

SMART ROBOTIC DUSTBIN WITH AUTOMATIC HAND SANITIZER DISPENSER

by

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**BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC
ENGINEERING**



Department of Electrical and Electronic Engineering
INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG

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A thesis/project
submitted as partial fulfilment of the requirement for the degree of

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INTERNATIONAL ISLAMIC UNIVERSITY CHITTAGONG

DECEMBER 2021

CERTIFICATE OF APPROVAL

The thesis/project entitled as “**Smart Robotic Dustbin with Automatic Hand Sanitizer Dispenser**” submitted by **Muhammad Nurul Amin**, bearing Matric ID. **ET151067R** and **Md. Tokibul Faiz**, bearing Matric ID. **ET153069R** of session **Spring 2021**, to the Department of Electrical and Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on **24 December, 2021**.

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this thesis/project has been submitted elsewhere for the award of any degree or diploma.

Muhammad Nurul Amin

Md. Tokibul Faiz

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Authors

ABSTRACT

The rate of urbanization has accelerated dramatically in recent decades. There is a rise in garbage generation at the same time. Waste management has been an important factor to address. This plan is a means of achieving this noble goal. The smart trashcan in this project is based on the Arduino Uno microcontroller platform, which is connected to a servo motor and an ultrasonic sensor. An ultrasonic sensor is installed on the top of the dustbin to measure the dustbin's height. The threshold height is set at a specific height. The Arduino will be configured such that when someone walks up to the trashcan, the servo motor will activate and open the lid, allowing the person to dispose of the waste. Rubbish can be managed properly to avoid excessive lumping of waste by the roadside once these smart bins are introduced on a big scale, replacing our typical bins today. The foul odor from these decaying wastes that have gone untreated for a long time due to authorities' neglect and the public's irresponsibility may cause long-term damage. Insects and mosquitoes can breed, causing a nuisance and promoting a disease in an unclean environment. This may even cause dreadful diseases. This system has an android mobile app with Bluetooth-enabled features. This android application-controlled bot through the lines drawn on the floor. There will be no contact between the dustbin and the person(user). An automatic hand sanitizer dispenser and Garbage fill alerting system are also incorporated.

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LIST OF ABBREVIATIONS

LED	Light Emitting Diode
SCL	Serial Clock Line
SDA	Serial Data Address
DC	Direct Current
Mah	mili Ampere per Hour
IR	Infrared Ray

CHAPTER 1

INTRODUCTION

1.1 Introduction

In today's society, many individuals get infected with infectious diseases as a result of poor garbage disposal, and keeping the environment clean has become the most difficult duty. Keeping this in mind, we've decided to make our paper's key point. We live in a fast-paced culture where science and technology are advancing at breakneck speed, and time has become the most important commodity. The proposed work is an embedded system capable of performing specific programming. The ATmega328p microcontroller is used here as the robot's brain. For the robot's wheels, we used two B.O. motors with a 9v operating voltage, and the robot is controlled using an HC05 Bluetooth device with no human interference. It also aids the physically handicapped and the elderly. People who are disabled. For those who are incapable of self-help, the proposed system provides a helpful hand at home. People can manage the automated smart dustbin via wireless media utilizing Bluetooth technology in their cell phones. When the trashcan reaches the threshold level, an indicator led and an alarm will turn on automatically. As a result, this process will not require human interaction.

The pace of waste generation in society is increasing exponentially in all areas of society, posing an increasing threat to living beings. Waste management is a critical issue that must be addressed sometimes disregarded. It takes a long time and a lot of effort to manage waste. The garbage disposal system is mismanaged as a result of a lack of time and poor efforts. Many people have noticed that the trash cans are overflowing. This overflow creates a filthy environment that is also unsanitary. Solid waste management is a high-priced city service in many developing nations, accounting for more than 30% of municipal corporations' yearly budgets [1]. The possibility of lowering fuel consumption was researched and noticed. According to a literature analysis, using optimal collection routes on a daily basis might 7.5 liters of fuel saved on average per vehicle. This can be solved by merging existing tactics with smart city development. Trash has a number of direct and indirect detrimental effects on the environment. As a result of direct effects, humans and the environment incur physical harm. The attitudes and behaviors that contribute to the problem are influenced by indirect impacts. Every day, Bangladesh produces between 133 and 770 tons of solid waste. According to statistics, small cities produce roughly 0.17 kg of garbage per person per day, while major cities produce

around 0.62 kg per person per day. There are 200 million houses in the United States with two distinct bins (normal garbage and recycling rubbish), totaling around 1.6 billion containers.

1.2 Motivation

Now a days, the whole world is devastated by the corona pandemic. Every year countless people are dying because of that kind of killing virus and bacteria. This is increasing day by day. That's why a health conscious and smart waste management is important for all of us.

1.3 Objectives

- To design a “Smart Dustbin” which is a Ultrasonic Sensor enabled bin which is automatically detects the garbage level and alert us through LED and buzzer, and there will be no touch between dustbin and person.
- To make our city “Digital Bangladesh” clean and healthy using “Smart Dustbin”
- In a specific area, a healthy atmosphere can be maintained.

1.4 Report Outline

The remaining part of this thesis is organized as follows:

Chapter 2 is dedicated to describe the literature review. Chapter 3 describes the components. Chapter 4 represents the design methodology of proposed system. Chapter 5 represents the implementation and results of the system. Chapter 6 represents the conclusion of this proposed project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Smart Dustbin or Automatic Lid Dustbin is widely used in the whole world. They are mainly used in places like- hospitals, educational institutions, offices etc. In our project, we have added automatic Lid System, Bluetooth controlled dustbin moving system, automatic hand sanitizer dispenser and Automatic Garbage fill alerting system.

2.2 Review of Previous Work

Using the Internet of Things (IoT) concept, Krishna Nirde [1] offer the concept of waste management authorities continuously monitoring rubbish bins. The containers are located across the city in various locations. Two types of remote real-time monitoring are available with the system: flop level detection and sensing of weight. The waste management authority can access a website that shows the current status of all the bins in real time. The Programmable Interface controller sends level and weight information to the radio frequency receiver through a radio frequency transmitter. The Arduino board then takes the data from the RF receiver and, using the internet shield, refreshes the webpage with the filled bins. There is currently no automated waste management system in place. When the bins are entirely filled, Balamurugan S. et al. [2] show how to transmit alert signals to authorities. Ultrasonic sensors are employed to measure garbage levels in this suggested system. This sensor node uses Bluetooth to communicate data to the server node. The data is then processed by the server node, which uses Arduino to send a message to the appropriate authorities. This project has been updated to provide new monitoring capabilities for hazardous gas emissions. Users may view what gases are being emitted in their immediate environment. Dr. N. Sathish Kumar et al. [3] offer a Smart Alarm System for municipal trash collection that sends an alarm to the municipal web server based on garbage levels, ensuring that bins are cleaned as soon as possible. The Android application can be used to remotely monitor the cleaning process carried out by the employees, obviating the need for the time-consuming process of monitoring and verification. Proximity sensor and weight sensor are used in another system suggested by Vincenzo Catania et al. [4]. The level is checked using a proximity sensor, and the weight is measured using a weight sensor. This project uses a Zigbee module to

send physical values and measurements to the next light pole. This system makes advantage of the Google Maps API to efficiently distribute work to the garbage collecting system. The rubbish pickup van is displaying the Google Maps API on paper[4]. Sateesh Reddy Avutu et al. [5] propose an ultrasonic sensor-based robot. The caster wheels are used to rotate the robot. The Arduino board is used to construct a map from start to finish[6]. An ultrasonic sensor on the robot senses the barrier in front of it. The LCD panel displays the robot's present location as well as its planned actions. The passage from one room to the next is depicted on a route map. An RFID and GSM-based system was presented by S. Vinoth Kumar et al. [7]. An ultrasonic sensor is utilized to assess the level of waste, and force sensors are used to estimate the weight in this system. The red LED on the dustbin glows when the measured value of the sensors exceeds the threshold level, indicating that the dustbin is full. If this does not happen, the green LED will turn on. The GSM technology is used to send the coordinates of the trashcan's location to the police. A list of all trash cans, together with their locations, will be presented on the screen after the garbage collection authority logs into the android application. The concept of route optimization for waste collection vehicles was presented by Saurabh Dugdhe et al. [8]. The level sensors detect the waste threshold, while the MQ4 gas sensor, which is extremely sensitive to methane gas, detects the hazardous waste level. The status of the bin is sent to the workstation. After that, the garbage pickup vehicle selects the most efficient waste collecting route. The daily summary is then submitted to the server, which generates reports based on the data. [9], which at the time accepted IoT, presented a trash bin with a 10-centimeter intensity. The ultrasonic sensor detects the amount of garbage in the bin and reports it to the controller. [10] The author presented a system for managing waste collection in communal housing. An ultrasonic sensor detects the amount of waste in the bins and can convey data to the region through GSM. The graphical user interface (GUI) was created to obtain data from trash in a variety of locations, with the help of simulation. As a result, it was one-of-a-kind. In the procedure, there were two sorts of units: a slave unit maintained in a bin and a master unit kept in an office. The sensor measures the amount of trash in the bin and sends messages to a slave device, which alerts the administrators when the bin is full. The article outlines a network that was used to collect waste inside a specific area[11]. The apparatus was employed to gather undesired rubbish in the city's outlying neighborhoods. The system was made up of two sections. The first step was to gather information from a variety of sources, including those who were interested in waste collection or controlled vehicles,

as well as those who needed to arrange for certain operators to bring rubbish to different cities.

CHAPTER 3

COMPONENTS

3.1 Introduction

Dustbins are little containers made of plastic (or metal) that are used to collect trash. collect garbage. They are frequently used to collect rubbish in a variety of settings, including homes, offices, streets, and parks. In some regions, littering is a serious felony, thus public waste containers are the only way to dispose of little debris. Waste, both wet and dry, as well as recyclables and non-recyclable waste, are normally collected in separate bins.

In this project, we designed a system called Smart Dustbin Arduino, Ultrasonic Sensor, Servo Motor, IR Sensor, Buzzer, Transistor, LED, DC Gear Motor, Motor Driver (L293D), Resistor, Switch, Water Pump, Bluetooth Module (HC-05), 3.7V Rechargeable Battery and Connecting Wire where the dustbin lid will automatically open when a human hand is detected. The smart dustbin is a thoughtfully designed solution to the social problem of garbage disposal; it recognizes the type of material put inside it and categorizes it as biodegradable or non-biodegradable..

3.2 List of Components

1. Arduino Uno
2. Ultrasonic Sensor
3. Servo Motor
4. IR Sensor
5. Buzzer
6. Transistor
7. LED
8. DC Gear Motor
9. Motor Driver (L293D)
10. Resistor
11. Switch
12. Water Pump
13. Bluetooth Module (HC-05)
14. 3.7V Rechargeable Battery

15. Connecting Wire

3.2.1 Arduino Uno

Arduino is a community that designs and manufacture user-friendly microcontrollers and microcontroller kit. It can receive and send data to various devices, including the internet, to command specific electrical equipment. It has become trendy amongst students. Students can easily afford it and easily interact with sensors, actuators, etc.

Arduino Uno was developed in Italy in 2008 by Arduino. cc. It is a tiny, comprehensive, and breadboard-friendly Microcontroller board. It is based on the ATmega328P. It is built with sets of analog and digital input/output (I/O). It can be programmed using the C and C++ programming languages. It has Universal Serial Bus (USB) port. The port is used for loading programs from a personal computer or android phone.

This board is an Arduino clone that is perfectly compatible with the Arduino IDE and its examples.

The Arduino Uno board's technical specs are as follows:

- Microcontroller ATmega328
- Operating Voltage is 5 V
- Input Voltage: 7-12 V (recommended)
- Input voltage is 6-20 V
- 14 Digital I/O Pins
- DC Current per unit I/O Pin: 40 mA
- Analog Input Pins: 8
- Flash Memory 32 KB
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed is 16 MHz
- Dimensions is 0.73" x 1.70"

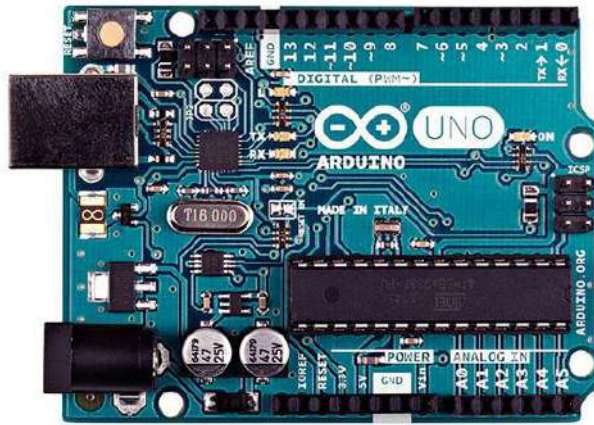


Fig. 3.2.1: Arduino Uno [12]

Powering the Arduino Uno

The Arduino Nano can be through the Mini-B USB connection, 6-20V unregulated outside strength delivers (pin 30), or 5V regulated outside power delivery (pin 27). The electricity supply is mechanically selected to the highest voltage supply.

Input and Output

Arduino Uno consists of 14 digital pins used as input or output, using `pinMode()`, `digital Write()`, and `digital Read()` functions. Their operating voltage is 5 V. Each pin can provide or receive a maximum 40 mA range of current and has an internal resistor which is pull up (disconnected by default) type and its range is 20-50 k Ω . Some pins perform technical parameters:

Serial: 0 (RX) and 1 (TX) pin. Used to receive (RX) data and transmit (TX) data data. These pins are connected to the FTDI USB-to-TTL Serial chip's corresponding pins.

External Interrupts pin 2 and 3. These two pins can be used to trigger an interrupt on a low value level, a rising or falling edge level, or a change in value.

PWM (Pulse Width Modulation): 3, 5, 6, 9, 10, and 11 pin.

SPI: pin 10 (SS), pin 11 (MOSI), 12 (MISO), 13 (SCK). Although the underlying hardware provides these pins support SPI communication, It is not yet supported by the Arduino programming.

LED: 13. A built-in LED is connected to digital pin 13 by a wire. The LED is turned on when the pin has a HIGH value. It's off when the pin is LOW.

The Uno has six analog inputs, each providing The resolution is 10 bits (i.e., 1024 different values). They measure from ground to 5 volts by default, but the analog Reference() function can be used to adjust the upper end of their range. Some pins also have specialized functions, such as:

I2C: A4 (SDA) and A5 (SCL). Using the Wire library, provide I2C (TWI) communication (documentation on the Wiring website).²⁵ There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analog Reference ().

Reset. To reset the microcontroller, set this line to LOW. They are typically used to add a reset button to shields that block the one on the board.

Communication

The Arduino Nano has several Centers for communicating with a laptop, another Arduino, or different microcontrollers. The ATmega328 presents UART TTL (5V) serial communication that's to be had on virtual pins 0 (RX) and 1 (TX). An FTDI FT232RL at the board channels this serial verbal exchange over USB, and the FTDI drivers (protected with the Arduino software) provide a virtual com port to software on the pc. The Arduino software consists of a serial display that lets in simple textual information. The Arduino board receives and sends data. When this happens, the RX and TX LEDs on the board will flash. facts are being transmitted through the USB connection to the FTDI chip pc (but not for a serial conversation on pins 0 and 1). A Software Serial library allows for a serial conversation on any of the Nano's virtual pins. The ATmega328 also helps I2C (TWI) and SPI conversation. The Arduino software consists of a Wire library to simplify the use of the I2C bus. To use the SPI communicate, please see the ATmega328 datasheet.

Programming

The Arduino may be programmed using the Arduino software (download). From the Tools > Board menu, choose "Arduino Duemilanove or Nano w/ ATmega328(in step with the microcontroller in your board). The ATmega328 on the Arduino Nano comes pre burned with a bootloader that permits you to add new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. You can also pass the

bootloader and application the microcontroller through the ICSP (In-Circuit Serial Programming) header using Arduino ISP or similar.

Automatic (Software) Reset

Rather than requiring a bodily press of the reset button before an upload, the Arduino Uno is made to be reset by way of a software program jogging on a linked computer. One of the pieces of hardware is going with the flow manage strains (DTR) The reset line of the ATmega328 is connected to the FT232RL thru a hundred nano farad capacitor. When this line is declared (taken low), the reset line drops long enough to reset the chip. The Arduino software program uses this functionality to upload code by using certainly urgent the upload button inside the Arduino environment. The bootloader method can have a shorter timeout because the lowering of DTR may be nicely coordinated with the beginning of the upload.[8] This setup has other implications. When the Uno is connected to both a laptop walking Mac OS X or Linux, it resets every time a connection is made from software (thru USB). For the subsequent half-2nd or so, the bootloader is jogging on the Uno. While it's far programmed to disregard malformed information (i.E., whatever besides an upload of new code), it'll intercept the preceding few bytes of facts despatched to the board after a connection is opened. Suppose a caricature strolling at the board gets one-time configuration or different records when it first starts. In that case, it makes sure that the software program with which it communicates waits for a 2nd after beginning the relationship and earlier than sending this information.

3.2.2 Ultrasonic Sensor

We used ultrasonic sensor or sonar sensor to detect object and control the robot manually. The trig pin of ultrasonic sensor transmits a sound wave and echo pin of sensor receive the sound wave and detect obstacle found or not. The full system works as this type of equation:

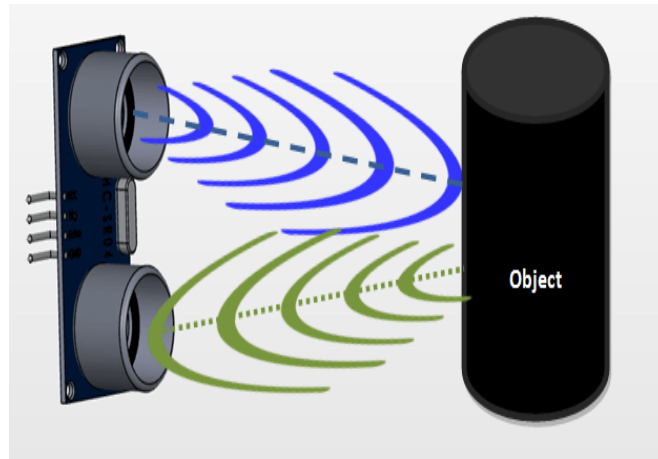


Fig. 3.2.2.1: Ultrasonic sensor distance measurement system [13]

It's an electrical component that sends and collects signals using an ultrasonic transmitter and receiver pair, resulting in accurate obstacle detection. The shorter the wavelength of transmitted radiation, the higher the resonance frequency, and the better the surrounding conditions. The higher the resolution of the measurement, the more directed the sonic wave is. Sensitivity aids in the reduction of the signal-to-noise ratio. As seen below, we used two 40kHz transducers.

An ultrasonic range finder is a circuit that uses ultrasonic sound to measure distance. The ultrasonic burst is released from the transmitter first, and then received by the receiver. In the medium, $c = 331,3 \text{ (m/s)} * (1+T/273)$ is the ultrasonic sound velocity. 1/2 The speed of a sonic wave changes with the temperature of the medium. Geometric spreading, molecular relaxation, boundaries, and refraction by non-homogeneous atmosphere, as well as diffraction by turbulence, conduction, and shear viscosity losses, all contribute to overall attenuation in air.

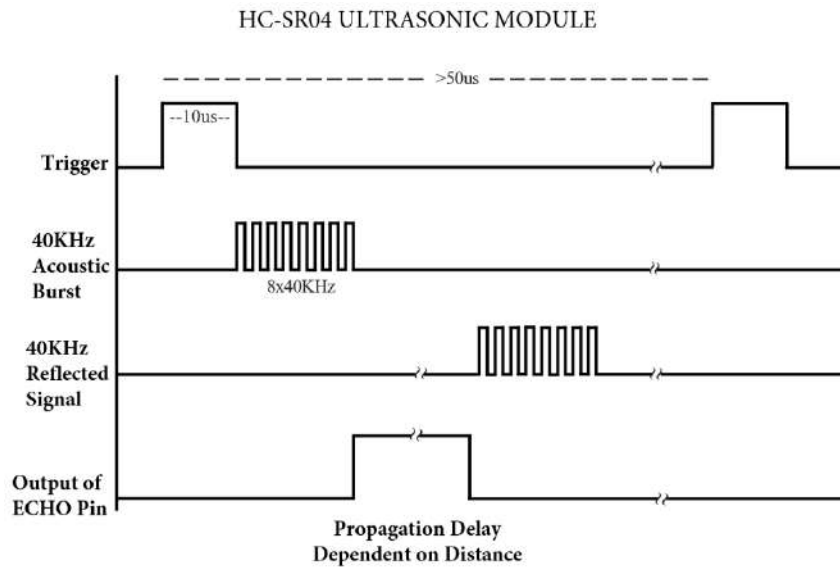


Fig. 3.2.2.2: Ultrasonic waves [13]

The amount of attenuation varies depending on how far the sonic wave travels. We are using two 40 kHz transducers in this experiment. A transducer is a device that alters one's physical state type of energy into electrical energy and then back to another type of energy. It is equipped with a piezoelectric substance that performs the energy conversions.



Fig. 3.2.2.3: Ultrasonic Sensor [13]

3.2.3 Servo Motor (SG-90)

A servo motor is an electrical device that can push or spin an object accurately. When you want to spin an object at a precise angle or distance, you use a servo motor. A basic motor appears to be the source of power. If the motor is DC powered, it is referred to as a DC servo motor; if it is AC powered, it is referred

to as an AC servo motor. We can have a servo motor with a lot of torque in a small and light package. Because of these characteristics, they are utilized in a variety of applications, including toy autos, RC helicopters and planes, robots, and machineries.



Fig. 3.2.3.1: Servo Motor [14]

Controlling Servo Motor

PWM (Pulse with Modulation) is utilized to drive the servo motor via the control wires. Pulses can be divided into three categories: minimum, maximal, and repetition rate. The servo motor can turn 90 degrees in any direction from its neutral point. The servo motor expects to see a pulse every 20 milliseconds (ms), and the length of the pulse determines how far the motor turns. For example, a 1.5ms pulse will rotate the motor 90 degrees. The shaft will move to 0° if the servo pulse is less than 1.5ms, and 180° if the servo pulse is larger than 1.5ms.

The duration of the applied pulse to a servo motor's Control PIN, which operates on the PWM (Pulse width modulation) principle, controls the angle of rotation. A DC motor and particular gears are used in servo motors, which are controlled by a variable resistor (potentiometer). A DC motor's high-speed force is converted into torque by gears. We know that $WORK = FORCE \times DISTANCE$, and that the force is smaller and the distance (speed) is greater in a DC motor, whereas the force is bigger and the distance is shorter in a servo. The output shaft of the servo is connected to a

potentiometer, which calculates the angle and stops the DC motor at the appropriate angle.

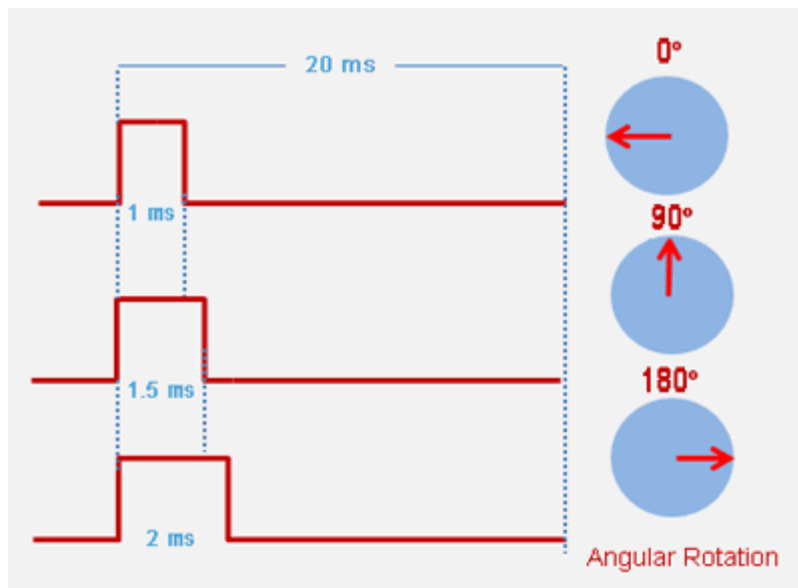


Fig. 3.2.3.2: Pulse Width Modulation [14]

All servo motors work with your +5V supply rails, but the amount of current they require must be considered. If you're going to use more than two servo motors, you'll need to make a servo shield.

IR Sensor

An infrared sensor is a device that uses infrared light to detect specific aspects of the surroundings. An infrared sensor can also detect motion and assess an object's temperature. A passive infrared sensor measures rather than emits infrared light. Almost every thing emits some form of infrared heat radiation. These are invisible to the human eye radiations that can be detected by an infrared sensor. A simple IR LED (Infrared Light Emitting Diode) serves as the emitter, while a simple IR photodiode serves as the detector. Light of the same wavelength is emitted by the IR LED. The resistances and output voltages of a photodiode alter as the amount of infrared light it receives changes.

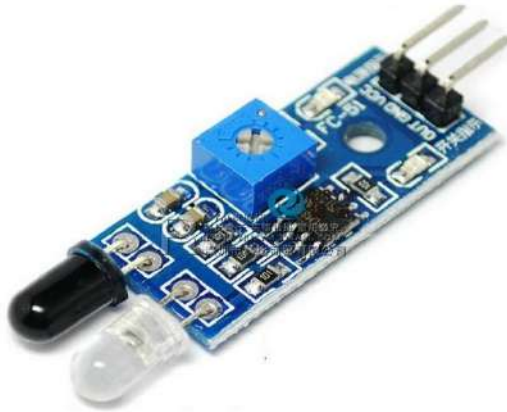


Fig. 3.2.4: IR sensor [15]

3.2.4 Buzzer

A mechanical, electromechanical, or piezoelectric buzzer or beeper is an aural signaling device. Alarm clocks, timers, and confirmation of human input such as a mouse click or keyboard are all popular uses for buzzers and beepers.



Fig. 3.2.5: Buzzer [16]

3.2.5 Transistor

A transistor is a type of semiconductor that has the ability to both amplify and switch electrical signals. Modern electronics would be incomplete without the transistor. It's typically constructed of semiconductor material and has three terminals for connecting to an electronic circuit. Only a voltage or current applied to one pair of transistor terminals controls the current through another set of transistor terminals. Because the controlled power can be greater than the controlling power, a transistor can magnify a signal. Integrated circuits comprise the bulk of transistors, despite the fact that some are packaged separately.



Fig. 3.2.6.1: Transistor [17]

Parts of a Transistor

Three layers of semiconductor materials make up a typical transistor, or terminals as they're known in the industry, that help connect the transistors to an external circuit and carry current. The current flowing through a transistor's other pair of terminals is turned into an electrical signal or current applied to one of the transistor's terminals. There are three terminals on a transistor.

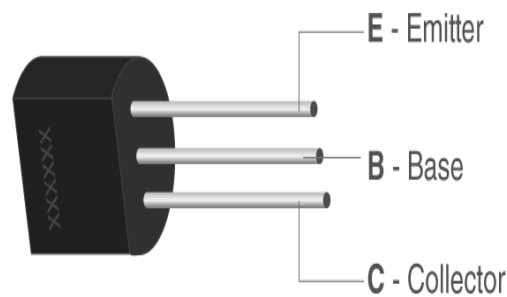


Fig. 3.2.6.2: Parts of a Transistor [17]

They are:

- Base: This is used to activate the transistor.
- Collector: It is the positive lead of the transistor.
- Emitter: It is the negative lead of the transistor.

3.2.6 LED

A two-lead semiconductor light source is a light-emitting diode (LED). It's a p-n junction diode that creates light when it's turned on. Electrons can recombine with electron holes inside the device, and energy is released in the form of photons when the leads are given the proper voltage. The color of the light that corresponds to the photon's energy (in relation to the photon's energy) is defined by the semiconductor's energy band gap, and this phenomenon is known as electroluminescence.

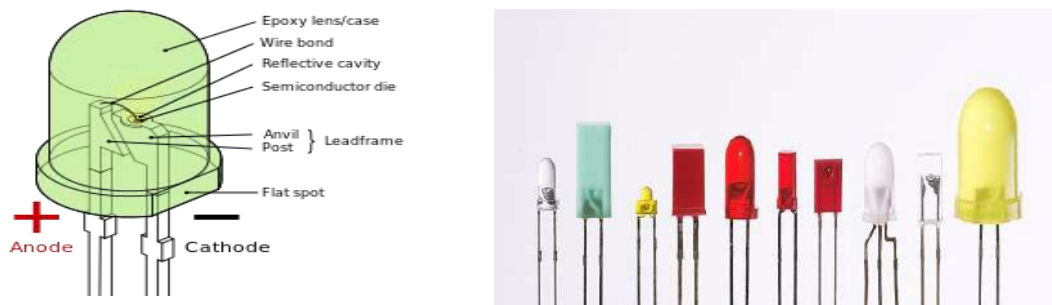


Fig. 3.2.7: LED [18]

3.2.7 DC Gear Motor

A mechanically driven DC motor is an electric generator. In the most common forms, magnetic fields are employed to generate force. Almost all DC motors feature an internal mechanism, either electromechanical or electronic, that reverses the direction of current flow in a section of the motor on a regular basis. Because they can be powered by existing direct-current lighting power distribution networks, DC motors were the first to acquire widespread adoption. The dc motor's speed may be varied across a wide range by changing the supply voltage or the current intensity in the field windings. Small DC motors are found in tools, toys, and appliances. The universal motor is a direct-current capable, lightweight brushed motor. Portable power tools and appliances have been known to employ motors. Larger DC motors are required for the propulsion of electric vehicles, elevator and hoist drives, and steel rolling mill drives. With the advent of power electronics, DC motors can now be substituted with AC motors in some applications.



Fig. 3.2.8: DC gear motor [19]

3.2.8 Motor Driver (L293D)

The L293D motor driver shield tutorial is a robotics project that involves driving several types of motors. The most common types of motors used in robotic applications are DC, servo, and stepper motors. These motors, on the other hand, are frequently incapable of being controlled directly by Arduino or another microcontroller. Due to their larger current and power ratings, motor shields or driver ICs are used instead. To isolate a motor's power source, these shields or ICs rely on control logic from the microcontroller circuitry. The L293D is a common Arduino motor driver shield. The L293D motor driver shield can control up to four bi-directional DC motors with 8-bit speed selection, two stepper motors, and two servo motors.

An L293D walkthrough

The L293D motor driver shield includes two L293 motor driver ICs and a 74HC595 shift register IC. The shield is made up of numerous important components.

The motor driver: The L293D is a two-motor dual-channel H-bridge motor driver that can control two DC motors or one stepper motor at the same time. The shield can technically control four DC motors due to the presence of two L293D ICs. This is perfect for robots with two or four wheels. To regulate the motors, the IC has two H-bridges, each of which delivers up to 0.6A to a motor.

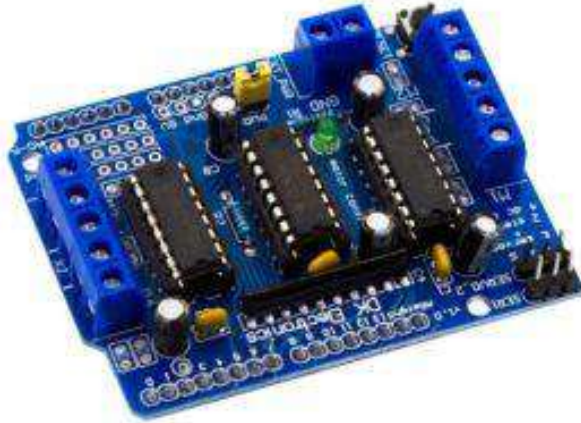


Fig. 3.2.9: Motor driver (L293D) [20]

The shift register: A shift register featuring an 8-bit serial input and serial/parallel output, the 74HC595 is a popular choice. It connects eight L293D motor driver IC direction control pins to four Arduino GPIO (or similar microcontroller) pins.

The power supply: The shield and Arduino can both be powered from the shield's power source, or they can be powered separately. If the shield is to share a common power source, a power jumper must be fitted on it. Power can be delivered by the USB port on the Arduino, the DC connector on the shield, or the 2-pin EXT-PWR block on the shield.

The power jumper should not be installed on the shield if a separate power supply is utilized. The shield's 2-pin EXT-PWR block should be used, and Arduino can be powered through USB or DC jack.

3.2.10 Resistor

A resistor is a two-terminal passive electrical component that implements electrical resistance to operate as a circuit element.



Fig. 3.2.10: Resistor [21]

Resistors are used in electronic circuits for a variety of purposes, including limiting current flow, changing signal levels, dividing voltages, biasing active devices, and terminating transmission lines. High-power resistors, which can waste hundreds of watts of electrical power as heat, are utilized in motor controllers, power distribution systems, and generator test loads.

Fixed resistors' resistance is unaffected by temperature, time, or operating voltage. Variable resistors can be used to control circuit elements (such as a volume control or a lamp dimmer), as well as to detect heat, light, humidity, force, or chemical activity.

Resistors are widely employed in electronic devices and are common components of electrical networks and electronic circuits. Because they are distinct components, practical resistors can be made from a wide range of materials, compounds, and forms. Integrated circuits have resistors as well.

The resistance of a resistor determines its electrical function; standard commercial resistors are available throughout a nine-order-of-magnitude range. The resistance's nominal value falls within the component's manufacturing tolerance.

Theory of Operation

The relationship that regulates the behavior of an ideal resistor is defined by Ohm's law:

The voltage (V) across a resistor is proportional to the current (I) according to

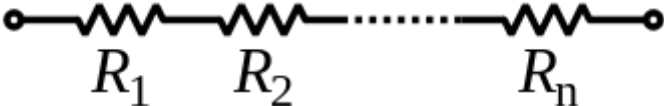
Ohm's equation, with the resistance serving as the proportionality constant (R). A 300 ohm resistor connected across the terminals of a 12 volt battery, for example, conducts a current of $12 / 300 = 0.04$ amperes.

Practical resistors in alternating current circuits also include inductance and capacitance, which affect the voltage-current connection.

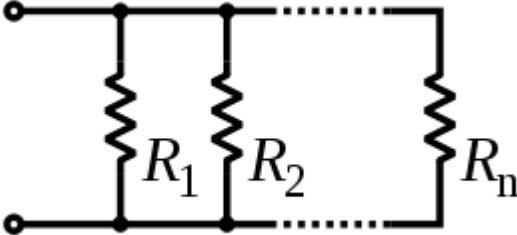
Georg Simon Ohm named the ohm (symbol: Ω) as the SI unit of electrical resistance. An ohm is the same as a volt per ampere. The derived units milliohm ($1 \text{ m} = 10^{-3}$), kilohm ($1 \text{ k} = 10^3$), and megohm ($1 \text{ M} = 10^6$) are extensively used since resistors are specified and manufactured in such a wide range of values.

Series and parallel resistors

The total resistance of resistors connected in series is the sum of their individual resistance values.



The reciprocal of the sum of the reciprocals of the individual resistors is the overall resistance of resistors connected in parallel.



A resistor network with parallel and series connections can be broken down into smaller parallel or series parts. Some complex resistor networks are inaccessible in this manner, demanding more advanced circuit study. In general, the Y-transform, or matrix techniques, can be used to solve such problems.

3.2.11 Switch

A switch is an electrical component that may be turned on or off in electrical components by interrupting or diverting electricity from one conductor to another. When a switch is pressed, the mechanism removes or restores a circuit's conducting path. It can be controlled manually, such as with a light switch or a keyboard button, by a moving item, such as a door, or by a pressure, temperature, or flow sensing sensor. In a switch, one or more sets of contacts may operate simultaneously, sequentially, or alternately. To avoid destructive arcing, switches in high-powered circuits must function quickly, and they may have special features to help terminate a huge current quickly. Actuators can be used to control or sense position, level, temperature, or flow and exist in a range of shapes and sizes. Among other things, special types are used to regulate machinery, reverse electric motors, and measure liquid level. Specialized forms come in a variety of shapes and sizes. To make it easier to control light fixtures, many switches can be wired onto a single circuit, which is a popular use case. Information-routing devices in a computer network are known as "switches" in the same way that devices that choose one or more possible electric current routes are referred to as "switches." These are typically more complicated than simple electromechanical toggles or pushbutton devices, and they operate without direct human interaction.



Fig. 3.2.11: Switch [22]

3.2.12 Water Pump

A pump is a mechanical device that turns one fluid into another to propel fluids (liquids or gases) or slurries. Pumps can be classified into three types based on how they transfer fluid: direct lift, displacement, and gravity pumps.

Pumps generate mechanical work (typically reciprocating or rotating) and consume it to transfer fluid. Pumps can be fueled by a number of different sources such as human labor, electricity, engines, or wind power. Pumps can range in size from miniscule pumps used in medical purposes to huge industrial pumps.

Well water pumping, aquarium filtering, pond filtering, and aeration, water cooling and fuel injection in automobiles, pumping oil and natural gas in the energy industry, and operating cooling towers and other components of heating, ventilation, and air conditioning systems are all examples of mechanical pumps in use. Pumps are employed in the medical industry for biochemical processes such as drug discovery and production, as well as artificial heart and penile prostheses.

There is only one spinning impeller in the casing of a single-stage pump. A double- or multi-stage pump is one that contains two or more revolving impellers in its casing.

Biology has produced many different types of chemical and biomechanical pumps, and biomimicry is occasionally used to create new mechanical pumps.



Fig. 3.2.12: Water pump [23]

3.2.13 Bluetooth Module (HC-05)

The Bluetooth gadget is used to communicate between the robot and a cell phone or a mobile. The robot is equipped with a Bluetooth device (HC-05) that can both receive and broadcast data from the mobile phone. It's used to turn a serial port into a Bluetooth device. Master and Slave are the two modes available. Bluetooth is a wireless communication system that operates at 2.4 GHz and has a client-server architecture,

making it ideal for establishing personal area networks. It's made for mobile phones and other similar devices (low power). The MAC address of the device is used by the Bluetooth protocol. Bluetooth establishes communication between two devices based on their MAC addresses.



Fig. 3.2.14: Bluetooth (HC - 05) [24]

3.2.14 3.7V Rechargeable Battery

The 18650 battery is a type of lithium-ion rechargeable battery. The first four digits of the identity "18650" give the physical dimensions, while the fifth digit indicates that the cell is a cylinder. The typical 18650 battery has a diameter of 18mm and a length of 65mm. Laptop battery packs, flashlights, electric automobiles, cordless tools, and a number of other gadgets that require portable power often use this battery.



Fig. 3.2.14: 3.7V rechargeable battery [25]

Pulse Discharge Rating

The maximum current that can be used to deplete the battery over a short period of time without harming it or lowering its capacity to the manufacturer's specifications.

Nominal Voltage

For classification purposes, a value is assigned. Typically, the nominal voltage is in the middle of that range and operation may be achievable within that range.

Protected

A small electronic circuit is built into the cell packaging of protected batteries. Temperature, overcharge, overdischarge, short circuit/overcurrent are all threats that this circuit protects the battery against. Because of the integrated circuit, a protected battery will last significantly longer.

3.2.15 Connecting Wire

A wire is a cylindrical and flexible single metal strand or rod. Wires are used to transport mechanical loads, energy, and telecommunications signals. Wire is formed by drawing metal through a hole in a die or drawing plate. Gauge numbers are used to describe wire gauges, which come in a range of sizes. A bundle of similar strands is referred to as a wire rope in mechanics or a cable in electrical engineering where it is referred to as "multistranded wire."

All types of wire are available, including solid core, stranded, and braided. Despite its circular cross-section, wire can be manufactured in square, hexagonal, flattened rectangular, or other cross-sections for ornamental purposes or functional requirements such as high-efficiency voice coils in loudspeakers. Edge-wound [a sort of coil spring built of a particular material, like the Slinky toy.

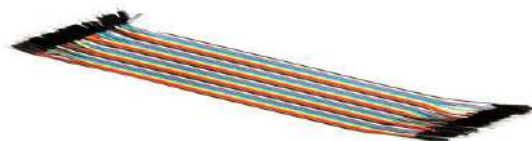


Fig. 3.2.15: Connecting Wire [26]

CHAPTER 4

DESIGN METHODOLOGY

4.1 Introduction

To design the system, we used different types of sensors to sense the different types of signals and Arduino Uno as a microcontroller or processor which can be processed all of the data.

4.2 Block Diagram

Here we powered all of the components through battery. We used ultrasonic sensor to sense the obstacle and servo motor is being used to open and close the bin. Arduino uno is used to process all of the data.

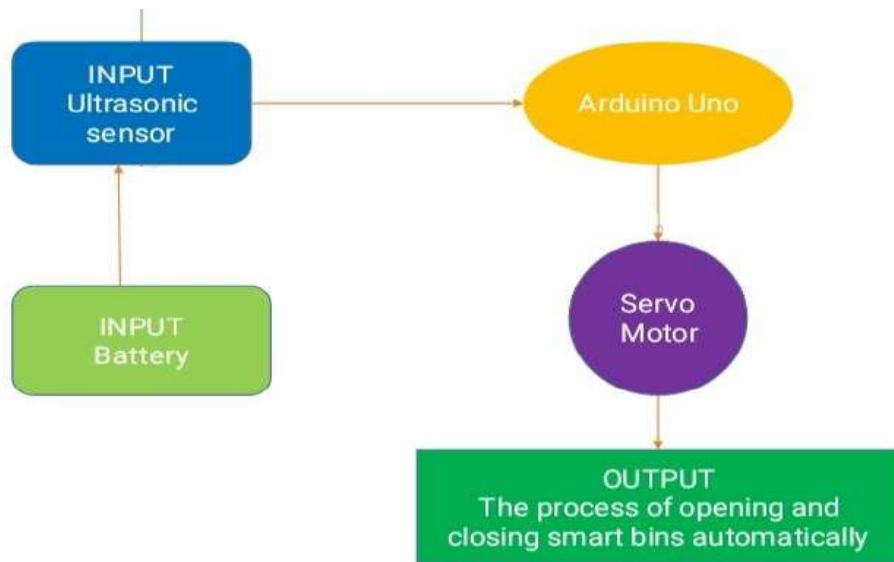


Fig. 4.2.1: Design of the open and closing system smart bin

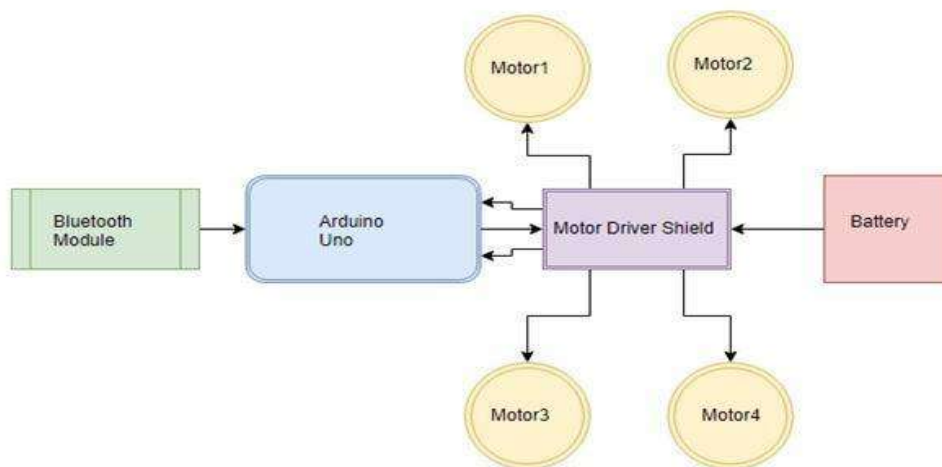


Fig. 4.2.2: Design of the dustbin moving system

In Figure 4.2.2, represents the battery is used as a power supply. Motor driver shield is used to drive the motor like forward, backward, left and right. We used Bluetooth module to control the robot through mobile phone. Here mobile phone act as a transmitter and Bluetooth module act as a receiver. We used Arduino to process all of the data.

4.3 Flow Chart

At first the program will be start. Then connect the system with smartphone via Bluetooth. Then check the signal which is given by using android software through smartphone. By given input signal Arduino will start to process the data and move the system like forward, backward, left and right. The program will be continuously running through prepropreccing command by a loop.

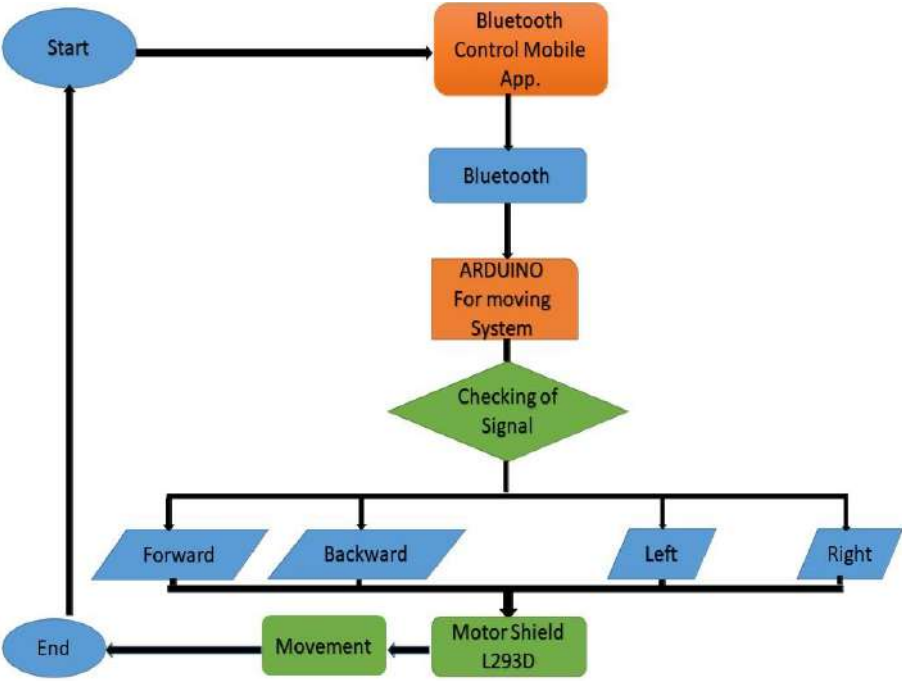


Fig. 4.3.1: Flow chart Dustbin moving System's Circuit diagram.

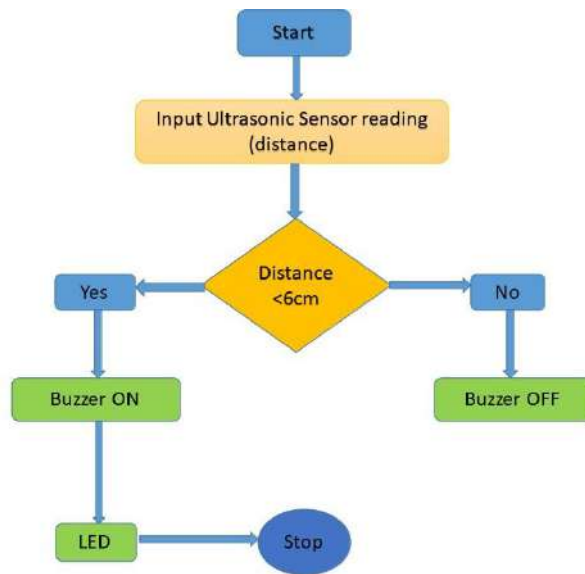


Fig. 4.3.2: Flow chart of the garbage fill alerting System.

Figure 4.3.2 presents the flow chart of the garbage fill alerting system. In this part, firstly the program will be start and check the ultrasonic sensor reading. If the obstacle distance is less than 6cm, the buzzer and LED will be ON. Else buzzer and LED is will be OFF.

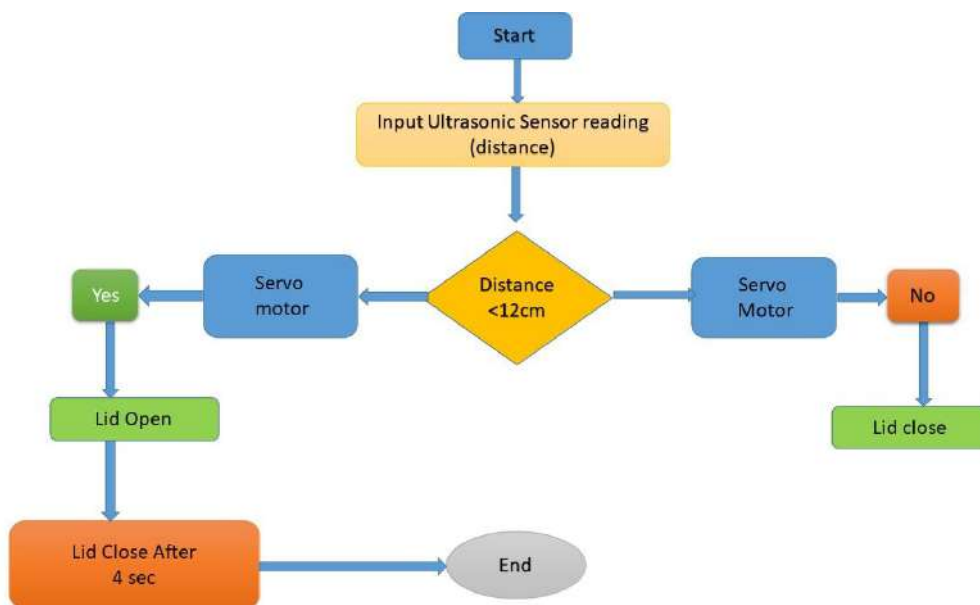


Fig. 4.3.3: Flow chart of the dustbin lid open & close system

Figure 4.3.3 presents the flow chart of the dustbin lid open and close system. In this part, firstly the program will be start and check the ultrasonic sensor reading. If the obstacle

distance is less than 12cm, the lid will be automatically open and it will be close after 4 second when obstacle remove behind the sensor.

4.4 Circuit Diagram

In this circuit, we represent the dustbin lid open & close system. We used ultrasonic sensor to sense the obstacle and servo motor is being used to open and close the bin. Ultrasonic sensor trig pin is connected with Arduino digital pin 5 and ultrasonic sensor echo pin is connected with Arduino digital pin 6. Servo motor data pin is connected with Arduino PWM pin 11. Arduino uno is used to process all of the data.

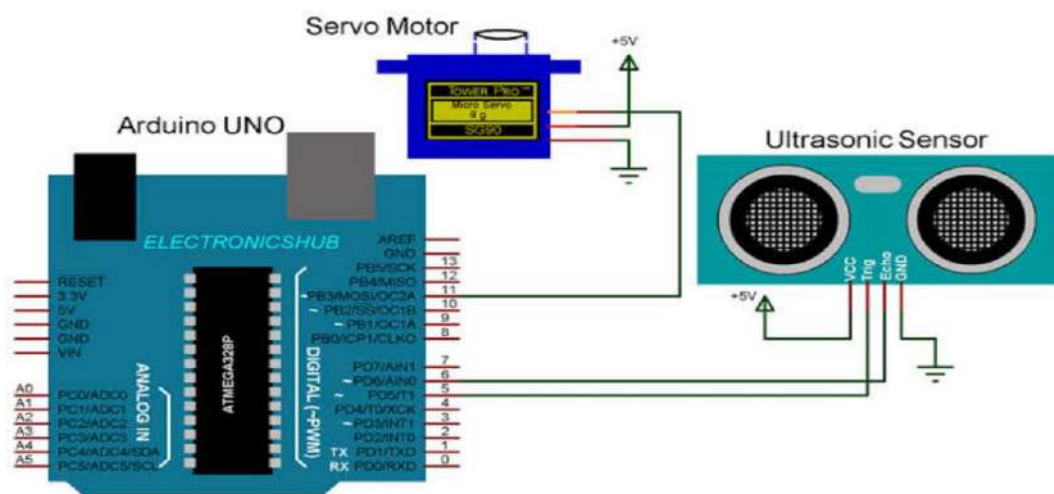


Fig. 4.4.1: Circuit Diagram Of the dustbin lid open & close system

In Figure 4.4.2, we represent the Garbage fill alerting System. We used ultrasonic sensor to sense the obstacle and buzzer is being used to produce a sound as a alert. Ultrasonic sensor trig pin is connected with Arduino digital pin 9 and ultrasonic sensor echo pin is connected with Arduino digital pin 10. Buzzer positive pin is connected with Arduino digital pin 13. Arduino uno is used to process all of the data.

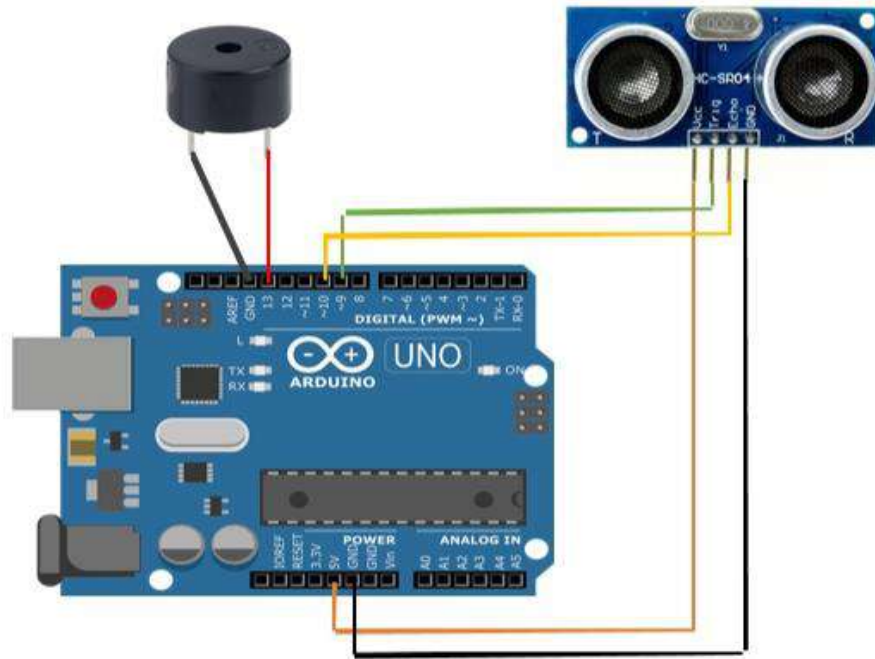


Fig. 4.4.2: Circuit Diagram of the Garbage fill alerting System.

In this Figure 4.4.2, we shown the Automatic Hand Sanitizer dispenser. We used an IR sensor to sense the obstacle (hand) and a pump is being used to spray the sanitizer. A transistor is used to automatic switching the pump through the sensor response.

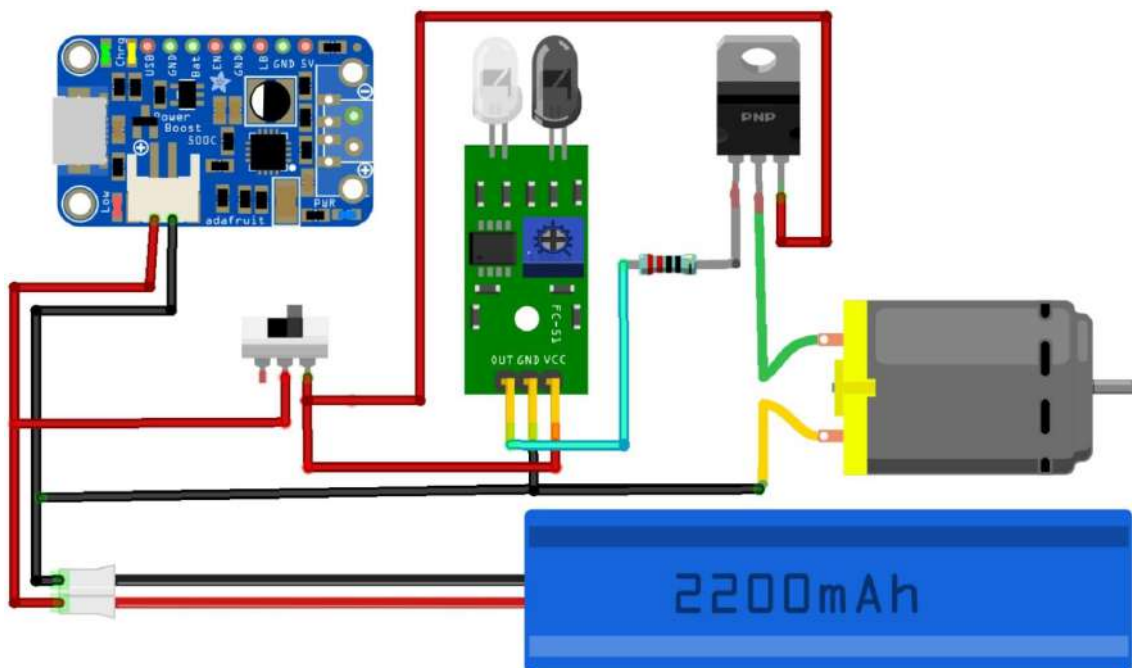


Fig. 4.4.3: Circuit diagram of the automatic hand sanitizer dispenser.

In Figure 4.2.4, the circuit represents the Dustbin moving System. Here battery is used to powered the whole system. Motor driver shield is used to drive the motor like forward, backward, left and right. We used Bluetooth module to control the robot through mobile phone.

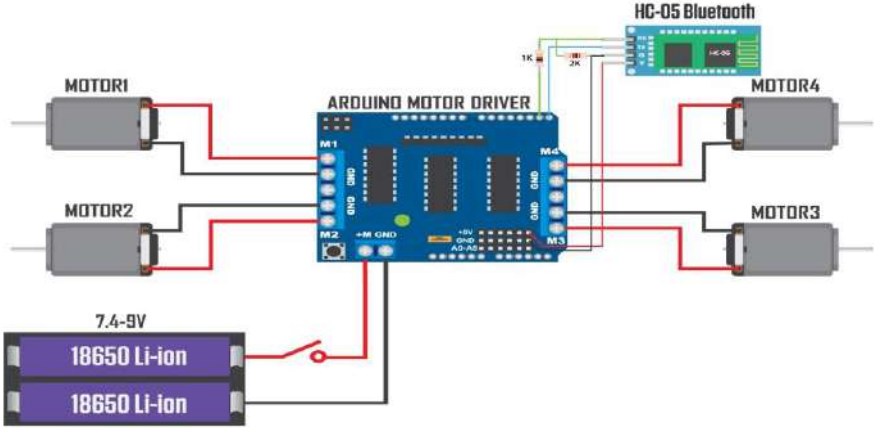


Fig. 4.4.4: Dustbin moving System's Circuit diagram.

CHAPTER 5

IMPLEMENTATION AND RESULT

5.1 Introduction

In this chapter we describe the step-by-step demonstration procedure of our projects and the results section also incorporated in this part.

5.2 Implementation

This Figure represents the Automatic Dustbin lid open and close lid system. When ultrasonic sensor finds any signal, the lid will automatically open either it is closed.



Fig. 5.2.1: Automatic Dustbin lid open and close lid system



Fig. 5.2.2: Two separate chambers for Biodegradable and Non- Biodegradable trash.

This Figure shown the Bluetooth Controlled Dustbin moving System. Here we used Bluetooth module, motor driver and motor to move the dustbin through smartphone.

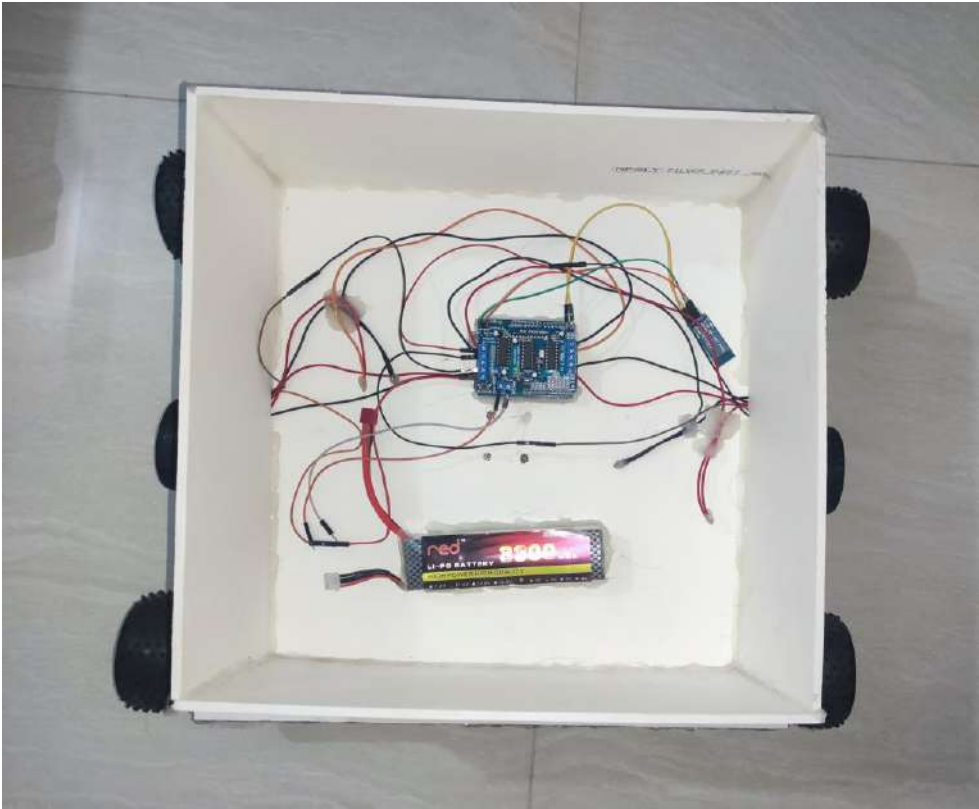


Fig. 5.2.3: Bluetooth Controlled Dustbin moving System

This Figure represents the complete setup of the smart dustbin. Here all of the sensors and components are incorporated.



Fig. 5.2.4: Complete Setup

5.3 Demonstration and Results

This Figure shows the dustbin opening system. When any person come to closure with the dustbin. The dustbin will be opened automatically.



Fig. 5.3.1: Automatic Dustbin lid open and close lid system

In Figure 5.3.2 presents the Garbage fill alerting system. When garbage will completely fill-up, the system will automatically alert through LED and buzzer.

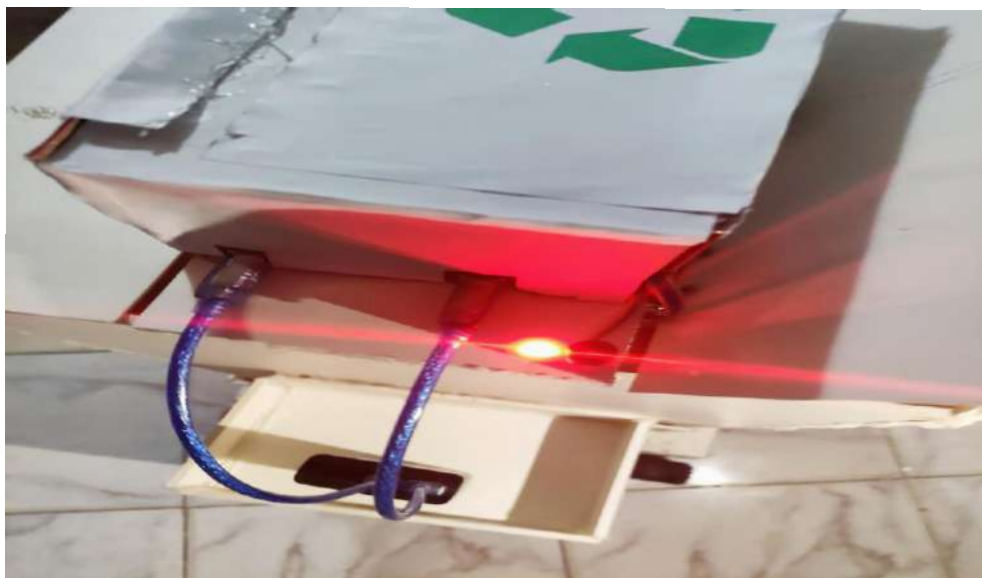


Fig. 5.3.2: Garbage fill alerting system

In this figure presents the Automatic Hand Sanitizer Dispenser system. When any person put their hand in this device, the sanitizer system will automatically spray the sanitizer.

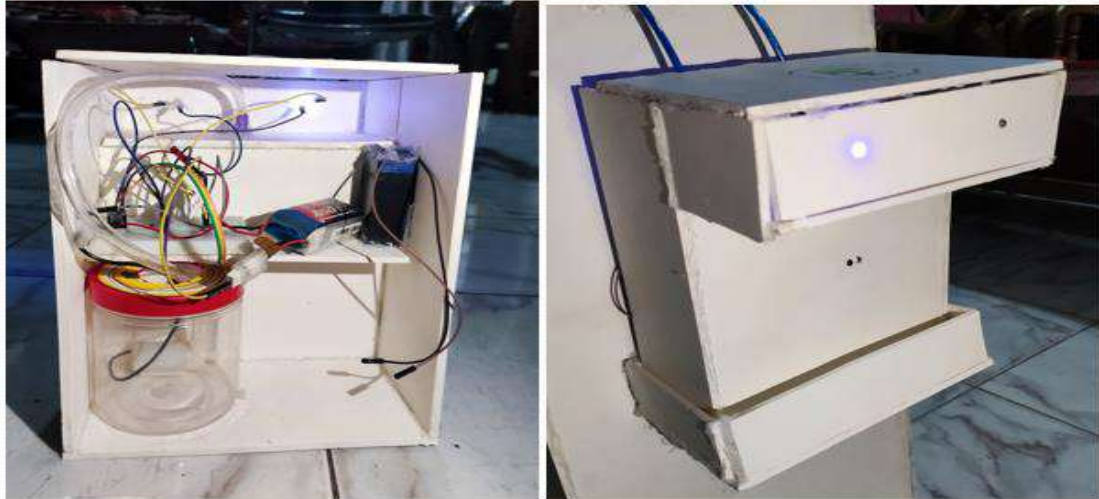


Fig. 5.3.3: Automatic Hand Sanitizer Dispenser

5.4 Total cost of the project

The total cost of the projects are more than 6000 taka.

Component Name	Quantity	Price (BDT)
Arduino Uno	3	1500/-
Ultrasonic Sensor	4	320/-
Motor Driver	1	250/-
Bluetooth Module	1	250/-
IR Sensor	1	200/-
DC Gear Motor	4	1200/-
DC Motor	2	150/-
Servo Motor	2	250/-
Transistor	1	30/-
Wheel	4	1000/-
LED	12	36/-
Buzzer	2	10/-
Pump	1	80/-
Board	1	500/-
Glue and Jumping Wire	N/A	200/-
Resistor	10	10/-
Breadboard	1	30/-
Total		6016/-

CHAPTER 6

CONCLUSION

6.1 Introduction

In conclusion, we described the applications of the project, advantage, disadvantage and future implementation of the projects.

6.2 Conclusion

People are getting smart day by day. At the same time, the thought comes up for smart cities a requirement smart waste management. Our waste management system is a place clean and healthy. Smart Dustbin ultimately helps to keep cleanliness in a particular area. The dustbin lid will Automatically open when an object comes near the dustbin, and a certain period will close. Therefore, the Automatic Garbage Fill Alerting system makes the garbage collection more efficient.

6.3 Applications

- Basic application for healthy waste management system and sanitization.
- Can be used at any smooth surface. For example, The bin can be used at hospitals for easy & hygienic disposal of wastes.
- It can be used in universities, colleges, hospitals, offices, homes etc. It can also be used in the Corona unit, where the waste management is an important issue.

6.4 Advantages

- Using smart garbage collection bins and systems with fill level sensors saves time and money. It can save up to 30% on infrastructure, operations, and maintenance. As smart transport trucks, only travel to containers or bins that are full.
- Because fewer waste collection vehicles are on the roads, it reduces traffic flow and, as a result, noise, resulting in reduced pollution levels.
- It maintains our surrounds clean, green, and free of rubbish odors, promotes a healthy environment, and beautifies cities.
- It also minimizes the amount of staff required to conduct the waste collection.
- The city becomes a "smart city" when smart waste management processes are used to maximize management, resources, and costs.

6.5 Limitation

- The system necessitates a higher number of garbage containers for separate waste collection in proportion to the city's population. Due to the high initial cost of smart dustbins in comparison to alternative ways, this results in a high initial cost.
- The memory size of the sensor nodes utilized in the dustbins is restricted.
- The system's wireless technologies, such as Bluetooth, ZigBee, and Wi-Fi, have a limited range and transmission speed. RFID tags are influenced by metal items in RFID-based systems (if any).
- It reduces manpower requirements, resulting in a rise in unemployment among the unskilled.
- Personnel who will be taking part in the smart waste management system will need to be trained.

6.6 Future Improvement

In future, we will be added different types of extra facilities to this project. Machine Learning and Artificial Intelligence system are also incorporated.

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APPENDIX

Control Part:

```
#include <AFMotor.h>
#include <SoftwareSerial.h>

SoftwareSerial bluetoothSerial(9, 10); // RX, TX

//initial motors pin
AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);

char command;

void setup()
{
  bluetoothSerial.begin(9600); //Set the baud rate to your Bluetooth module.
}

void loop() {
  if (bluetoothSerial.available() > 0) {
    command = bluetoothSerial.read();

    Stop(); //initialize with motors stoped

    switch (command) {
      case 'F':
        forward();
        break;
      case 'B':
        back();
        break;
      case 'L':
        left();
        break;
      case 'R':
        right();
        break;
    }
  }
}

void forward()
{
  motor1.setSpeed(255); //Define the maximum speed
  motor1.run(FORWARD); //clockwise rotation of the motor
  motor2.setSpeed(255); //Define the maximum speed
  motor2.run(FORWARD); //clockwise rotation of the motor
  motor3.setSpeed(255); //Define the maximum speed
  motor3.run(FORWARD); //clockwise rotation of the motor
  motor4.setSpeed(255); //Define the maximum speed
  motor4.run(FORWARD); //clockwise rotation of the motor
}

void back()
```

```

{
  motor1.setSpeed(255); //Define the maximum speed
  motor1.run(BACKWARD); //clockwise rotation of the motor
  motor2.setSpeed(255); //Define the maximum speed
  motor2.run(BACKWARD); //clockwise rotation of the motor
  motor3.setSpeed(255); //Define the maximum speed
  motor3.run(BACKWARD); //clockwise rotation of the motor
  motor4.setSpeed(255); //Define the maximum speed
  motor4.run(BACKWARD); //clockwise rotation of the motor
}

void left()
{
  motor1.setSpeed(255); //Define the maximum speed
  motor1.run(BACKWARD); //clockwise rotation of the motor
  motor2.setSpeed(255); //Define the maximum speed
  motor2.run(BACKWARD); //clockwise rotation of the motor
  motor3.setSpeed(255); //Define the maximum speed
  motor3.run(FORWARD); //clockwise rotation of the motor
  motor4.setSpeed(255); //Define the maximum speed
  motor4.run(FORWARD); //clockwise rotation of the motor
}

void right()
{
  motor1.setSpeed(255); //Define the maximum speed
  motor1.run(FORWARD); //clockwise rotation of the motor
  motor2.setSpeed(255); //Define the maximum speed
  motor2.run(FORWARD); //clockwise rotation of the motor
  motor3.setSpeed(255); //Define the maximum speed
  motor3.run(BACKWARD); //rotate the motor anti-clockwise
  motor4.setSpeed(255); //Define the maximum speed
  motor4.run(BACKWARD); //rotate the motor anti-clockwise
}

void Stop()
{
  motor1.setSpeed(0); //Define the minimum speed
  motor1.run(RELEASE); //stop the motor when release the button
  motor2.setSpeed(0); //Define the minimum speed
  motor2.run(RELEASE); //rotate the motor clockwise
  motor3.setSpeed(0); //Define the minimum speed
  motor3.run(RELEASE); //stop the motor when release the button
  motor4.setSpeed(0); //Define the minimum speed
  motor4.run(RELEASE); //stop the motor when release the button
}

```

Dustbin open and close part:

```

#include <Servo.h> //servo library
Servo servo;
int trigPin = 5;
int echoPin = 6;
int servoPin = 7;
int led= 10;
long duration, dist, average;
long aver[3]; //array for average
void setup()
{

```

```

Serial.begin(9600);
servo.attach(servoPin);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
servo.write(0); //close cap on power on
delay(100);
servo.detach();
}
void measure()
{
digitalWrite(10,HIGH);
digitalWrite(trigPin, LOW);
delayMicroseconds(5);
digitalWrite(trigPin, HIGH);
delayMicroseconds(15);
digitalWrite(trigPin, LOW);
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
dist = (duration/2) / 29.1; //obtain distance
}
void loop()
{
for (int i=0;i<=2;i++) { //average distance
measure();
aver[i]=dist;
delay(10); //delay between measurements
}
dist=(aver[0]+aver[1]+aver[2])/3;
if ( dist<50 )
{
//Change distance as per your need
servo.attach(servoPin);
delay(1);
servo.write(0);
delay(3000);
servo.write(150);
delay(1000);
servo.detach();
}
Serial.print(dist);
}

```

Alarm Part:

```

int trigPin = 9;
int echoPin = 10;
int led = 7;

void setup() {
Serial.begin(9600);
pinMode(led, OUTPUT);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
// put your setup code here, to run once:
}

```

```
void loop() {
  long duration, distance;
  digitalWrite(trigPin,HIGH);
  delayMicroseconds(1000);
  digitalWrite(trigPin, LOW);
  duration=pulseIn(echoPin, HIGH);
  distance =(duration/2)/29.1;
  Serial.print(distance);
  Serial.println("CM");
  delay(10);

  if((distance<=10))
  {
    digitalWrite(led, HIGH);
  }
  else if(distance>10)
  {
    digitalWrite(led, LOW);
  }
}
```