

SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION

Submitted in partial fulfillment of the requirements for the award of
Master in Engineering Degree in Computer Science and Engineering

by

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**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
SCHOOL OF COMPUTING**

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **ANNIE LINCY F(Reg No: 39310001)** who carried out the project entitled “**SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION**” under our supervision from **NOVEMBER 2020** to **APRIL 2021**.

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DECLARATION

I, **ANNIE LINCY F (Reg No: 39310001)** hereby declare that the Professional Training Report on **“SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION”** done by me under the guidance of guide **Dr. T. SASIKALA M.E., Ph.D., Dean,** Department of Computer Science and Engineering at Sathyabama Institute of Science and technology is submitted in partial fulfillment of the requirements for the award of Master **of Engineering (M.E)** degree in **Computer Science and Engineering (CSE).**

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ABSTRACT

At present, population rate in the main cities has increased tremendously. This has increased the production of waste. The management of huge volume of waste has become more difficult and challenging. The public dustbins are overflowing and have become nobody's concern. Due to the lack of responsibility of the corporation people, the overflowing garbage wastes have created unhygienic surroundings and foul smell. So, to overcome this issue, smart dustbin is designed. This smart dustbin is built on Arduino Uno board and is interfaced with GSM, GPRS and sensors. The sensors are used to check the threshold level of the dustbin. The threshold levels are already set. If the garbage hits the mentioned threshold level, continuous alert is sent to the respective authority until the garbage is recovered and the externally fixed LED is changed into red color. Once, the garbage from the bin cleared the LED changes to green color. This alert system is triggered by the sensors to the GSM modem. A time limit is given to respective authority, where if he/she fails the duty, the alert to the higher authority is sent. By this facility, the higher authority will be able to take action on the irresponsible workers. Features like maps are used to locate the dustbins which make the authority to reach the location easily. Connectivity among the dustbins are given to establish communication among the bins and provides smart system. Thus, the implementation of smart dustbins will create a hygienic society and will make the management of waste easy. The negligence of authorities and the public may be reduced. A clean and disease free environment can be created.

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LIST OF ABBREVIATION

GSM	Global System for Mobile Communication.
GPRS	General Packet Radio Service.
LED	Light – Emitting Diode.
LCD	Liquid – Crystal Display.
Wi-Fi	Wireless Fidelity.
IDE	Integrated Development Environment.
USB	Universal Serial Bus.
IOT	Internet Of Things.
IR	Infrared
GUI	Graphical User Interface.
PC	Personal Computer.
PCMCIA	Personal Computer Memory Card International Association.
RFID	Radio – Frequency Identification.
AT commands.	Attention commands.
SPI	Serial Peripheral Interface.
PWM	Pulse Width Modulation.
RAM	Random Access Memory.
GHZ	Giga Hertz.
MHZ	Mega Hertz.

CHAPTER 1

INTRODUCTION

1.1. DOMAIN DESCRIPTION.

The **Internet of things (IoT)** describes the network of physical objects—“things”—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

Things have evolved due to the convergence of multiple technologies, real-time analytics, machine learning, commodity sensors, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), and others all contribute to enabling the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems and cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smart phones and smart speakers. IoT can also be used in healthcare systems.

There are a number of serious concerns about dangers in the growth of IoT, especially in the areas of privacy and security, and consequently industry and governmental moves to address these concerns have begun including the development of international standards[3].

The perfect network connectivity option would consume extremely little power, have huge range, and would be able to transmit large amounts of data (high bandwidth). Unfortunately, this perfect connectivity doesn't exist. Each connectivity option represents a tradeoff between power consumption, range, and bandwidth. This allows us to create a conceptual framework that segments the various connectivity options into three major groups:

- ❖ High Power Consumption, High Range, High Bandwidth - To wirelessly send a lot of data over a great distance, it takes a lot of power. A great example of this is

your smart phone. Your phone can receive and transmit large amounts of data (e.g. video) over great distances, but you need to charge it every 1–2 days. Connectivity options in this group include cellular and satellite. Cellular is used when the sensor/device is within coverage of cell towers. For sensors/devices that are, say, on a ship in the middle of the ocean, satellite becomes necessary.

- ❖ **Low Power Consumption, Low Range, High Bandwidth** - To decrease power consumption and still send a lot of data, you have to decrease the range. Connectivity options in this group include Wi-Fi, Bluetooth, and Ethernet. Ethernet is a hard-wired connection, so the range is short because it's only as far as the length of the cable. Wi-Fi and Bluetooth are both wireless connections with lower power consumption than cellular and satellite and with up to or greater than the bandwidth. However, as I'm sure you've experienced just walking around your home, the range is limited.
- ❖ **Low Power Consumption, High Range, Low Bandwidth** - To increase range while maintaining low power consumption, you have to decrease the amount of data that you're sending. Connectivity options in this group are called Low-Power Wide-Area Networks (LPWAN).

1.2 ADVANTAGES OF IOT

- **Easy Access** - Right now, you can easily access the necessary information in real-time, from (almost) whichever location you are at. All it takes is a smart device and internet connection. We use Google Maps to see where we are, instead of asking a person in the street. Booking is simpler than ever. Factual information is easily accessible, even from the latest scientific research, or business analysis. It is only a click away.
- **Speed** - All this data pouring in enables us to complete numerous tasks with envying speed. For example, IoT makes automation easy. Smart offices automate repetitive tasks, thus allowing employees to invest their time and effort into something more challenging.

- **Adapting to New Standards** - Though IoT is ever-changing, its alterations are minimal compared to the rest of the high tech world. Without IoT, it would be hard for us to keep track of all the latest updates.
- **Better Time Management** - Overall, the IoT is an incredible time-saving tool. We can search for the latest news on our phones during our daily commute, or visit a blog about our favorite pastime, purchase an item in an online shop, you name it.

1.3 INTRODUCTION OF THE PROJECT.

The society, in the urge of transforming a city into smart city, has to work on various sectors. The main sector is the management of waste. So the smart dustbin concept has been evolved. This project involves the hardware components like Arduino Uno, Servo motors, connecting wires and batteries. It also inherits the concept of GSM for SMS and GPRS for Maps to locate the dustbin.

The **Ultrasonic sensors** detects and evaluates the distance of the object. An **Infrared sensor** emits IR radiation in order to sense any action. An IR sensor detects the thermal radiation from other objects.

The **Arduino Uno**, microcontroller board is equipped with digital and analog, input and output pins.. The board has 14 Digital pins, 6 Analog pins, and is programmable with the Arduino IDE using a USB cable. It is powered by the USB cable or an external battery as it accepts voltages from 7 to 20.

A **Servomotor** is an actuator that provides precise control position, velocity and acceleration. The **Global System for Mobile Communications (GSM)** and **General Packet Radio Service (GPRS)** standards are used for data communication.

The Blynk application was designed for the IoT. It can control hardware remotely, it can display sensed data, store data, visualize the data. The three major components of BLYNK are Application, Server and Libraries.

1.4 PROBLEM STATEMENT

The objective is to design and build an automatic open and close dustbin. Dustbins are provided with a sensor which helps in tracking the level of the garbage in the bins and a

unique ID is given to every dustbin in the city so that it is easy to identify which garbage bin is full. To provide easy accessibility to all the people, GUI is created which helps people to know the location and status of the dustbin.

1.5 PROBLEM DESCRIPTION

With increase of population, the scenario of cleanliness with respect to garbage management is degrading tremendously. In cities there are many public places where we see that garbage bins or dustbins are placed but are overflowing. This creates unhygienic condition in the nearby surrounding. Also creates ugliness, serious diseases, produces foul smell which degrades the valuation of that area. To avoid such situation, a project called “Smart Dustbin” is developed, which is a GSM based Garbage and garbage level in the dustbin is indicated using LED lights, as well as the GPRS to locate the dustbins.

CHAPTER 2

LITERATURE SURVEY

2.1 STATE OF ART

Authors Twinkle Sinha, K. Mugesh Kumar, P. Saishara (2015) in the paper about “SMART DUSTBIN, ” - A single directional cylinder is suspended next to the lid of dustbin. The piston is free to move up and down vertically inside the dustbin to a certain level. A plate is attached to the cylinder for compressing the garbage. The shape of this plate depends upon the shape of the dustbin. The compressing plate consists of a side hole through which the leaf switch is suspended upside down. The level of leaf switch is placed lower to the maximum level to which the compressing plate can reach down thus even after the switch gets pressed, garbage can be dumped in the dustbin to a certain extent.

In the paper “Smart dustbin for economic growth”, the authors U. Nagaraju, Ritu Mishra, Chaitanya Kumar, Rajkumar(2017) emphasized on the concept of smart dustbin which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. A GSM modem can be an external device or a PC Card / PCMCIA Card. An external GSM modem is connected to a computer through a serial cable or a USB cable. When a GSM modem is connected to a computer, this allows the computer to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile for internet connectivity, many of them can also be used for sending and receiving SMS and MMS message. GSM Modem sends and receives data through radio waves. In this project GSM 900 modem is used to send the messages. It consists of a GSM/GPRS modem with standard communication interfaces like RS-232 (Serial Port), USB, so that it can be easily connected to the other devices. The power supply circuit is also built in the module that can be turn ON by using a suitable adaptor.

In the paper titled “Smart Dustbin- An Intelligent Approach to Fulfill Swatchh Bharat Mission”, the authors Priyam Parikh, Dr. Rupesh Vasani, Akshar Rava (2017) had Interfaced RFID with Arduino UNO. Interfacing Serial LCD with Arduino. Sending AT

commands to GSM module. Decision making with the use of ultrasonic sensor. Common DC power supply designing. Implementing SPI communication in Arduino. Multiple Serial Port communication. Circuit Size Reduction. Providing PWM signals to Servo Motor.

Authors M.R. Sundarakumar, S. Naveen, S. Arun kumar, Kamal Kumar Ray (2017) in the paper “Smart dustbin – garbage monitoring system by efficient arduino based” have used ultrasonic sensors used to measure the garbage height. Arduino is used to connect all the modules for data transformation. By the GSM module the message will be sent to the user when the dust bin is full. Bluetooth module used to display the garbage height to the user mobile. Instead of normal battery the lithium battery and solar panel will be used because it can rechargeable.

In the paper “Smart Waste Bin with Real-Time Monitoring System” the authors Norfadzlia Mohd Yusof, Mohd Faizal Zulkifli, Nor Yusma Amira Mohd Yusof, Azziana Afifie Azman (2018) - As a guidelines for proposing the new framework for waste management system, several problems in waste management are considered:

1. Lack of information about the collecting time and area.
2. Lack of proper system to monitor the trucks and trash bins that have been collected in real time.
3. There is no estimation to the amount of solid waste inside the bin and the surrounding area due to the scattering of waste.
4. There is no quick response to urgent cases like truck accident, breakdown, longtime idling.
5. There is no quick way to response to client's complaints about uncollected waste.
6. There is no analysis of finding best route path of collecting waste.

The proposed confirmed able to provide solutions to all above problems. In this paper the framework is used to develop modules for problems 1, 2, 3 and 5. This framework consists of three segments namely the solar power system, smart waste bin and control station. Each part is facilitates with subsystems that will execute different tasks. All these segments and subsystems will be further described in the following section.

In the paper titled “IoT based garbage monitoring using Arduino” the authors Md. Aasim Anwar, Prateek Sarkar, Rajeshwar Dutta, Md. Sadik Mohammad Mollick (2018) – have designed structure of the system is developed before implementation of circuit. Used advanced microcontroller called Arduino (ATmega8). It is in-built with many components like analog to digital converter, clock of 16 MHz, shift registers. In this project we put the ultrasonic sensor on top of the garbage bin/ dump. The output of the ultrasonic sensor is processed by the Arduino and the output is then sent to the GSM module which sends a text message to the concerned person. We have a threshold value of 5cm. Which means that if the distance of the sensor from the top of the garbage is less than 5cm, the output will come with a message that the basket is full? Also, a buzzer will ring if output is less than 5cm. The DHT11 sensor will show the temperature and the humidity.

In the paper “Smart Dustbin” authors namely Dr. Baidyanath Ram Prajapati (2018) – have designed a “Smart Dustbin” which is a GSM enabled bin which automatically detects the garbage level and sends message to respective municipal authorities updating the status of the bin. To make our adopted village Kachhera Warsabad, G.B. Nagar, UP clean and healthy using “Smart Dustbins”.

Authors Anilkumar C.S., Suhas G, Sushma S (2019) in the paper “A Smart Dustbin using Mobile Application” discussed that there is no moving dustbin available in the market. It makes work simple for physically challenged people and aged who are unable to use in the dustbin and also provides a solution for Inappropriate placement of dustbin in the surrounding. A Smart Dustbin using Mobile Application. None of the system contains real time tracking status of the fullness of the bins. No dust bins are present that can detect the odour caused by the bins.

In the paper “SMART DUSTBIN USING ARDUINO,” the authors Mamta Pandey, Anamika Gowala, Mrinal Jyoti Goswami, ChinmoySaikia and Dr. Dibyajyoti Bora. (2020) – Smart dustbin using arduino is an IOT based project. Here we are using arduino for code execution, for sensing we used ultrasonic sensor which will open lid and wait for few moment. It will bring drastic changes in terms of cleanliness with the help of technology. Everything is getting with smart technology for the betterment of human being. So this help in maintaining the environment clean with

the help of technology. It is a sensor based dustbin so it would be easy to access/use for any age group. Our aim is also to make it cost effective so that many numbers of people can get the benefit from this. And it should be usable to anyone and helpful for them.

2.2 INFERENCE FROM LITERATURE

From all the above Literature reviews it is clearly understood that there are various ideas suggested for the Smart dustbin concept and various ideas suggested to deal with the garbage collected. But from the user's point of view, the perspective varies. This system helps users to take responsible decisions by allowing them to act as a responsible citizen for not taking the waste management for granted, since it is a serious challenge that every country all around the world is facing. This can be achieved by providing the users with a GUI that gives them clear information about the location of every dustbin in the area. Even if one dustbin is full they can easily access another nearby dustbin by easily viewing the status and location of each dustbin in the GUI.

Another important facility that this system provides is the LED light indicator system. This helps all the users to understand the capacity of the dustbin and act accordingly. People who are using the dustbins, either literate or illiterate can understand the capacity of the dustbin and take decisions accordingly.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

The existing project work is the implementation of Automatic Garbage Fill Alerting system using Ultrasonic sensor, Arduino Uno, Buzzer and Wi-Fi module. This system assures the cleaning of dustbins soon when the garbage level reaches its maximum. It will take power supply with the help of Piezoelectric Device. If the dustbin is not cleaned in specific time, then the record is sent to the Sweeper or higher authority who can take appropriate action against the concerned contractor. This system also helps to monitor the fake reports and hence can reduce the corruption in the overall management system[6]. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. It ultimately helps to keep cleanliness in the society. A few drawbacks of the existing system are as follows[4].

- GPRS coordinates is not available to get the location of the dustbins.
- GUI could be used to easily visualization.
- Power constraints can be handled more efficiently.
- AI technology can be used to collect garbage from the filled dustbins first.

3.2 PROPOSED SYSTEM

From the existing system, this project advances in features like maps and the automatic lock of the lid and remote access. Nowadays, maps play a major importance in various applications like finding a shortest route among various others, distance, to locate a vehicle like cabs etc,. In this project, the maps are used to locate the dustbins and helps the respective authority to get quick and easy to the location. The locking system is used to avoid overflow of trash and the spreading of foul smell around the area.

Even after the dustbin is full, people may try to dispose trash into dustbin. But the dustbin is designed in such a way that the lid is locked. This may confuse the person, literate or illiterate, that the dustbin is malfunctioning. So, to alert the person that the

garbage is full, LED lights can be used. The LED lights has to be placed in the front, in a easily visible place. When the dustbin is full the LED light has to turn into red color. When the dustbin is not full the LED light has to turn into green color.

For the people in the control room to understand the status of the dustbin, a GUI is used. It can either be a website or an app. It should provide the garbage locations using maps and the status of the garbage. The application database also holds the details of the respective authorities and their details. Advantages of the proposed system are as follows.

- GPRS coordinates is available to get the location of the dustbins.
- GUI can be used for easy visualization.
- Power constraints is handled more efficiently.
- AI technology can be used to collect garbage from the filled dustbins first.

3.3 HARDWARE REQUIREMENTS

The most common set of requirements defined by any operating system or software application is the physical computer resources, also known as hardware. A hardware requirements list is often accompanied by a hardware compatibility list, especially in case of operating systems. The minimal hardware requirements are as follows,

1. PROCESSOR : INTEL CORE I5
2. RAM : 4GB
3. PROCESSOR : 2.4 GHZ
4. MAIN MEMORY : 4B RAM
5. PROCESSING SPEED : 600 MHZ
6. HARD DISK DRIVE : 1TB
7. KEYBOARD :104 KEYS
8. Arduino Uno
9. Ultrasonic sensor
10. IR sensor
11. Servo motor
12. GSM module SIM800L

- 13. SIM card
- 14. LED lights
- 15. GPRS module neo 6M.
- 16. Jumper wires (MTM/MTF/FTF)
- 17. 1k ohm resistors
- 18. 9V external batteries
- 19. 12V 1AMP adaptor
- 20. Bread board.

3.4 SOFTWARE REQUIREMENTS

Software requirements deals with defining resource requirements and prerequisites that needs to be installed on a computer to provide functioning of an application. These requirements are need to be installed separately before the software is installed. The minimal software requirements are as follows,

1. IDE : ARDUINO IDE
2. OPERATING SYSTEM :WINDOWS 10

3.5 FEASIBILITY STUDY

The subject of the study was an examination of the possibilities for improving the existing waste management system, reducing costs, increasing efficiency and increasing profits. In addition to the economic motives, a significant driving factor was also the improvement of waste management, which would, in turn, increase the protection of the environment.

By monitoring the availability of bins, it is possible to plan routes of the vehicles for discharging full bins without unnecessarily going to places of empty or half-empty bins, which would reduce fuel consumption and vehicle wearing (depreciation), and increase the effective work of workers and drivers. In addition, the company would have information on the possible disposal of recyclable waste, and could make the recasting of unprofitable and uneconomic placement courts. The aim of the study was to propose the introduction of the IoT concept in order to improve the waste management system.

CHAPTER 4

METHODOLOGIES

4.1 LANGUAGE DESCRIPTION

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, mac OS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program `avrdude` to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware. By default, `avrdude` is used as the uploading tool to flash the user code onto official Arduino boards. Arduino IDE is a derivative of the Processing IDE, however as of version 2.0, the Processing IDE will be replaced with the Visual Studio Code-based Eclipse Theia IDE framework.

4.2 ABOUT BLYNK APPLICATION

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

1. Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
2. Blynk Server - responsible for all the communications between the smart phone and hardware. You can use our Blynk Cloud or run your private Blynk server

locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

3. Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and outgoing commands.

4.2.1 Features of BLYNK application

- Similar API & UI for all supported hardware & devices
- Connection to the cloud using:
 - Wi-Fi
 - Bluetooth and BLE
 - Ethernet
 - USB (Serial)
 - GSM
- Set of easy-to-use Widgets
- Direct pin manipulation with no code writing
- Easy to integrate and add new functionality using virtual pins
- History data monitoring via Super-Chart widget
- Device-to-Device communication using Bridge Widget
- Sending emails, tweets, push notifications, etc.

You can find example sketches covering basic Blynk Features. They are included in the library. All the sketches are designed to be easily combined with each other.

4.3 IOT DEVICES USED

The IoT devices help in collecting very minute data from the surrounding environment. All of this collected data can have various degrees of complexities ranging from a simple temperature monitoring sensor or a complex full video feed.

A device can have multiple sensors that can bundle together to do more than just sense things.

4.3.1 Arduino UNO

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board[1].

- The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package. The Arduino is a microcontroller board based on the ATmega8. It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC to-DC adapter or battery to get started .The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter .Revision 2 of the Uno board has a resistor pulling the 8U2HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:
- Pin out: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage IOT BASED GARBAGE MONITORING SYSTEM USING ARDUINO provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.

- Stronger RESET circuit.
- AT mega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.



Fig 4.1. Arduino Uno Board.

Parameters For Arduino UNO Description

Microcontroller	Arduino UNO
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog Input Pins	6

DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32KB(ATmega328) of which 0.5KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16MHz
Length	68.6 mm
Width	53.4 mm
Weight	53gm

Table 4.1: Arduino UNO description.

4.3.2 Ultrasonic sensor

HC-SR04 is an ultrasonic sensor which is used for measuring the distance between the top of the lid to the top of the garbage.

PIN NUMBER	PIN NAME	DESCRIPTION
1.	VCC	The Vcc pin powers the sensor, typically with +5V
2.	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending

		US wave.
3.	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4.	GND	This pin is connected to the Ground of the system.

Table 2: Pins and Functioning of Ultrasonic sensor

The following are the features of Ultrasonic sensor:

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15ma
- Operating Frequency: 40Hz

The HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module. Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the

US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor[5].

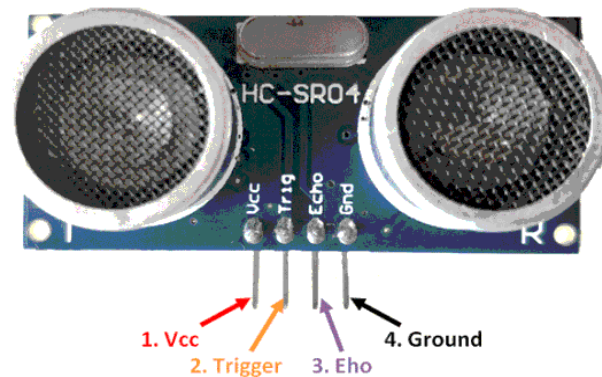


Fig 4.2: Ultrasonic sensor

4.3.3 Infrared sensor

An infrared (IR) sensor is an electronic device that measures and detects infrared radiation in its surrounding environment. Infrared radiation was accidentally discovered by an astronomer named William Herchel in 1800. While measuring the temperature of each color of light (separated by a prism), he noticed that the temperature just beyond the red light was highest. IR is invisible to the human eye, as its wavelength is longer than that of visible light (though it is still on the same electromagnetic spectrum). Anything that emits heat (everything that has a temperature above around five degrees Kelvin) gives off infrared radiation.

There are two types of infrared sensors: active and passive. Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is detected by the receiver. Active IR sensors act as proximity sensors, and they are commonly used in obstacle detection systems (such as in robots).

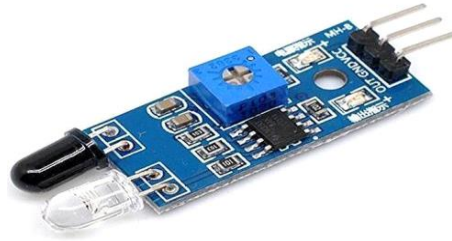


Fig 4.3: IR sensor

4.3.4 Servo motor

A servo motor is a motor whose shaft turns to position something based off a control signal. They are typically used to steer remote control airplanes by adjusting the wing flaps, flight position for drones, controlling valves used in flow control or continuous drive of wheels for robots. They can be used to position or adjust almost anything you can think of. They consist of a plastic housing which contains a DC motor, a control circuit and a few gears for torque.

Servo motor control of the shaft position comes from using a pulse width modulation signal (PWM) to turn the shaft clockwise or counter clockwise, depending on the pulse width of the signal. Typically, a pulse width of 1 ms will rotate the shaft clockwise and a 2 ms pulse will rotate the shaft counter clockwise. To position the shaft $\frac{1}{2}$ way, or in the middle, a 1.5 ms pulse typically works. You will need 20 ms between each pulse.



Fig 4.4: Servo motor

4.3.5 GSM module SIM800L

SIM800L is a miniature cellular module which allows for GPRS transmission, sending and receiving SMS and making and receiving voice calls. Low cost and small footprint and quad band frequency support make this module perfect solution for any project that require long range connectivity. After connecting power module boots up, searches for cellular network and login automatically. On board LED displays connection state (no network coverage - fast blinking, logged in - slow blinking).

This module have two antennas included. First is made of wire (which solders directly to NET pin on PCB) - very useful in narrow places. Second - PCB antenna - with double sided tape and attached pigtail cable with IPX connector. This one have better performance and allows to put your module inside a metal case - as long the antenna is outside. The following are the specifications of the GSM module.

- Supply voltage: 3.8V - 4.2V
- Recommended supply voltage: 4V
- Power consumption:
 - sleep mode < 2.0mA
 - idle mode < 7.0mA
 - GSM transmission (avg): 350mA
 - GSM transmission (peek): 2000mA
- Module size: 25 x 23 mm
- Interface: UART (max. 2.8V) and AT commands
- SIM card socket: micro SIM (bottom side)
- Supported frequencies: Quad Band (850 / 950 / 1800 /1900 MHz)
- Antenna connector: IPX
- Status signaling: LED
- Working temperature range: -40 do + 85 ° C

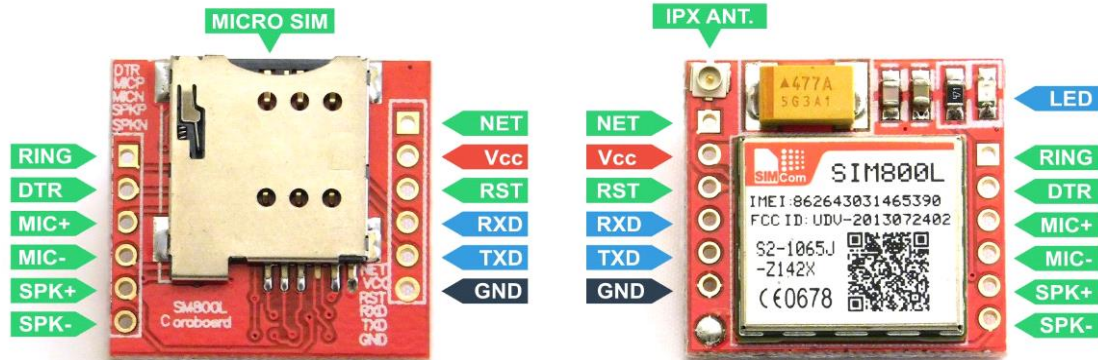


Fig 4.5: SIM800L module pin-out diagram.

- RING (not marked on PBC, first from top, square) - LOW state while receiving call
- DTR - sleep mode. Default in HIGH state (module in sleep mode, serial communication disabled). After setting it in LOW the module will wake up.
- MICP, MICN - microphone (P + / N -)
- SPKP, SPKN - speaker (P + / N -)
- NET - antenna
- VCC - supply voltage
- RESET - reset
- RXD - serial communication
- TXD - serial communication
- GND – ground

4.3.6 GPS module NEO-6M

[10]At the heart of the module is a NEO-6M GPS chip from u-blox. The chip measures less than the size of a postage stamp but packs a surprising amount of features into its little frame.



Fig 4.6: [10]NEO – 6M GPS CHIP

It can track up to 22 satellites on 50 channels and achieves the industry's highest level of sensitivity i.e. -161 dB tracking, while consuming only 45mA supply current.

[10]Unlike other GPS modules, it can do up to 5 location updates a second with 2.5m Horizontal position accuracy. The u-blox 6 positioning engine also boasts a Time-To-First-Fix (TTFF) of under 1 second.

[10]One of the best features the chip provides is Power Save Mode(PSM). It allows a reduction in system power consumption by selectively switching parts of the receiver ON and OFF. This dramatically reduces power consumption of the module to just 11mA making it suitable for power sensitive applications like GPS wristwatch.

[10]The necessary data pins of NEO-6M GPS chip are broken out to a 0.1" pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate from 4800bps to 230400bps with default baud of 9600.

Receiver Type	50 channels, GPS L1(1575.42Mhz)
Horizontal Position Accuracy	2.5m
Navigation Update Rate	1HZ (5Hz maximum)
Capture Time Cool start:	27sHot start: 1s
Navigation Sensitivity	-161dBm

Communication Protocol	NMEA, UBX Binary, RTCM
Serial Baud Rate	4800-230400 (default 9600)
Operating Temperature	-40°C ~ 85°C
Operating Voltage	2.7V ~ 3.6V
Operating Current	45mA
TXD/RXD Impedance	510Ω

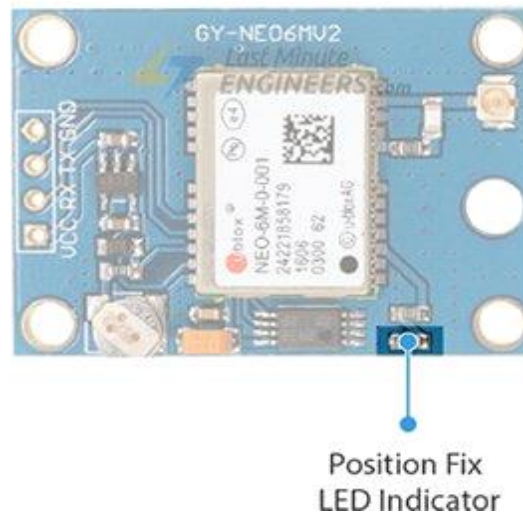


Fig 4.7: [10]Position fix LED indicator.

[10]There is an LED on the NEO-6M GPS Module which indicates the status of Position Fix. It'll blink at various rates depending on what state it's in:

No Blinking – It's searching for satellites.

Blink every 1s – Position Fix is found(The module can see enough satellites).

3.3V LDO Regulator

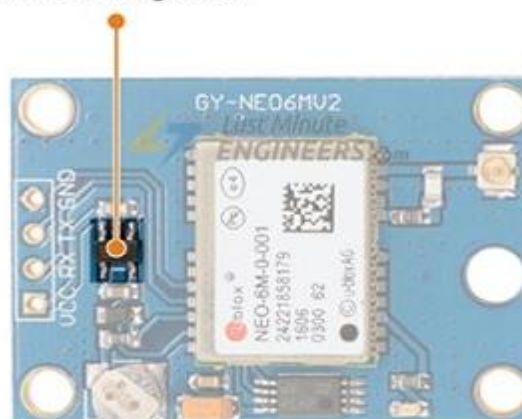


Fig 4.8: [10]3.3V LDO regulator

The operating voltage of the NEO-6M chip is from 2.7 to 3.6V. But the good news is that, the module comes with MIC5205 ultra-low dropout 3V3 regulator from MICREL. The logic pins are also 5-volt tolerant, so we can easily connect it to an Arduino or any 5V logic microcontroller without using any logic level converter.

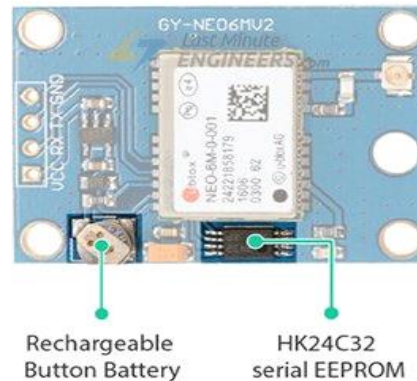


Fig 4.9: [10]Battery and EEPROM

[10]The module is equipped with an HK24C32 two wire serial EEPROM. It is 4KB in size and connected to the NEO-6M chip via I2C. The module also contains a rechargeable button battery which acts as a super-capacitor.

[10]An EEPROM together with battery helps retain the battery backed RAM (BBR). The BBR contains clock data, latest position data(GNSS orbit data) and module configuration. But it's not meant for permanent data storage.

[10]As the battery retains clock and last position, time to first fix (TTFF) significantly reduces to 1s. This allows much faster position locks.

[10]Without the battery the GPS always cold-start so the initial GPS lock takes more time. The battery is automatically charged when power is applied and maintains data for up to two weeks without power.

[10]An antenna is required to use the module for any kind of communication. So, the module comes with a patch antenna having -161 dBm sensitivity.

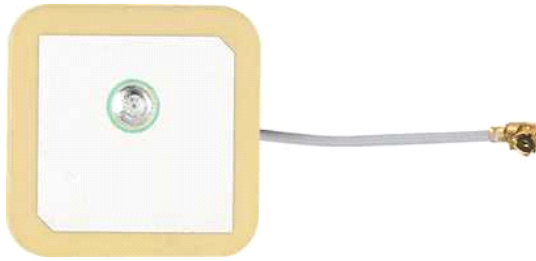


Fig 4.10: [10]GPRS antenna

You can snap-fit this antenna to small U.FL connector located on the module.

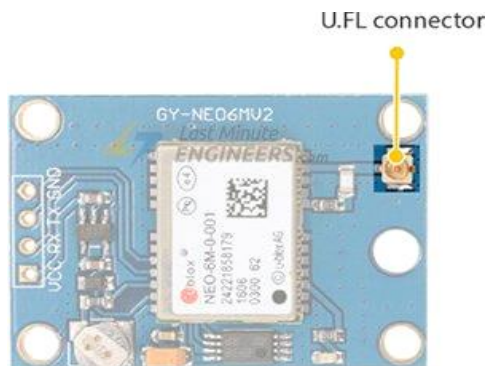


Fig 4.11: [10]U.FL connector

Patch antenna is great for most projects. But if you want to achieve more sensitivity or put your module inside a metal case, you can also snap on any 3V active GPS antenna via the U.FL connector.

The NEO-6M GPS module has total 4 pins that interface it to the outside world. The connections are as follows:

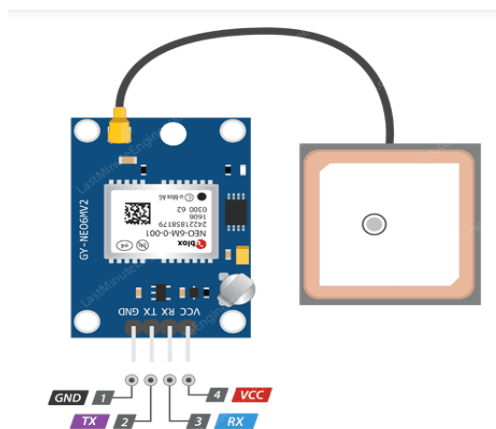


Fig 4.12: [10]NEO-6M GPS module pin-out

GND is the Ground Pin and needs to be connected to GND pin on the Arduino.

TxD (Transmitter) pin is used for serial communication.

RxD (Receiver) pin is used for serial communication.

VCC supplies power for the module. You can directly connect it to the 5V pin on the Arduino.

4.4 ARDUINO IDE:

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

4.4.1 Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog.

4.4.2 Tabs, multiple files and compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

4.4.3 Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Key span USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4,

COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be `/dev/ttyACMx`, `/dev/ttyUSBx` or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The boot loader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

4.4.4 Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more `#include` statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its `#include` statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

4.4.5 Third – party hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, boot loaders, and programmer definitions. To

install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

4.4.6 Serial monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

4.5 UML DIAGRAMS

UML stands for Unified Modeling Language. UML is a standardized general-purpose modeling language in the field of object-oriented software engineering. The standard is managed, and was created by, the Object Management Group.

- The goal is for UML to become a common language for creating models of object oriented computer software. In its current form UML is comprised of two major components: a Meta-model and a notation. In the future, some form of method or process may also be added to; or associated with, UML.
- The Unified Modeling Language is a standard language for specifying, Visualization, Constructing and documenting the artifacts of software system, as well as for business modeling and other non-software systems.
- The UML represents a collection of best engineering practices that have proven successful in the modeling of large and complex systems.
- The UML is a very important part of developing objects oriented software and the software development process. The UML uses mostly graphical notations to express the design of software projects.

4.5.1 Goals

The Primary goals in the design of the UML are as follows:

- Provide users a ready-to-use, expressive visual modeling Language so that they can develop and exchange meaningful models.
- Provide extensibility and specialization mechanisms to extend the core concepts.
- Be independent of particular programming languages and development process.
- Provide a formal basis for understanding the modeling language.
- Encourage the growth of OO tools market.
- Support higher level development concepts such as collaborations, frameworks, patterns and components.
- Integrate best practices.

4.5.2 System architecture diagram

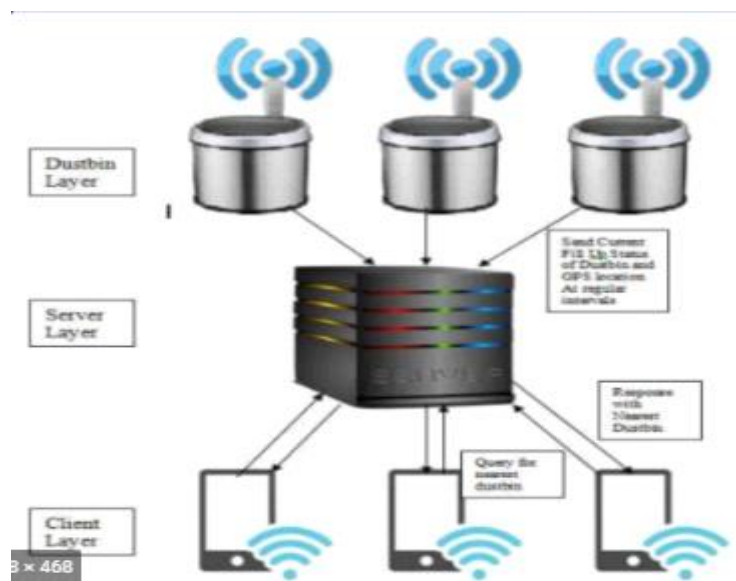


Fig 4.13. System Architecture diagram

4.5.3 Block diagram

A block diagram is a diagram of a system in which the principal parts or functions are represented by blocks connected by lines that show the relationships of the blocks.

They are heavily used in engineering in hardware design, electronic design, software design, and process flow diagrams.

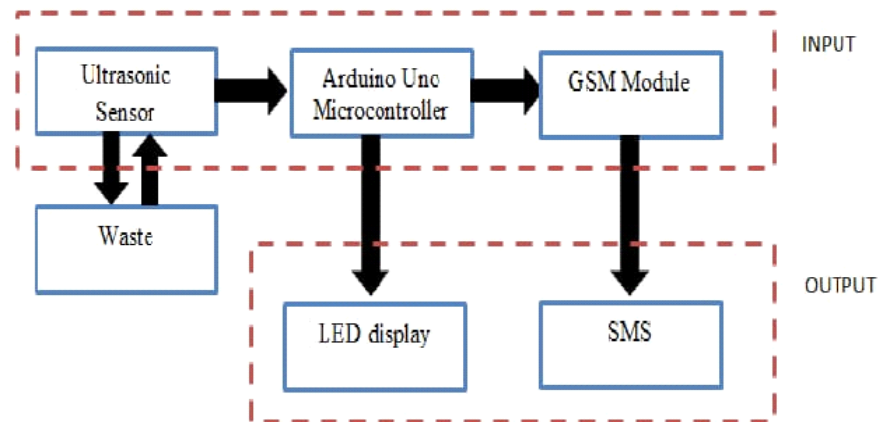


Fig 4.14: Block diagram

4.5.4 Sequence diagram

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

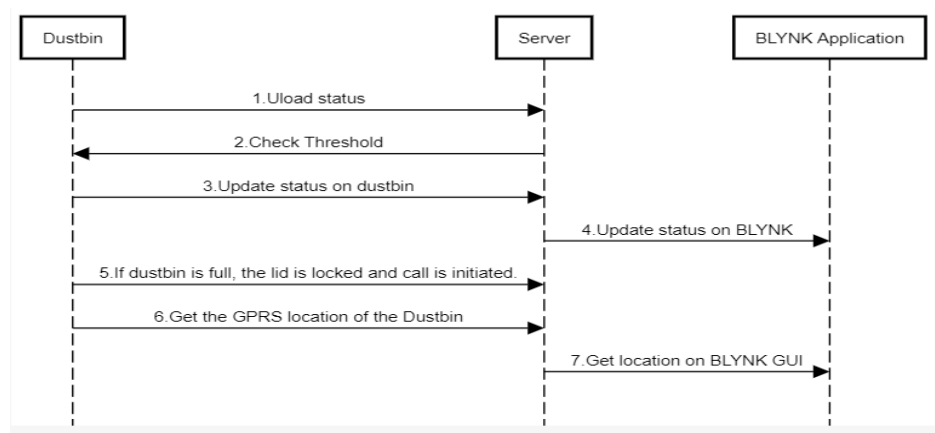


Figure 4.15: Sequence diagram.

4.5.5 Flow chart

A flowchart is a picture of the separate steps of a process in sequential order. It is a generic tool that can be adapted for a wide variety of purposes, and can be used to

describe various processes, such as a manufacturing process, an administrative or service process, or a project plan.

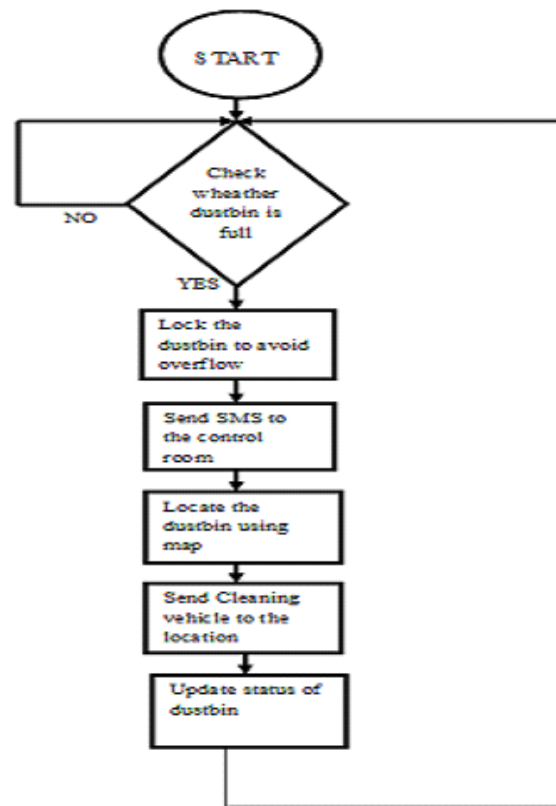


Fig 4.16: Flow chart

CHAPTER 5

RESULTS AND DISCUSSION

5.1 RESULTS

From the existing system, this project advances in features like maps and the automatic lock of the lid and remote access. Nowadays, maps play a major importance in various applications like finding a shortest route among various others, distance, to locate a vehicle like cabs etc,. In this project, the maps are used to locate the dustbins and helps the respective authority to get quick and easy to the location. The locking system is used to avoid overflow of trash and the spreading of foul smell around the area.

Even after the dustbin is full, people may try to dispose trash into dustbin. But the dustbin is designed in such a way that the lid is locked. This may confuse the person, literate or illiterate, that the dustbin is malfunctioning.

So, to alert the person that the garbage is full, LED lights can be used. The LED lights has to be placed in the front, in a easily visible place. When the dustbin is full the LED light has to turn into red color. When the dustbin is not full the LED light has to turn into green color.

For the people in the control room to understand the status of the dustbin, a GUI is used. It can either be a website or an app. It should provide the garbage locations using maps and the status of the garbage. The application database also holds the details of the respective authorities and their details.

The prototype of the idea is created for better understanding of the project. The images of empty, half filled and completely filled dustbins are below.

Empty Bin (0% capacity) (White LED is on HIGH):

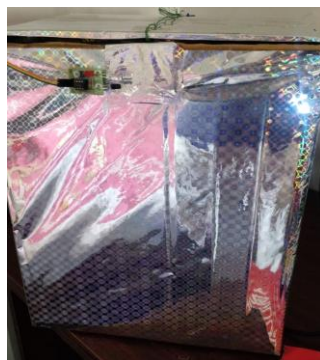


Fig 5.1: Empty bin

Half filled Bin (50% capacity) (White and Green LED is on HIGH):



Fig 5.2: Half filled bin.

Completely filled Bin (100% capacity) (White, Green and Red LED is on HIGH) :

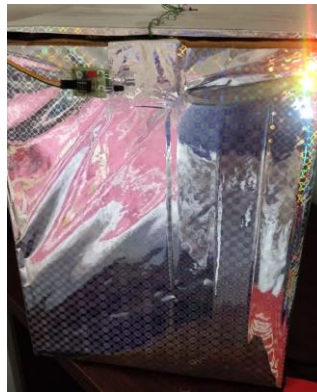


Fig 5.3: Completely filled bin

When the dustbin is empty, the locking system is OFF and the dustbin opens. When the dustbin is full, the locking system is ON and the dustbin does not open.

Empty dustbin with locking system on OFF (White LED is on HIGH) :



Fig 5.4: Empty dustbin with locking system on OFF

Completely filled dustbin with locking system on ON (White, Green and Red LED is on HIGH) :

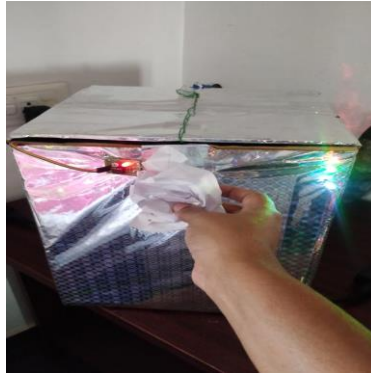


Fig 5.5: Completely filled dustbin with locking system on “ON”

When the dustbin is full, a call is sent to the control room by the GSM module. This is an indication of the completely filled dustbin. The authorities can take actions based on the call received from the respective bins.

Indication of completely filled bin by call using GSM module (White, Green and Red LED is on HIGH) :

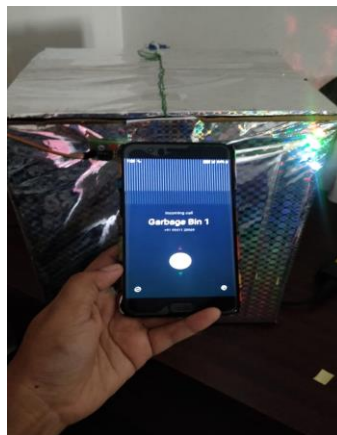


Fig 5.6: GSM module initiating calls

Here in this project, we use the application called **Blynk - IoT for Arduino, ESP8266/32, Raspberry Pi**. It helps us to connect our project in remote using Blynk server. This app connects to internet with the help of Wi-Fi in the smart phone rather than depending upon a separate Wi-Fi module. To connect the project to the internet, download the blynk application from the android play store. To connect this app to our

project, we need to install the necessary drivers and libraries in the Arduino IDE. To download the necessary drivers to be able to use Arduino Uno, open the Arduino IDE again, click on tools, boards, then boards manager.

In the search bar, search for " Intel curie boards". In that select the version as Arduino IDE and click on install to download the drivers.

Once the drivers are installed, we need to download the libraries. Some of the libraries that we need to run this project are WiFi101 library, Blynk library, Ultrasonic library and so on. All these libraries can be found in the Arduino IDE's built-in manager. To download the libraries, go to sketch, include libraries and library manager. In the search bar, search for the required libraries to run the project.

After installing all the necessary drivers and libraries, open the Blynk app and create a new project by entering the project name, device type, connection type and theme.

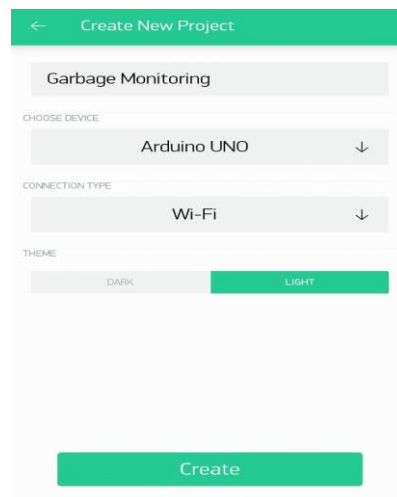


Fig 5.7: BLYNK - Create new project.

Once creating the project, add the necessary widgets on the screen. In this project I have used 3 LEDs to know the level of the garbage filled in the dustbin and a Map to locate the dustbin. The LEDs are Green, Orange and Red indicators which represents empty(0%), half filled(50%) and completely filled(100%) dustbin. Once the capacity of the dustbin reaches the threshold level, all the LEDs will glow.

To connect the Arduino IDE and the Blynk project, we need to use the Authentication token which we will receive once after creating the project. Mention the Authentication token in the code to allow communication between the Arduino IDE and the Blynk server.

Empty Bin (0% capacity):

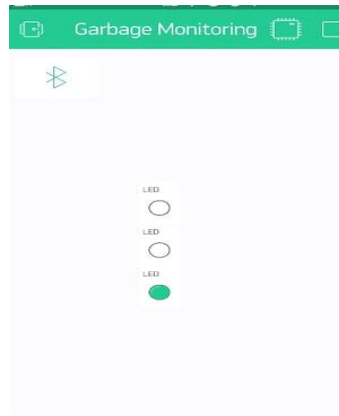


Fig 5.8: BLYNK - Empty bin

Half filled Bin (50% capacity):

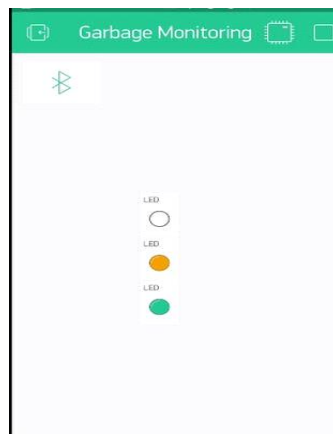


Fig 5.9: BLYNK - Half filled bin

Completely filled Bin (100% capacity):

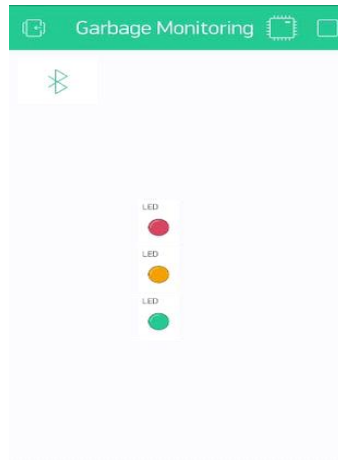


Fig 5.10: BLYNK - Completely filled bin

To access the maps through remote access, the map widget is used. To get the exact location of the Dustbin, get the coordinates from the GPRS module from the IDE and feed it to the Blynk app to get it on maps.

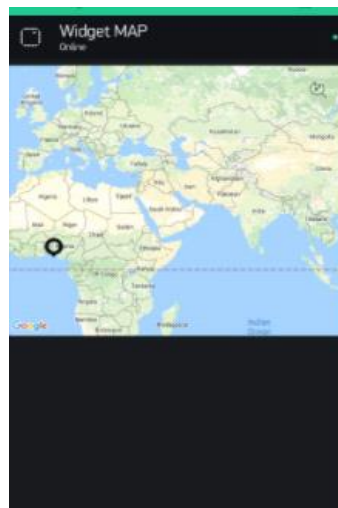


Fig 5.11: BLYNK - Maps



Fig 5.12: BLYNK - Shows the location of the filled dustbins

5.2 COMPARISON GRAPH

SENSOR READING (cm)	ACTUAL READING (cm)
10	9
15	15
20	19
25	26
35	36
40	39

Table 5.1: Ultrasonic sensor, distance reading vs actual readings

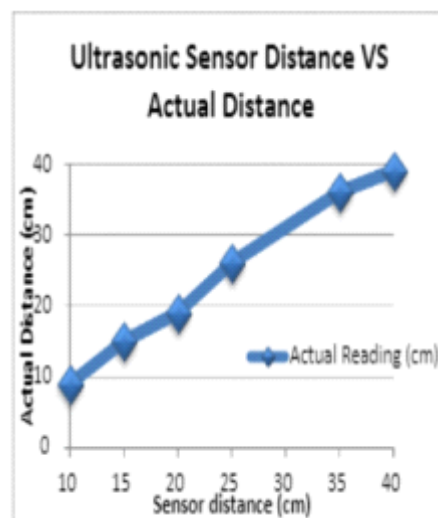


Fig 5.13: Graph of Sensor distance vs actual distance

CHAPTER 6

CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

This project helps us to keep the area neat and clean. This system also helps to monitor if the authorities are doing the allotted work in their region. This system reduces the total number of trips of garbage collection vehicle as the system alerts once the dustbin is full and locates the area using maps. Hence it reduces the overall expenditure associated with the garbage collection. Since the LED lights (red and green) are used, literate or the illiterate will be able to understand the status of the dustbin. We can also help domestic animals like dogs, cats, goats, cows etc from eating plastics. Therefore this system is used to create a clean environment with efficient trash management system.

6.2 FUTURE WORK

The smart dustbins can be made more smarter by enhancing some more features like inter – connection and communication among the dustbins using IOT. The dustbin can also be designed in such a way that one large bin must have various divisions to segregate all the trash. Trash can be separated when disposal as liquid waste, decomposable waste, non decomposable waste. This can also be done using moisture sensor. By this, the management of waste will become much more easier.

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APPENDICES

A. SAMPLE CODE

SMART DUSTBIN.INO:

```
#include<Servo.h>
#include <TinyGPS++.h>
#include <SoftwareSerial.h>

#include <BlynkSimpleCurieBLE.h>
#include <CurieBLE.h>
#include <Ultrasonic.h>
static const int RXPin = 4, TXPin = 3;
static const uint32_t GPSBaud = 4800;
// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "1v5DITTeQRy7rHDTek0-oCn2DpYHYuG1";
#define BLYNK_PRINT Serial
BLEPeripheral blePeripheral;
WidgetLED green(V1);
WidgetLED orange(V2);
WidgetLED red(V3);

SoftwareSerial sim(5, 6);

int _timeout;
String _buffer;
String number = "+919941144517"; //-> change with your number
Servo motor1;
const int trig = 9;
const int echo = 10;

const int LED1 = 11;
```

```

const int LED2 = 12;
const int LED3 = 13;

int duration = 0;
int distance = 0;
TinyGPSPlus gps;

// The serial connection to the GPS device
SoftwareSerial ss(RXPin, TXPin);
void setup()
{
  pinMode(4,INPUT);
  motor1.attach(3);
  motor1.write(10);

  pinMode(trig , OUTPUT);
  pinMode(echo , INPUT);

  pinMode(LED1 , OUTPUT);
  pinMode(LED2 , OUTPUT);
  pinMode(LED3 , OUTPUT);

  Serial.begin(9600);
  _buffer.reserve(50);
  sim.begin(9600);

  Serial.begin(9600);
  delay(1000);

  blePeripheral.setLocalName("garbage");
  blePeripheral.setDeviceName("garbage");

```

```

    blePeripheral.setAppearance(384);
    Blynk.begin(blePeripheral, auth);
    blePeripheral.begin();
    Serial.println("Waiting for connections...");

    Serial.begin(115200);
    ss.begin(GPSBaud);

    Serial.println(F("DeviceExample.ino"));
    Serial.println(F("A simple demonstration of TinyGPS++ with an attached GPS
module"));
    Serial.print(F("Testing TinyGPS++ library v. "));
Serial.println(TinyGPSPlus::libraryVersion());
    Serial.println(F("by Mikal Hart"));
    Serial.println();
}
void loop()
{
    int x = digitalRead(4);
    delay(1000);
    if( x==1)
    {
        if ( distance > 15 )
        {
            motor1.write(360);
            delay(3000);
        }
    }
    else
    {
        motor1.write(10);
    }
}

```

```

}
digitalWrite(trig , HIGH);
digitalWrite(trig , LOW);
duration = pulseIn(echo , HIGH);
distance = (duration/2) / 28.5 ;
if ( distance <= 15 )
{
    digitalWrite(LED1, HIGH);
    green.on();
    orange.on();
    red.on();
    Serial.println(3);
}
else
{
    digitalWrite(LED1, LOW);
}
if ( distance <= 25 )
{
    digitalWrite(LED2, HIGH);
    green.on();
    orange.on();
    Serial.println(2);
}
else
{
    digitalWrite(LED2, LOW);
}
if ( distance <= 40 )
{
    digitalWrite(LED3, HIGH);

```

```

    green.on();
    Serial.println(1);
}
else
{
    digitalWrite(LED3, LOW);
}

if ( distance <= 15 )
{
    if (Serial.available() > 0)
    {
        callNumber();
    }
    if (sim.available() > 0)
    Serial.write(sim.read());
}
}

String _readSerial() {
    _timeout = 0;
    while (!sim.available() && _timeout < 12000 )
    {
        delay(13);
        _timeout++;
    }
    if (sim.available()) {
        return sim.readString();
    }
}

void callNumber() {
    sim.print (F("ATD"));

```

```

sim.print (number);
sim.print (F("\r\n"));
_buffer = _readSerial();
Serial.println(_buffer);
}
// This sketch displays information every time a new sentence is correctly encoded.
while (ss.available() > 0)
  if (gps.encode(ss.read()))
    displayInfo();

if (millis() > 5000 && gps.charsProcessed() < 10)
{
  Serial.println(F("No GPS detected: check wiring."));
  while(true);
}
}

void displayInfo()
{
  Serial.print(F("Location: "));
  if (gps.location.isValid())
  {
    Serial.print(gps.location.lat(), 6);
    Serial.print(F(", "));
    Serial.print(gps.location.lng(), 6);
  }
  else
  {
    Serial.print(F("INVALID"));
  }
  Serial.print(F(" Date/Time: "));
  if (gps.date.isValid())

```

```

{
    Serial.print(gps.date.month());
    Serial.print(F("/"));
    Serial.print(gps.date.day());
    Serial.print(F("/"));
    Serial.print(gps.date.year());
}
else
{
    Serial.print(F("INVALID"));
}
Serial.print(F(" "));
if (gps.time.isValid())
{
    if (gps.time.hour() < 10) Serial.print(F("0"));
    Serial.print(gps.time.hour());
    Serial.print(F(":"));
    if (gps.time.minute() < 10) Serial.print(F("0"));
    Serial.print(gps.time.minute());
    Serial.print(F(":"));
    if (gps.time.second() < 10) Serial.print(F("0"));
    Serial.print(gps.time.second());
    Serial.print(F("."));
    if (gps.time.centisecond() < 10) Serial.print(F("0"));
    Serial.print(gps.time.centisecond());
}
else
{
    Serial.print(F("INVALID"));
}
Serial.println();

```

B. PAPER PUBLICATION

SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION

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Abstract - At present, population rate in the main cities has increased tremendously. This has increased the production of waste. The management of huge volume of waste has become more difficult and challenging. The public dustbins are overflowing and have become nobody's concern. Due to the lack of responsibility of the corporation people, the overflowing garbage wastes have created unhygienic surroundings and foul smell. So, to overcome this issue, smart dustbin is designed. This smart dustbin is built on Arduino Uno board and is interfaced with GSM, GPRS and sensors. The sensors are used to check the threshold level of the dustbin. The threshold levels are already set. If the garbage hits the mentioned threshold level, continuous alert is sent to the respective authority until the garbage is recovered and the externally fixed LED is changed into red color. Once, the garbage from the bin cleared the LED changes to green color. This alert system is triggered by the sensors to the GSM modem. A time limit (say 24 hours) is given to respective authority, where if he/she fails the duty, the alert to the higher authority is sent. By this facility, the higher authority will be able to take action on the irresponsible workers. Features like maps are used to locate the dustbins which make the authority to reach the location easily. Connectivity among the dustbins are given to establish communication among the bins and provides smart system. Thus, the implementation of smart dustbins will create a hygienic society and will make the management of waste easy. The negligence of authorities and the public may be reduced. A clean and disease free environment can be created.

Keywords: Smart Dustbin, Blynk, Arduino Uno, GPRS, GSM, Locking System, LED indicator.

I. INTRODUCTION

The society, in the urge of transforming a city into smart city, has to work on various sectors. The main sector is the management of waste. So the smart dustbin concept has been evolved. Proper waste management is essential for the construction of sustainable cities. So without an effective and efficient waste management, the waste generated by both industrial and domestic users can cause high risk in health and highly harm the environment. In many countries, the disposal of garbage is very poorly done in rivers, streets or in open ground. The

advancements in IoT technologies bridges the gap between ubiquitous network-based devices and technologies that monitor and collect information from physical world observations to provide various services for a better living. So the smart waste bin is based on an IoT approach. The smart bin is created and demonstrated in a real solution. The data such as filling level of the dustbin, temperature, humidity, smell and various other necessary details can be collected from the sensors and processed. The processed data can be further studied to access and analyze the garbage management system.

This project involves the hardware components like Arduino Uno, Servo motors, connecting wires and batteries. It also inherits the concept of GSM for SMS and GPRS for Maps to locate the dustbin. The **Ultrasonic sensor** detects and evaluates the distance of the object. An **Infrared sensor** emits IR radiation in order to sense any action. An IR sensor detects the thermal radiation from other objects. The **Arduino Uno**, microcontroller board is equipped with digital and analog, input and output pins.. The board has 14 Digital pins, 6 Analog pins, and is programmable with the Arduino IDE using a USB cable. It is powered by the USB cable or an external battery as it accepts voltages from 7 to 20. A **Servomotor** is an actuator that provides precise control position, velocity and acceleration. The **Global System for Mobile Communications (GSM)** and **General Packet Radio Service (GPRS)** standards are used for data communication.

BLYNK APPLICATION - Blynk was designed for the IoT. It can control hardware remotely, it can display sensed data, store data, visualize the data. The three major components of BLYNK are Application, Server and Libraries.

II. LITERATURE SURVEY

Smart garbage bin concept is a highly debatable topic. IoT has led to the development of Smart dustbin concept. Each idea is mostly similar but varies with the technology used and the efficiency obtained from the model. Since the IoT plays a major role in our everyday life, it helps us to satisfy our daily needs by making things simple. At hardware level, the smart system is a garbage bin with IR sensor, Ultrasonic sensor, Servo motor, Arduino Uno micro-controller, GPRS module and GSM module for transmission of data. IoT enables connection among various devices worldwide using the cloud centric technology.

First, a single directional cylinder is suspended next to the lid of dustbin in [5]. The piston is free to move up and down vertically inside the dustbin to a certain level. A plate is attached to the cylinder for compressing the garbage. The shape of this plate depends upon the shape of the dustbin. The compressing plate consists of a side hole through which the leaf switch is suspended upside down.

A second IoT-based smart bin is proposed in [6] where the design is emphasized on the concept of smart dustbin which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. A GSM modem can be

an external device or a PC Card / PCMCIA Card. An external GSM modem is connected to a computer through a serial cable or a USB cable. When a GSM modem is connected to a computer, this allows the computer to communicate over the mobile network.

A third IoT based system in [7] had Interfaced RFID with Arduino UNO. Interfacing Serial LCD with Arduino. Sending AT commands to GSM module. Decision making with the use of ultrasonic sensor. Common DC power supply designing. Implementing SPI communication in Arduino. Multiple Serial Port communication. Circuit Size Reduction. Providing PWM signals to Servo Motor.

A fourth IoT based system in [8] has used ultrasonic sensors used to measure the garbage height. Arduino is used to connect all the modules for data transformation. By the GSM module the message will be sent to the user when the dust bin is full. Bluetooth module used to display the garbage height to the user mobile. Instead of normal battery the lithium battery and solar panel will be used because it can rechargeable.

In [9], Smart Dustbin is designed in which is a GSM enabled bin which automatically detects the garbage level and sends message to respective municipal authorities updating the status of the bin.

In [10], the authors discussed that there is no moving dustbin available in the market. It makes work simple for physically challenged people and aged who are unable to use the dustbin and also provides a solution for inappropriate placement of dustbin in the surrounding. A Smart Dustbin using Mobile Application. None of the system contains real time tracking status of the fullness of the bins. No dust bins are present that can detect the odor caused by the bins.

Smart dustbin using arduino in [11] is an IOT based project. Here we are using arduino for code execution, for sensing we used ultrasonic sensor which will open lid and wait for few moment. It will bring drastic changes in terms of cleanliness with the help of technology. Everything is getting with smart technology for the betterment of human being.

III. EXISTING SYSTEM

The existing project work is garbage alerting system using Ultrasonic sensor, Arduino Uno, Buzzer and Wi-Fi module. This system helps us by providing an alert when the dust bin is full. If the dustbin is not

cleared within the specific time given, the alert is sent to the higher authority who can take appropriate action against the concerned worker. This system provides flawless data and helps find if the worker is responsible or irresponsible. This data also helps in reducing the total number of trips taken by the garbage collection vehicle. Therefore, the existing system makes the garbage collection more efficient.

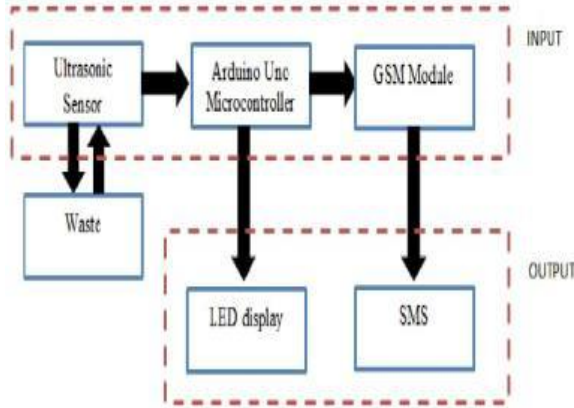


Fig.1. Block diagram of existing system.

From the above Literature reviews of the existing systems it is clearly understood that there are various ideas suggested for the Smart dustbin concept and various ideas suggested to deal with the garbage collected. But from the user's point of view, the perspective varies. This system helps users to take responsible decisions by allowing them to act as a responsible citizen for not taking the waste management for granted, since it is a serious challenge that every country all around the world is facing. This can be achieved by providing the users with a GUI that gives them clear information about the location of every dustbin in the area. Even if one dustbin is full they can easily access another nearby dustbin by easily viewing the status and location of each dustbin in the GUI.

IV. PROPOSED SYSTEM

From the existing system, this project advances in features like maps and the automatic lock of the lid and remote access. Nowadays, maps play a major importance in various applications like finding a shortest route among various others, distance, to locate a vehicle like cabs etc,. In this project, the maps are used to locate the dustbins and help the respective authority to get quick and easy to the location. The locking system is used to avoid overflow of trash and the spreading of foul smell around the area.

Even after the dustbin is full, people may try to dispose trash into dustbin. But the dustbin is designed in such a way that the lid is locked. This may confuse the person, literate or illiterate, that the dustbin is malfunctioning. So, to alert the person that the garbage is full, LED lights can be used. The LED lights have to be placed in the front, in an easily visible place. When the dustbin is full the LED light has to turn into red color. When the dustbin is not full the LED light has to turn into green color.

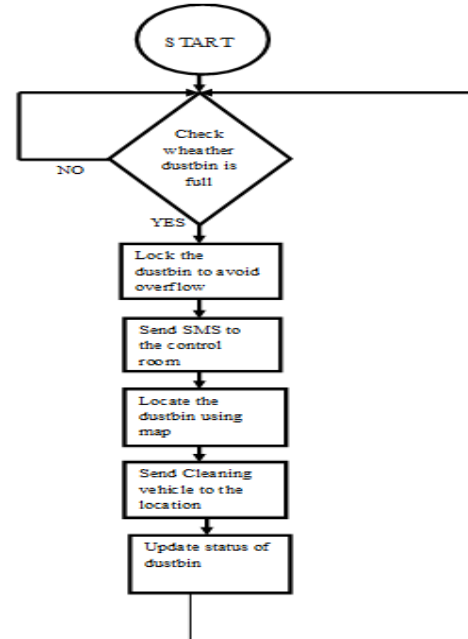


Fig.2. Sample Flow chart for the proposed system.

For the people in the control room to understand the status of the dustbin, a GUI is used. It can either be a website or an app. It should provide the garbage locations using maps and the status of the garbage. The application database also holds the details of the respective authorities and their details.

V. RESULT AND DISCUSSION.

The prototype of the idea is created for better understanding of the project. The images of half filled bin with locking system on OFF and completely filled bin with locking system on ON. When the dustbin is empty, the locking system is OFF and the dustbin opens. When the dustbin is full, the locking system is ON and the dustbin does not open.



Fig.3. Not completely filled dustbin with locking system on OFF
(White LED is on HIGH).



Fig.4. Completely filled dustbin with locking system ON
(White, Green and Red LED is on HIGH)

When the dustbin is full, a call is sent to the control room by the GSM module. This is an indication of the completely filled dustbin. The authorities can take actions based on the call received from the respective bins. In the search bar, search for "Intel curie boards". In that select the version as Arduino IDE and click on install to download the drivers.

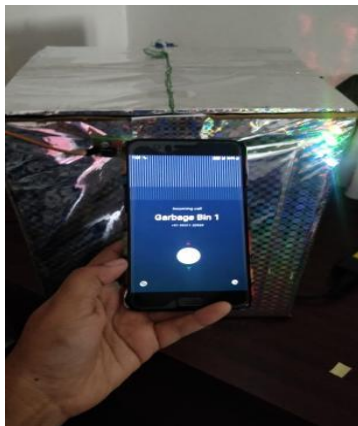


Fig.5. Indication of completely filled bin by call using GSM module (White, Green and Red LED is on HIGH)

Here in this project, we use the application called **Blynk - IOT for Arduino, ESP8266/32, Raspberry Pi**. It helps us to connect our project in remote using Blynk server. This app connects to internet with the help of Wi-Fi in the smart phone rather than depending upon a separate Wi-Fi module. To connect the project to the internet, download the blynk application from the android play store. To connect this app to our project, we need to install the necessary drivers and libraries in the Arduino IDE. To download the drivers to use Arduino Uno, open the Arduino IDE, click on tools, boards and then boards manager.

Once the drivers are installed, we need to download the libraries. Some of the libraries that we need to run this project are WiFi101 library, Blynk library, Ultrasonic libraries and so on. All these libraries can be found in the Arduino IDE's built-in manager. To download the libraries, go to sketch, include libraries and library manager. In the search bar, search for the required libraries to run the project.

After installing all the necessary drivers and libraries, open the Blynk app and create a new project by entering the project name, device type, connection type and theme.

Once creating the project, add the necessary widgets on the screen. In this project I have used 3 LEDs to know the level of the garbage filled in the dustbin and a Map to locate the dustbin. The LEDs are Green, Orange and Red indicators which represents empty(0% to 40%), half filled(41% to 90%) and completely filled(More than 90%) dustbin. Once the capacity of the dustbin reaches the threshold level, all the LEDs will glow.

To connect the Arduino IDE and the Blynk project, we need to use the Authentication token which we will receive once after creating the project. Mention the Authentication token in the code to allow communication between the Arduino IDE and the Blynk server.

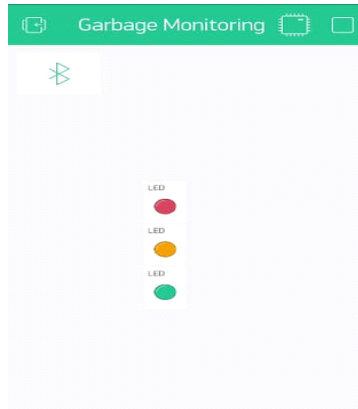


Fig.6. Blynk app: Screenshot of the status of the dustbin.

To access the maps remotely, the map widget is used. To get the exact location of the Dustbin, get the coordinates from the GPRS module from the IDE and feed it to the Blynk app to get it on maps.

SENSOR READING (cm)	ACTUAL READING (cm)
10	9
15	15
20	19
25	26
35	36
40	39

Table 1. Ultrasonic sensor distance Vs actual distance.

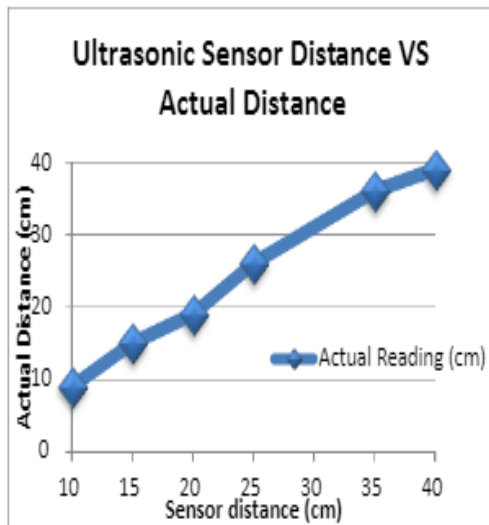


Fig.7. Ultrasonic sensor distance vs actual distance.

The distance is manually measured using a centimeter scale and then compared with the distance measured by the ultrasonic sensor. Distance formula is used to measure the ultrasonic sensor distance. On comparing, it is understandable that there is not a very huge difference in the measurements.

The advantages of the proposed system are as follows.

- ❖ The garbage will be collected on a time – to –time basis or as soon as possible.
- ❖ The dustbin is designed with a lid and so there are very less chances of foul smell in the surrounding area.
- ❖ The domestic animals might not disturb the garbage and this system would help them avoid consuming plastics from the garbage by mistake.
- ❖ Real time notifications using GSM and location using GPRS is given to the higher authorities to take immediate actions on the filled or repaired dustbins.
- ❖ As the system provides the location, the number of round trips to collect the garbage maybe reduced. Thus, saving the fuel and provides an efficient working system.

The disadvantages of the proposed system are as follows.

- ❖ The cost of implementation of IoT based projects is always high as it involves hardware devices.
- ❖ Each dustbin unit should be properly maintained as the IoT components play the important role in this system.
- ❖ Risk of data privacy and security is high.
- ❖ When the number of dustbins increases the design, development and maintenance is complicated.

VI. CONCLUSION

This project helps us to keep the area neat and clean. This system also helps to monitor if the authorities are doing the allotted work in their region. This system reduces the number of trips of garbage collection vehicle, as the system alerts once the dustbin is full and locates the area using maps. Hence it reduces the cost associated with the collection of garbage. Since the LED lights (red and green) are used, literate or the illiterate will be able to understand the status of the dustbin. We can also help domestic animals like dogs, cats, goats, cows etc from eating plastics. Therefore this system is used to create a clean environment with efficient trash management system.

VII. FUTURE ENHANCEMENT

The smart dustbins can be made smarter by enhancing some more features like inter – connection and communication among the dustbins using IOT. The dustbin can also be designed in such a way that one large bin must have various divisions to segregate all the trash. Trash can be separated when disposal as liquid waste, decomposable waste, non decomposable waste. This can also be done using moisture sensor. The garbage can be compressed using the compression plate to avoid the empty space that has not been utilized. By this, the management and transportation of waste will become much easier.

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C. PUBLICATION ACCEPTANCE LETTER

 ICOEI 2021	5th International Conference on Trends in Electronics and Informatics (ICOEI 2021) 3-5, June 2021 icoei.com/2021 icoei.conf@gmail.com
<u>Letter of Acceptance</u> To F. Annie Lincy, Dr. T. Sasikala, Department of Computer Science and Engineering, Sathyabama Institute of Science and Technology Chennai, India. Greetings!! On behalf of the SCAD College of Engineering and Technology Tirunelveli, we take great pleasure in inviting you to attend the “5th International Conference on Trends in Electronics and Informatics (ICOEI 2021)” which is going to be held during 3-5, June 2021 at Tirunelveli, India. We are glad to inform you that your submitted article entitled “SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION” [Paper id: ICOEI-0177] has been accepted for publication at ICOEI 2021. We welcome you to join us and share your research and views. This conference will offer you an unforgettable experience in exploring new opportunities. We look forward to seeing you at Tirunelveli, India. With Thanks, Yours' Sincerely  Dr. P. Ebby Darney, Principal, SCAD College of Engineering and Technology, Tirunelveli, TamilNadu, India.	
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SMART DUSTBIN MANAGEMENT USING IOT AND BLYNK APPLICATION

Annie Lincy. F, Sasthala. T.

5th International Conference on Trends in Electronics and Informatics (ICOEI 2021)

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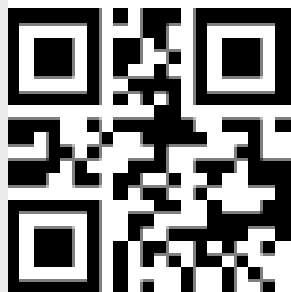
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