of Bad smell and toxic gases due to unclean dustbins.

#### Advantages of the proposed system:

1. Implementation of Automatic Lid on off mechanism.
2. Continuous data identified with the trash container
3. It is improving the quality of the environment.
  - A. Less scents
  - B. Cleaner urban communities
4. Wisely deal with the garbage container.
5. Viably utilize the dustbins.

### 4. Proposed Work:

Our proposed smart garbage bin fundamentally comprises of an ultrasonic sensor which have the capacities as the distance calculator. It will be attached to garbage bin which is placed in open areas. It constantly measure the distance in front of the bin and if it found the distance fall below a particular value the presence of humans can be identified. At this same time the H Bridge can be activated and the lid can be opened, and a buzzer can be activated for indicating the operation.

This proposed system will altogether be powered by inexhaustible solar energy. Since the solar energy is exceptionally fluctuating voltage regulator circuit is utilized for making a constant supply of voltage to charge the battery and here LM317 voltage regulator is used. The previously mentioned functionality has been accomplished by interfacing the ultrasonic modules with the breadboard and Jump wires. The Ultrasonic Sensor connected with two modules. One is servo motors for dustbin assembly and another module is SD card module adapter which is connected with speaker for playing audio.

For the second part sensing the garbage level, the proposed system suggests to have sensors in waste bin and passing the information about the bin. All these garbage bins are interfaced with the micro controller based system with IR Sensors and RF modules and here IR sensor monitor the height of the garbage's in waste bin and sends the signals to micro controller and these signal are also encoded and analyzed and send through RF Transmitter. It is received and decoded by RF receiver at the Central Server or required destination through WIFI driver. The received data analyzed and processed which can displays the status of the Garbage in the dustbin.



Figure2: Internal structure of dustbin

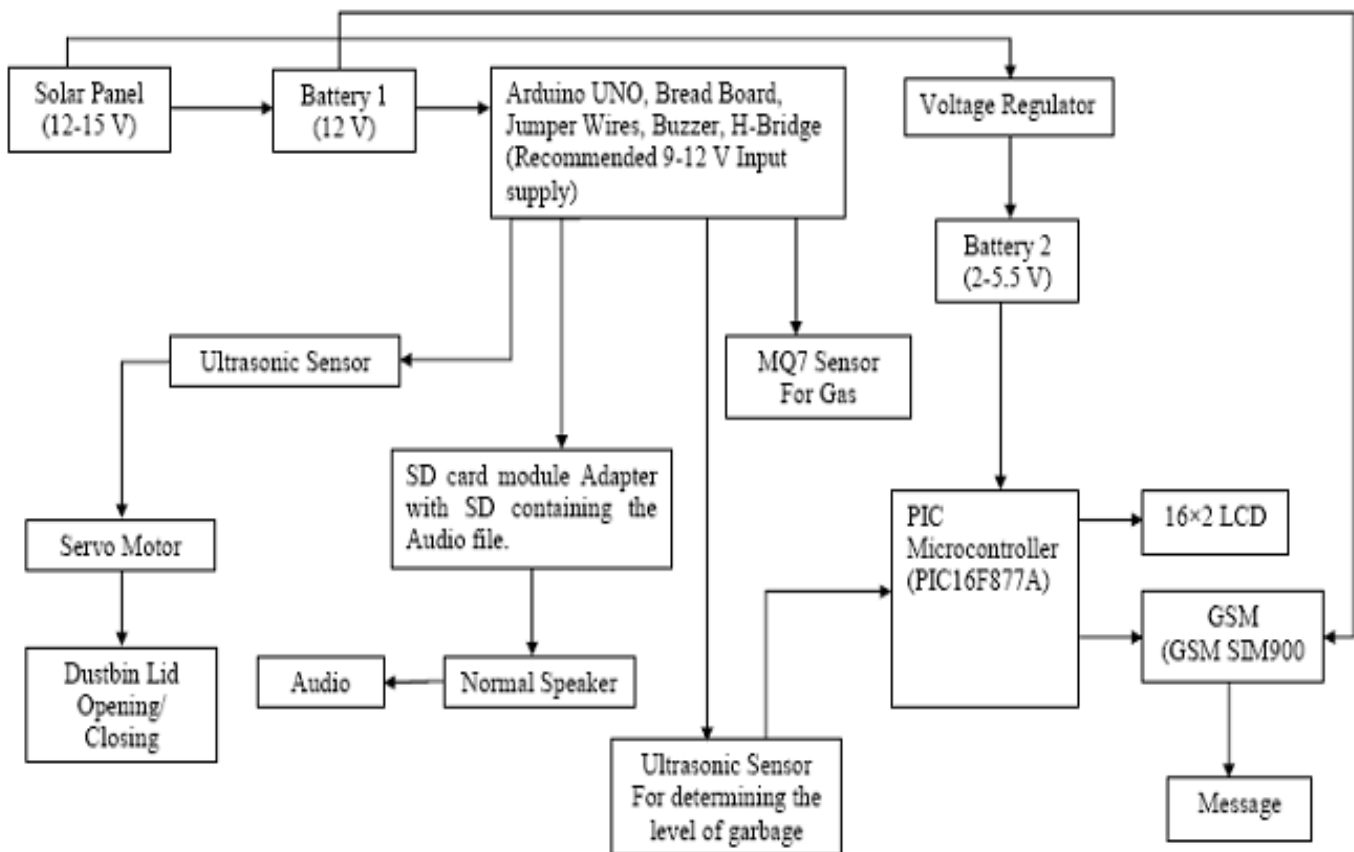


Figure 3: Working Process of Proposed System



## 5. Technical Description

### Arduino Uno:

The Arduino Uno (refer fig. 4), a 68.6 mm long and 53.4 mm wide, is an open source microcontroller board based on the ATmega328. Any general Arduino UNO has 14 digital input/output pins i.e. pins that can take only two types of values, HIGH or LOW (of which 6 can be used as PWM outputs) and 6 analog inputs pins which can take any number of values ranging from 0 to 5 V. Each of the pins works at a recommended operating current of 20mA with maximum permissible current of 40mA beyond which permanent damage to the microcontroller may occur. It also has a 16 MHz ceramic resonator, a USB connection that allows power to be drawn at 5V, a DC power jack with input of 7 to 12 V, an ICSP header, and a reset button. In simple words, all it needs is a logical programmable code from your PC written in Arduino IDE and a power supply. Here it connected mainly with the required electronics sensors and components via breadboard and jumper wires.

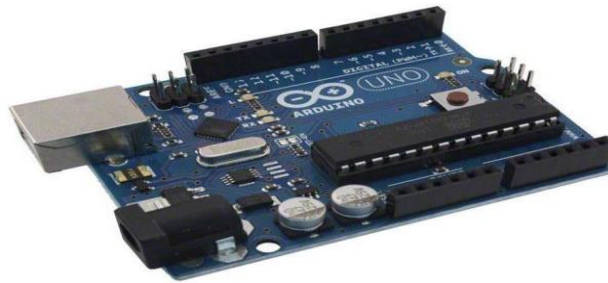


Figure 4: Arduino Uno

**Ultrasonic sensor:** An ultrasonic transducer or a proximity sensor (refer fig. 5) is quite similar in operation to a RADAR OR A SONAR proximity sensor. This sensor basically converts an electric signal to a sound signal, sends this sound signal which after striking the nearest object reflects back to the sensor from where it is reconverted back to an electric signal. The ultrasonic sensor will switch to receive mode after emitting the sound waves. The sensor in general senses the ping time for the total travel of sound wave which can then be used to calculate the distance of the object provided the speed of the sound ( $v$ ) in the medium is known. The distance can be calculated using  $d = (v * \text{pingtime}) / 2.0$ . An ultrasonic sensor has the following features, supply voltage of 5 V, global current consumption of 15 mA, Ultrasonic Frequency of 40 kHz, Maximal Range 400 cm, Minimal Range 3 cm, Resolution 1 cm, Trigger Pulse Width 10  $\mu$ s, Outline Dimension 43x20x15 mm can be used for the purpose.

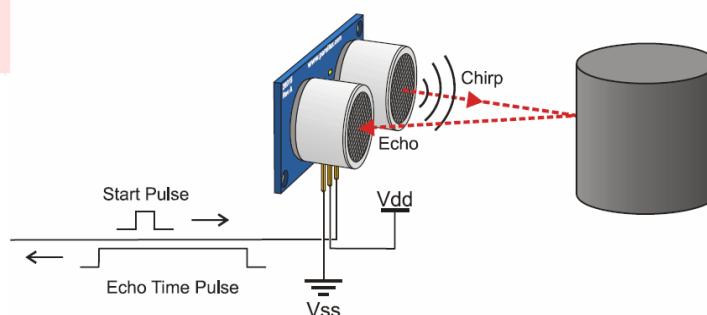


Figure 5: Working Principal of Ultrasonic Sensor

**Bread Board:** A breadboard (refer fig. 6) is a solderless assembly base for mock-up of electronic circuits. It is internally connected pin to pin by metal strips. It is very simple to use and comes in varying sizes depending on the number of individual circuit points in the circuit.

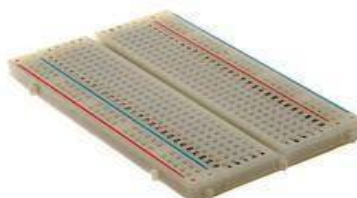


Figure 6: Bread Board

**Jump Wires:** Jump wires (also called jumper wires) are the so called electronic wires used for connection of various electronic components. They are mainly of two types depending upon the condition of end pins namely male to male jumper wires and male to female jumper wires. Jump wire material for ready-made or homemade wires should usually be 22 AWG (area of cross section =  $0.33 \text{ mm}^2$ ) solid copper, tin-plated wire - assuming no tiny plugs are to be attached to the wire ends.



Figure 7: Jump Wires

**Solar Panel:** Photovoltaic solar panels have become a popular name in the market mainly due to increased stress on the use of renewable energy. In simple words, it is an energy transforming device that converts the solar energy into electrical energy. A typical photovoltaic (PV) module is a systematic arrangement of typically  $6 \times 10$  photovoltaic solar cells (refer fig. 8). Photovoltaic modules comprises of the photovoltaic array of a photovoltaic system which generates and supplies solar electricity. For our proposed work we will generate the electricity through solar panel to provide power to the different components of the smart waste bin.

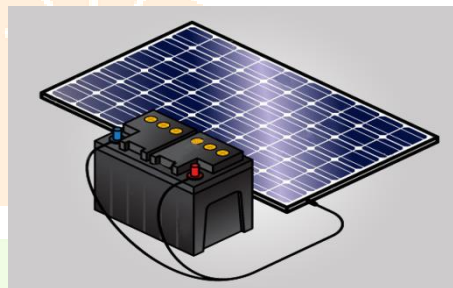


Figure 8: Solar panel with battery

**Servo Motor:** It differs from a normal motor with respect to the degree of rotation that it provides. A commonly used servo motor rotates within a certain range from 0 to 180 degrees. It basically used the concept of positive feedback to operate its motion and final position. The servo motor can be considered to be an assembly of four components: a normal DC motor, a position-sensing device, gear reduction unit and a control circuit (refer fig. 9). It is connected with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. The gear box then transfers the motion to the servo arm. The material of gears for servo motors depends on its application. For high power requirements the preferred material is metal whereas for low power use, the gear material is plastic. Here it is used for opening and closing the lid of the dustbin.

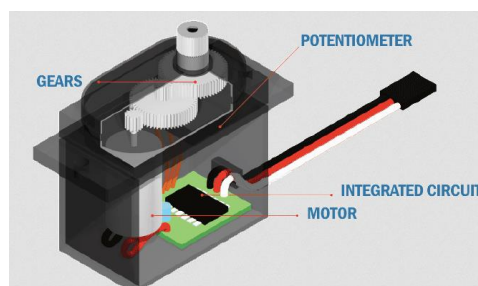


Figure 9: Different components of servo motor.

**Gas sensor:** This sensor (refer fig. 10) is user friendly and compact in size and is primarily used for detecting the carbon monoxide gas which is present in air. This sensor is also capable of detecting other gases like  $\text{H}_2$  (Hydrogen),  $\text{CH}_4$  (Methane), LPG and alcohol. The gas sensor in use (i.e MQ7 gas sensor) has a very fast response time and is very sensitive to the above mentioned specific gases.

**PIC micro-controller:** Sensors outputs are received by PIC micro-controller and then send them through RF transmitter. It is also send SMS to Mobile by using GSM.



**Figure 10: Gas Sensor**

**GSM Modem:** It is a specially designed modem and is quite similar to a mobile phone as it can accept any kind of SIM card and operates over a subscription to the concerned operator. Advantage of this modem is that there is RS232 port, which is used for communication purpose also used for advanced embedded application. Application like SMS handling, transferred data, etc. For wireless data transmission GSM is used. Radio waves perform vital in GSM. In GSM, Data is send as well as receive by using radio Waves. AT command Instruction is used for Modem control. GSM is connected to PIC Micro-controller. Message is send to that authority who takes appropriate action. GSM is low cost device and provide short message services.



**Figure 11: GSM Modem**

## 6. Results:

Following are the result which can be obtained from this proposed system,

- Automatic Lid On Off operation
- Garbage level detection inside the dustbin.
- Transmit the data remotely.
- Information can be gathered whenever and from anyplace.

## 7. Conclusions:

This work is a financially effective and it has high social outcome. We are trying to give an effective solution to the waste management issue by our work named smart bin. One more critical perspective gets accomplished by this scheme is educated and make individuals mindful to utilize regular dustbins in appropriate way by alert framework. Henceforth, this paper shows profoundly progressed and completely automatic scheme to manage garbage's efficiently. We truly hope that our system can prove to be useful in the Swacch Bharat mission of the Government of India.

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