LET ME DO

A Project Report

Submitted in partial fulfilment of the

Requirements for the award of the Degree of

BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)

By

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Laxmi Charitable Trust's

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(Affiliated to University of Mumbai)

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MAHARASHTRA

2021-2022

PROFORMA FOR THE APPROVAL PROJECT PROPOSAL

PNR No.: …… Roll no.: xx

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2. Title of the Project

   LET ME DO

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4. Teaching experience of the Guide: 19 years

5. Is this your first submission? Yes

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CERTIFICATE

This is to certify that the project entitled, "**Let me Do**", is bonafied work of **ABHISHEK MEDATIYA and PRIYA THALARI** bearing Seat.No: **xxxx** submitted in partial fulfillment of the requirements for the award of degree of BACHELOR OF SCIENCE in INFORMATION TECHNOLOGY from University of Mumbai.

Internal Guide **Coordinator**

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Date: **College Seal**

ABSTRACT

Most of the days, the garbage bins are overflowing with excess waste and are scattered out in the road. These scattered wastes get either decayed or burnt therein place or overflows everywhere that ends up in serious health problems to humans. The wastes that are drop are separated by humans that ends up in health issues to them. To beat this downside a well organised waste segregation and monitoring system has been designed. It's an IoT based Waste Segregation and monitoring system that is an innovative way to keep the cities clean and healthy. Since the population of our world is increasing speedily, the surroundings should be clean and hygienical so as to lead a much better life. This is a model for Waste Segregation for smart cities.

ACKNOWLEDGEMENT

This project could not have been accomplished if not for the direct or indirect contribution from many known and unknown individuals. I wish to take this opportunity to express my sincere gratitude to all of them. I express my gratitude to my internal guide Mrs. Sneha Gokarnkar who gave me unending support from the stage the project was initiated. A source of inspiration, given by her constantly kept our spirits high, whenever I was dispirited. I would also like to thank our head of department Mrs. Sneha Gokarnkar as well as our director Mrs. Jyoti Gaitonde the foundation that I have been able to develop today owes much credit to them. Always ready to co-operate, they have been very kind in guiding us how to go about developing the successful project. I would even like to thank my college SHETH L.U.J. & SIR M.V. COLLEGE OF ARTS, SCIENCE & COMMERCE and all respected teachers and family. Above all I would like to thank first, the almighty who have given me inspiration and courage to accept it's a course of life.

DECLARATION

I hereby declare that the project entitled, "**Let me Do**" done at **SHETH L.U.J. & SIR M.V. COLLEGE OF ARTS, SCIENCE & COMMERCE**, has not been in any case duplicated to submit to any other university for the award of any degree. To the best of my knowledge other than me, no one has submitted to any other university.

The project is done in partial fulfilment of the requirements for the award of degree of **BACHELOR OF SCIENCE (INFORMATION TECHNOLOGY)** to be submitted as final semester project as part of our curriculum.

Abhishek & Priya

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Chapter 1

Introduction

Worldwide interest in smart Cities has raise, encourage by the requirement to seek out effective remedies to the major challenges expected for consecutive years. As one of the applications of smart town, Waste Management in a city could be a formidable challenge featured by the general public administrations. Waste is outlined as any material within which something valuable isn't getting used or isn't usable and represents no economic value to its owner, the waste generator. looking on the physical state of the waste, they are categorized as solid waste and wet waste.

Background

The garbage is collected from the streets, homes and different institutions on time unit basis, that isn't an efficient management system. Cleansing of garbage bin isn't done once it's required. In keeping with the recent survey, it's been calculated that garbage production in Republic of India is around 1.3 pounds per person each year. In developing countries, over 377M urban individuals board cities. They generate over 62M tonnes of municipal solid waste every year. Out of those only 43 million tonnes of the waste area unit collected by the municipality. Remainder of the wastes area unit left scattered within the streets thanks to poor maintenance of garbage bins. The normal method of manually observance the garbage bins is a complex, clumsy method and utilize a lot of human effort, time and value. The prevailing system haven't any correct designing concerning the gathering of garbage that makes the city or town unhygienic. Existing system don’t frequently update the amount and odour of the garbage bin to the authority. It intimates the municipality only through SMS alert. In some systems RFID tag and reader is used so whenever the garbage truck comes close to the bin it updates the present standing of the bin to the employee within the truck. The employee then cleans the bin once it's stuffed. This methodology contains a disadvantage of additional fuel consumption and time overwhelming too. The labours who are cleansing the dustbins are additionally not taking any responsibility that makes the system worse in pressing cases. correct observance of wastes is obligatory to run town clean and inexperienced. The conservative and manual garbage observance and assortment system is just on the market. The labours cannot always monitor the elevation and scent of

the ash-bin manually around all places of town. No web technology destined systems that is additional systematic, cost- effective and energy- economical exist.

Objective

The foremost goal of this project is to automatically segregate the wastes and to perceive the level of the dustbins which is delivered through wireless mesh network. With such information, litter bin providers and cleaning contractors are able to make better decision for the efficient disposal. IR sensor identifies the objects, Moisture sensors detects the wet waste. Ultrasonic sensor observes the levels of bin. The waste is dropped inside the bin where the sensor identifies the type of the waste. The bin consists of two partitions inside were each bin collects type of waste respectively. The motor then flaps and waste gets dumped into the partition and is collected.

Purpose, Scope, and Applicability

Purpose

Most of the days, the garbage bins are overflowing with excess waste and are scattered out in the road. These scattered wastes get either decayed or burnt therein place or overflows everywhere that ends up in serious health problems to humans. The wastes that are drop are separated by humans that ends up in health issues to them. To beat this downside a well organised waste segregation and monitoring system has been designed. It's an IoT based Waste Segregation and monitoring system that is an innovative way to keep the cities clean and healthy. Since the population of our world is increasing speedily, the surroundings should be clean and hygienical so as to lead a much better life. This is a model for Waste Segregation for smart cities.

Scope

Though the globe is in a stage of up gradation, there is one more drawback that has got to be prohibited. Garbage! Pictures of garbage bins being full and also the garbage being spilled out from the bins may be seen all around. This results in various diseases as large number of insects and mosquitoes breed on that. Safeguarding the environment using technology sources is required nowadays. Majority of the general public environment appears to be contaminated with the waste product Environmental issues are raised by modern cities for waste assortment and disposal.

A big challenge within the urban cities is solid waste management. Majority of viruses and microorganism infections develop in contaminated surroundings. Therefore, Let me Do is a system which might eradicate this drawback or scale back it to the minimum level. Smart segregator systems became essential for cities that aim to cut back value and manage resources and time. Optimizing the method of pickup is that the main purpose of the smart solutions provided by business. the aim of this work is to gift an economical smart dustbin for localized and small-scale cases, like small parks, university campus and hospitals.

The project "Let me Do" can contribute a lot towards clean and hygienic environment in building a smart city. It will also help in avoiding over flow of garbage in residential area. Since the technology is new in India, proper awareness should be created among the public before it is implemented on a large scale. Otherwise, sensitive devices like sensors might be damaged due to rough action of the users. Project implementation is done for a single bin. Integration of many bins each with unique id can be done by implementing principles of IOT. Database can be created for each bin by using SQL technology.

Applicability

Segregation at source

The new rules have mandated the source segregation of waste in order to channelise the waste to wealth by recovery, reuse and recycle. Waste generators would now have to know segregate waste into three streams- Biodegradables, Dry (Plastic, Paper, metal, Wood, etc.) and Domestic Hazardous waste (diapers, napkins, mosquito repellents, cleaning agents etc.) before handing it over to the collector.

Institutional generators, market associations, event organisers and hotels and restaurants have been directly made responsible for segregation and sorting the waste and manage in partnership with local bodies. In case of an event, or gathering of more than 100 persons at any licensed/ unlicensed place, the organiser will have to ensure segregation of waste at source and handing over of segregated waste to waste collector or agency, as specified by the local authority.

All hotels and restaurants will also be required to segregate biodegradable waste and set up a system of collection to ensure that such food waste is utilised for composting /bio methanation. The rules mandate that all resident welfare and market associations and gated communities with an area of above 5,00q m will have to segregate waste at

source into material like plastic, tin, glass, paper and others and hand over recyclable material either to authorised waste-pickers and recyclers or to the urban local body.

Collection and disposal of sanitary waste

The manufacturers or brand owners of sanitary napkins are responsible for awareness for proper disposal of such waste by the generator and shall provide a pouch or wrapper for disposal of each napkin or diapers along with the packet of their sanitary products.

Collect back scheme for packaging waste

As per the rules, brand owners who sale or market their products in packaging material which are non-biodegradable, should put in place a system to collect back the packaging waste generated due to their production.

Achievements

While working on this project, I gained some information regarding IoT technology and its various applicability in various sectors. And found the contribution that Let me Do is individually applicable in numerous sectors like public places, institutes, apartments, and household organizations.

Coding was most helpful for me, I got hands-on experience in coding the hardware components. Also discovered amazing facts and utilization about sensors and various sensing devices used in this project. Let me Do help me to obtain facts about cloud computing technology, with the help of this scheme I explored various cloud computing techniques used for IoT.

Organisation of Report

More, in this project statement, I will explain in detail the technology utilized and will also explain the hardware and software requirements of Let me Do and its system design with making scheme. The project report contains several diagrams, tables, and graphs for a better opinion of the topic. Also going to have a look at the implementation methods and various testing is done to accomplish the project objectives.

Chapter 2

Survey of technologies

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

Increasingly, organizations in a variety of industries are using IoT to operate more efficiently, better understand customers to deliver enhanced customer service, improve decision-making and increase the value of the business.

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments.

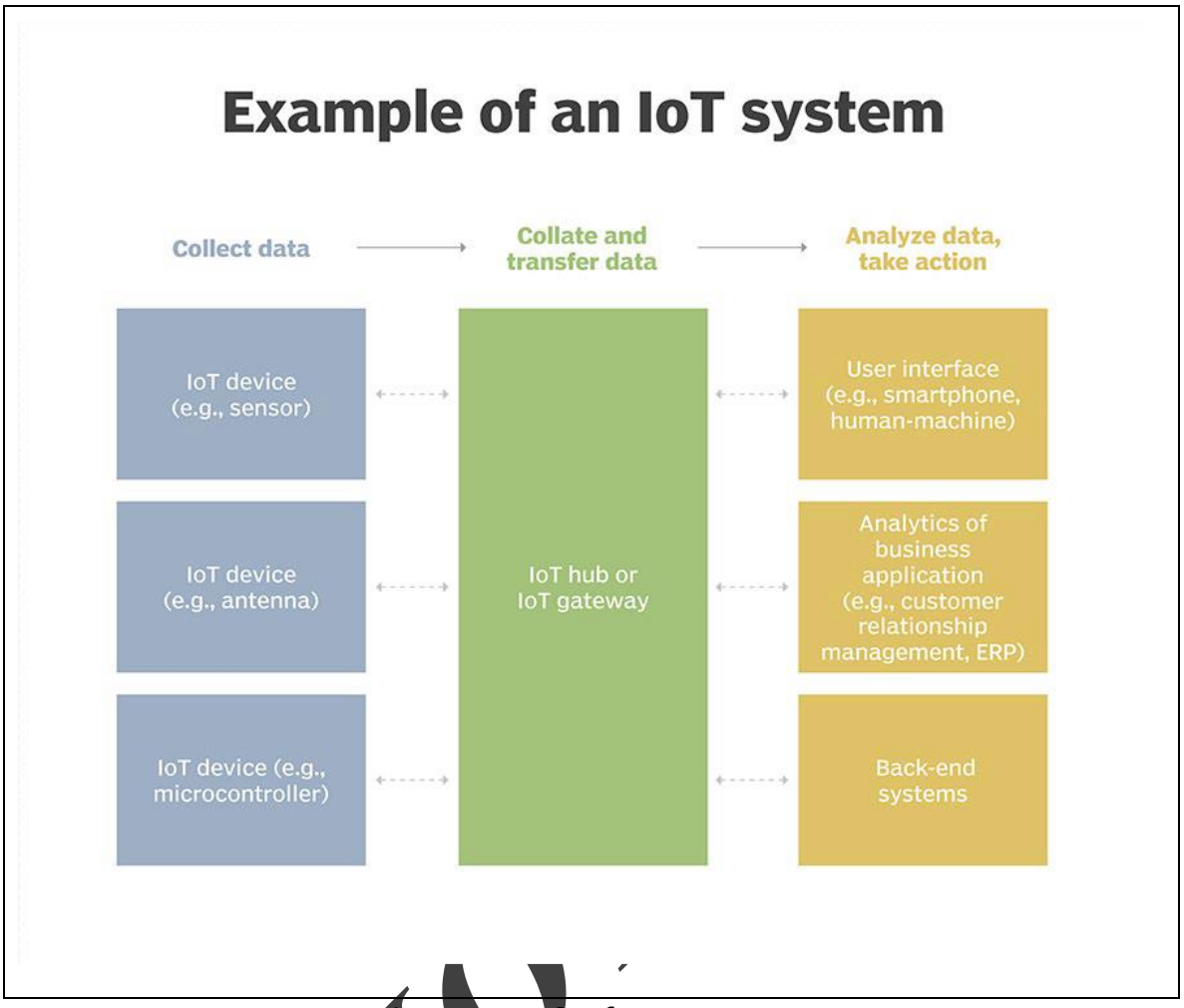

Fig 1: Example of IoT Ecosystem

IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analysed or analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the devices – for instance, to set them up, give them instructions or access the data. The connectivity, networking and communication protocols used with these web-enabled devices largely depend on the specific IoT applications deployed. IoT can also make use of artificial intelligence (AI) and machine learning to aid in making data collecting processes easier and more dynamic.

Chapter 3

Requirements and Analysis

Problem Definition:

While working on the Let me Do project was to get required parts at appropriate price to reduce the overall cost. Further problem was to manage and code for particular components (passing incorrect values may damage the component as well as the Arduino board.).

The segregation is done using man power. Many dumping yards are located near villages and due to unemployment peoples residing near dumping yard goes and collects plastics, metals and other reusable materials. As they are done with collection, they sell it to factories which recycles it and get themselves reward or paid. But dumping yard generates many harmful gases, they don't have proper disposal of it. Most recyclable waste ends up in a dump yard due to the lack of efficient waste management. People collecting reusable materials suffers from various diseases they risk their life just to earn sum amount of money.

Requirements Specification:

The project Let me Do is the formation of various hardware components. The following describes components to be required:

- Arduino UNO
- IR sensor
- Rain sensor
- Servo motor
- Ultrasonic sensors
- Gsm module
- Set of connecting cables
- Power supply
- Set of containers

Planning and Scheduling

The tricky part of project development signifies designing and planning so to standardize the project creation method I managed to create or divided the whole method into tasks which can be allotted so as to accomplish the goal. Throughout the designing and planning method, I succeed to rectify the errors which can appear throughout the Let me Do development program. In the process, I confirmed whether sufficient resources are available to bring out the plan or not.

	Task	Start date	End date	No. of days
1.	Topic Selection	22nd July 2021	2nd August 2021	11
2.	Survey of Technologies	2nd August 2021	10th August 2021	8
3.	Requirements Elicitation	10th August 2021	20th August 2021	10
4.	Designing	18th August 2021	05th September 2021	19
5.	Decertation	03rd September 2021	12th September 2021	10
6.	Assembling	20th September 2021	05th October 2021	16
7.	Coding	05th October 2021	01st December 2021	58
8.	Testing	01st December 2021	03rd February 2022	65
9.	Final Documentation	03rd February 2022	19th March 2022	41

Table 1: Planning and Scheduling tasks against No. of days

Gann Chart

A Gantt chart is a commonly used graphical depiction of a project schedule. It's a type of bar chart showing the start and finish dates of a project's elements such as resources, planning and dependencies.

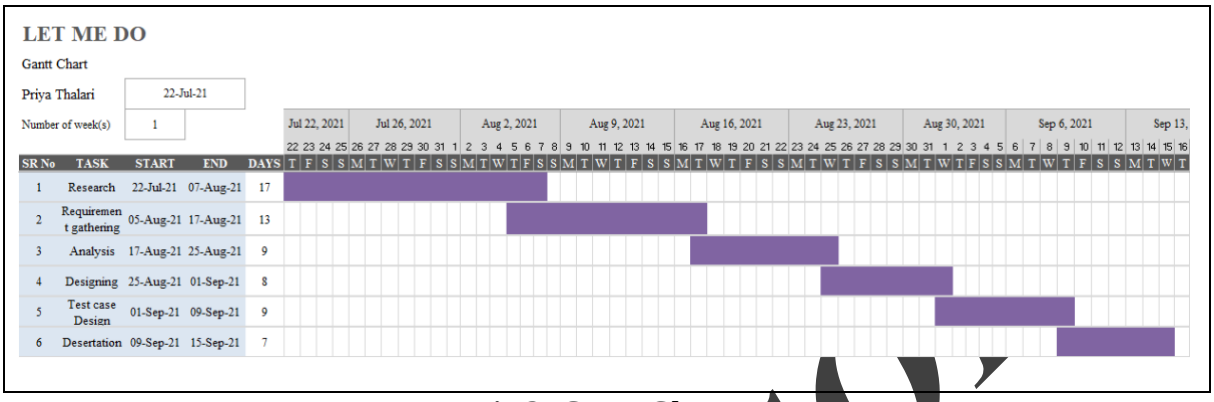

Fig 2: Gantt Chart 1

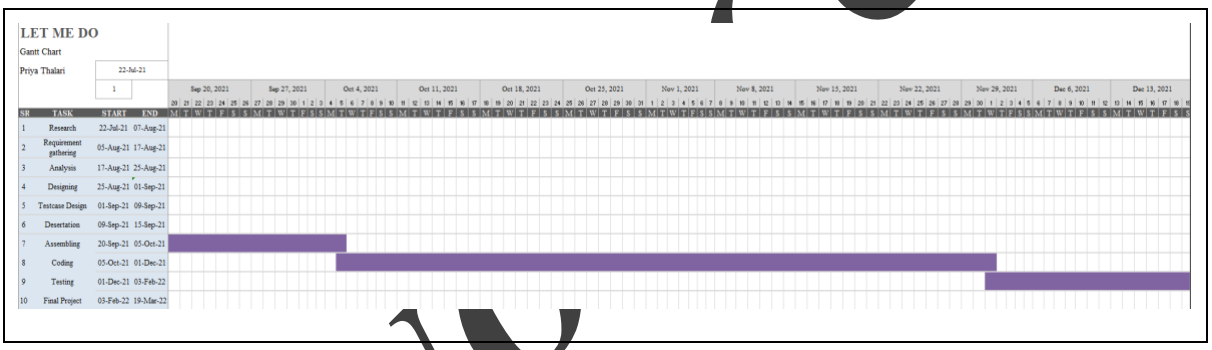

Fig 2.1: Gantt Chart 2

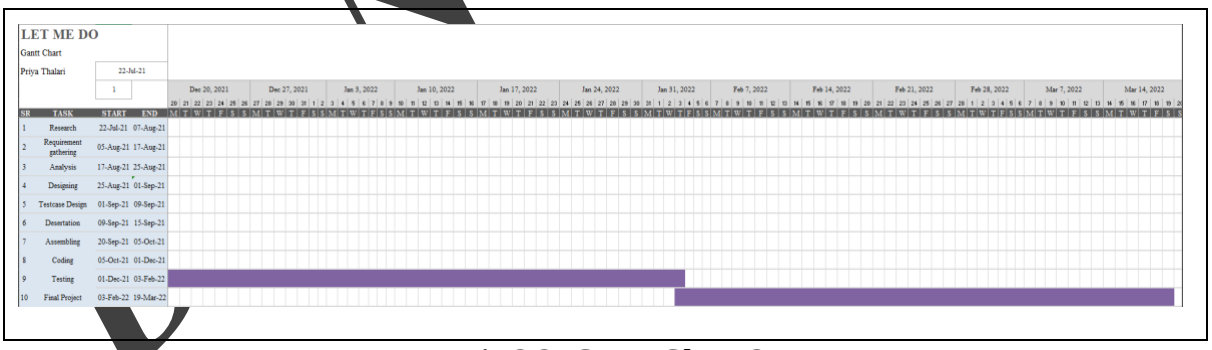

Fig 2.2: Gantt Chart 3

Pert Chart

A PERT chart is a project management tool that provides a graphical representation of a project's timeline. The Program Evaluation Review Technique (PERT) breaks down the individual tasks of a project for analysis. PERT charts are considered preferable to Gantt charts because they identify task dependencies, but they're often more difficult to interpret.

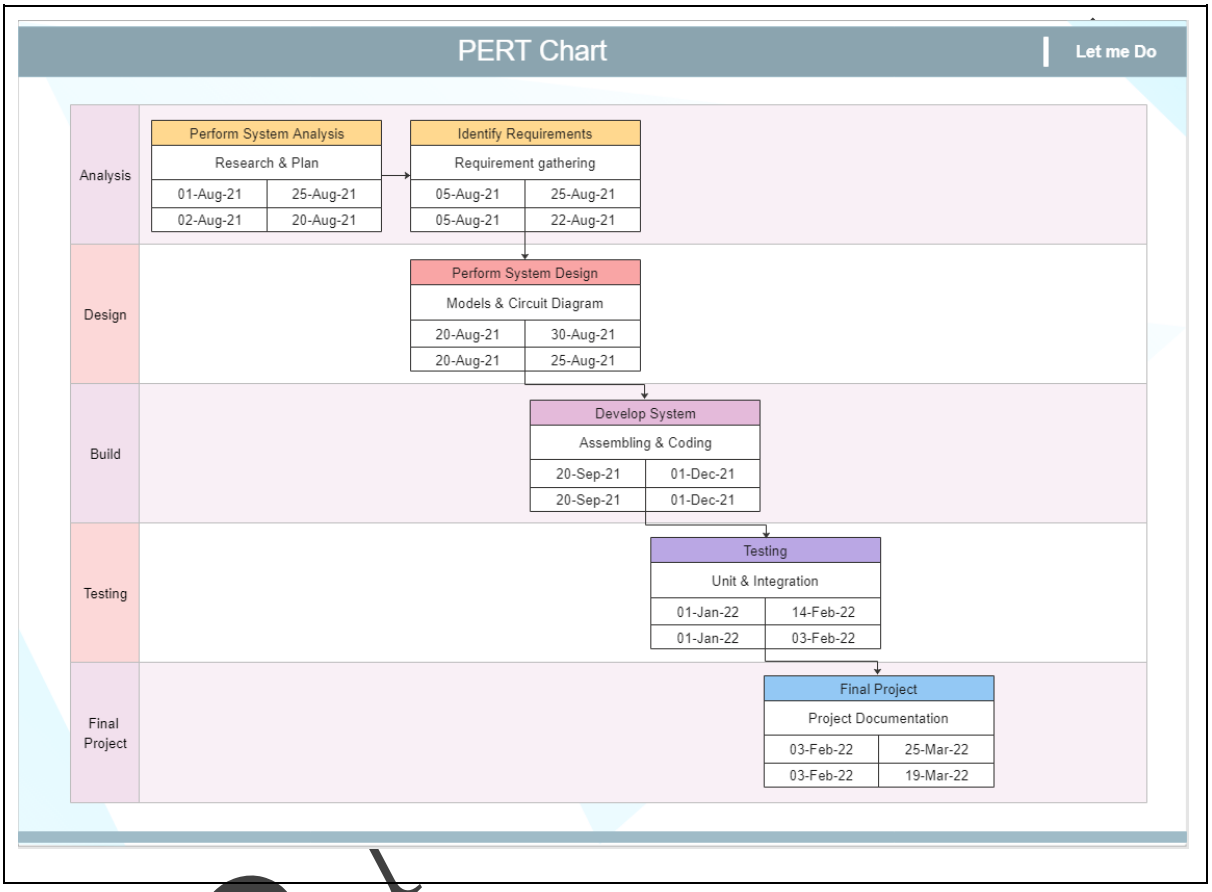

Fig 3: Pert Chart

Hardware and Software Requirements:

Following are the details of all the software and hardware needed for the development and implementation of the Let me Do project.

Hardware Requirement:

1. Arduino UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, 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 an AC-to-DC adapter or battery to get started. You can tinker with your UNO without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

Fig 4: Arduino Uno R3

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

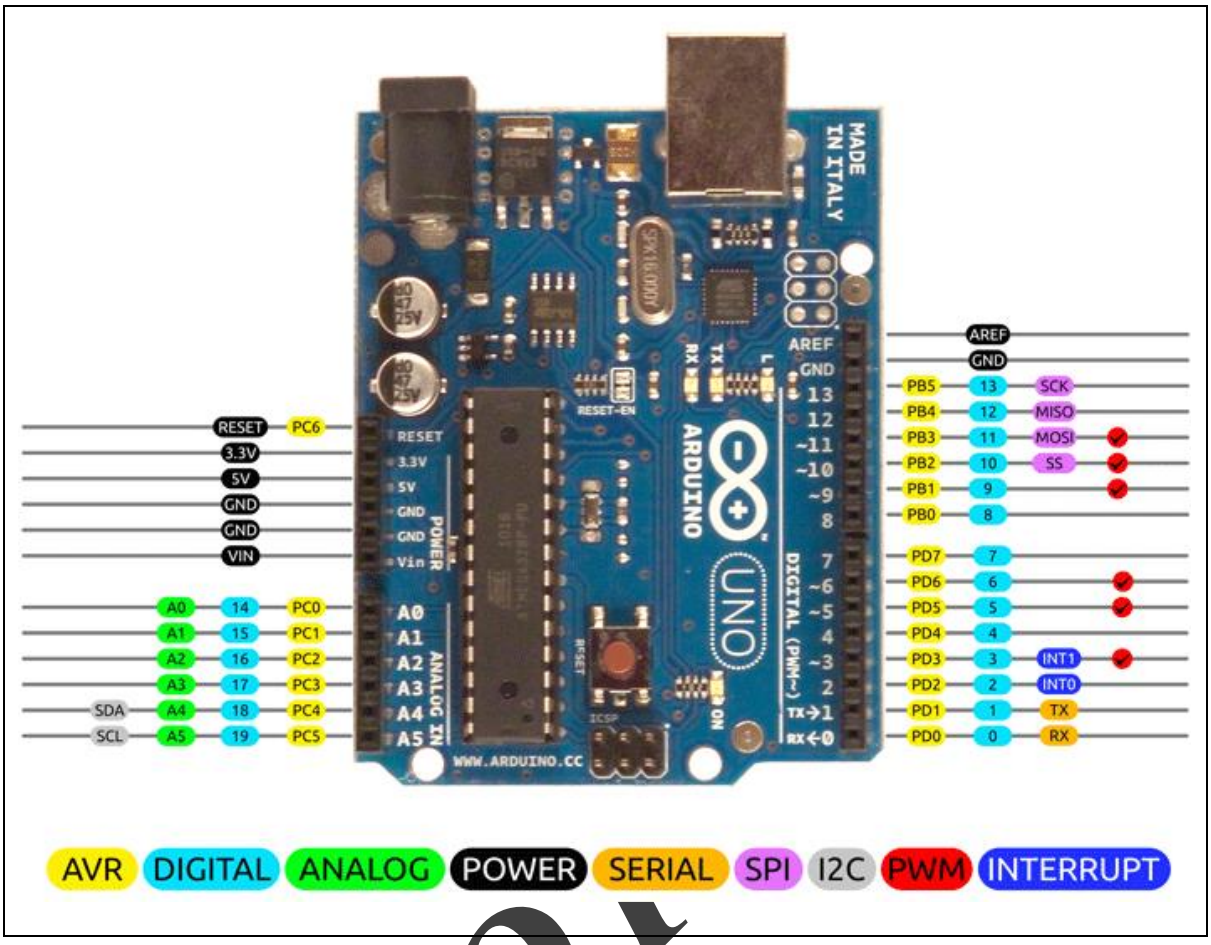

Fig. 4.1: Pin diagram

Arduino Uno Pinout Configuration

Pin Category	Pin Name	Details
Power	Vin	Input voltage to Arduino when using an external power source.
	3.3V	3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA.
	5V	Regulated power supply used to power microcontroller and other components on board.

	GND	Ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 – 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.

Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Table 2: Arduino pinout configuration.

2. IR Sensor

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings.

IR detectors are digital out - either they detect 38KHz IR signal and output low (0V) or they do not detect any and output high (5V). Photocells act like resistors, the resistance changes depending on how much light they are exposed to.

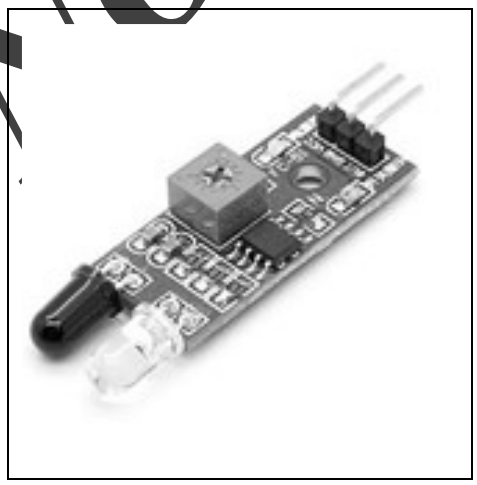

Fig. 5: IR Sensor

An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.

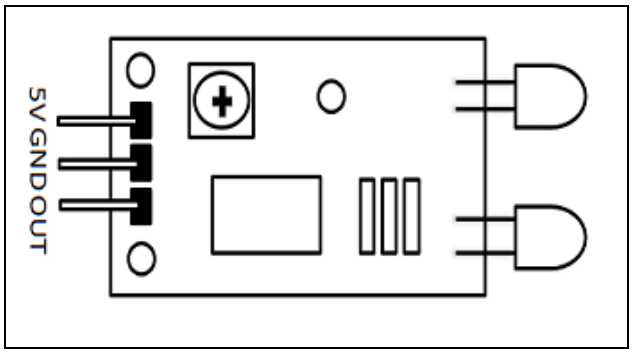

Fig. 5.1: IR Pin Configuration

IR Sensor Module Pinout Configuration

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

Table 3: IR Sensor Module Pinout Configuration

IR Sensor features

- 5VDC Operating voltage
- I/O pins are 5V and 3.3V compliant
- Range: Up to 20cm
- Adjustable Sensing range
- Built-in Ambient Light Sensor
- 20mA supply current
- Mounting hole

Applications

- Obstacle Detection
- Industrial safety devices

- Wheel encoder

3. Rain sensor

A rain sensor or rain switch is a switching device activated by rainfall. There are two main applications for rain sensors.

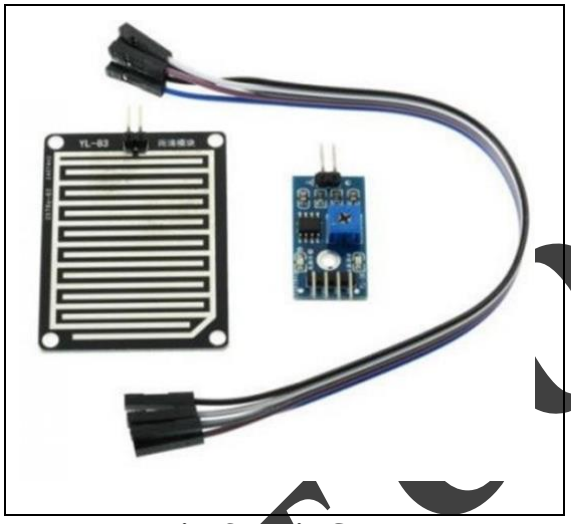

Fig. 6: Rain Sensor

The first is a water conservation device connected to an automatic irrigation system that causes the system to shut down in the event of rainfall. The second is a device used to protect the interior of an automobile from rain and to support the automatic mode of windscreen wipers. The sensor acts as a variable resistance that will change status: the resistance increases when the sensor is wet and the resistance is lower when the sensor is dry. The comparator has 2 outputs connected to the rain sensor, a digital output (0/1) and an analog output (0 to 1023).

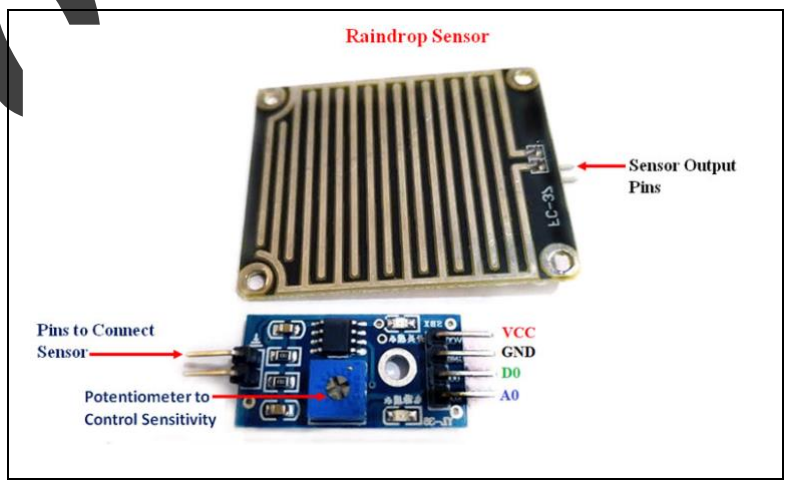

Fig. 6.1: Rain sensor Pin configuration

Pin Configuration of Rain Sensor:

Sr. No:	Name	Function
1	VCC	Connects supply voltage- 5V
2	GND	Connected to ground
3	D0	Digital pin to get digital output
4	A0	Analog pin to get analog output

Table 4: Rain Sensor pinout configuration

Raindrop Sensor Features:

- Working voltage 5V
- Output format: Digital switching output (0 and 1), and analog voltage output AO
- Potentiometer adjust the sensitivity
- Uses a wide voltage LM393 comparator
- Comparator output signal clean waveform is good, driving ability, over 15mA
- Anti-oxidation, anti-conductivity, with long use time
- With bolt holes for easy installation
- Small board PCB size: 3.2cm x 1.4cm

Applications of Rain sensor:

- Automatic windshield wipers
- Smart Agriculture
- Home-Automation

4. Servo motor

A servo motor is an electromechanical device that produces torque and velocity based on the supplied current and voltage.

Fig. 7: Servo motor

A servo motor works as part of a closed loop system providing torque and velocity as commanded from a servo controller utilizing a feedback device to close the loop. The feedback device supplies information such as current, velocity, or position to the servo controller, which adjusts the motor action depending on the commanded parameters.

Fig. 7.1: Servo motor wire configuration

Wire Configuration

Wire Number	**Wire Colour**	**Description**
1	Brown	Ground wire connected to the ground of system

2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

Table 5: Servo motor wire configuration

SG-90 Features

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation: 0°-180°
- Weight of motor: 9gm

Applications

- Used as actuators in many robots like Biped Robot, Hexapod, robotic arm etc.
- Commonly used for steering system in RC toys.
- Robots where position control is required without feedback.
- Less weight hence used in multi DOF robots like humanoid robots.

5. Ultrasonic sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.

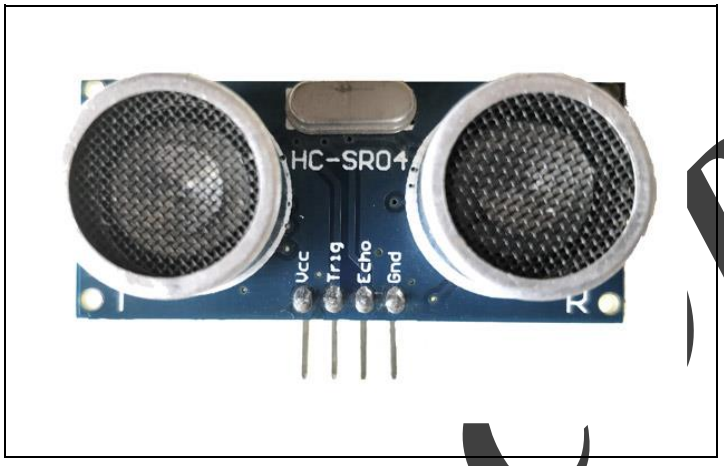

Fig. 8: Ultrasonic Sensor

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.

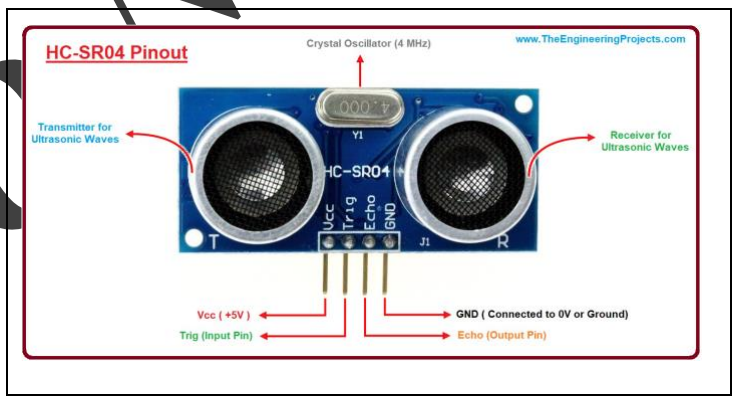

Fig. 8.1: Ultrasonic Sensor Pin Configuration

As shown above 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 were 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

Distance = Speed × Time

Ultrasonic Sensor Pinout Configuration

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	Ground	Connects to ground

Table 6: Ultrasonic sensor pinout configuration

HC-SR04 Sensor Features

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

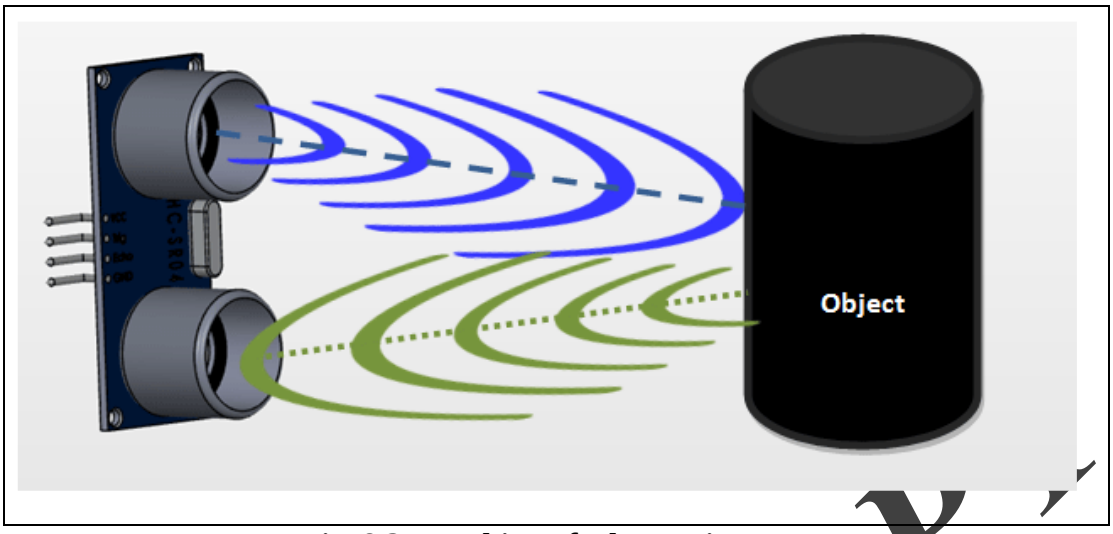

Fig. 8.2: Working of Ultrasonic sensor

Applications

- Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2cm to 400cm.
- Can be used to map the objects surrounding the sensor by rotating it.
- Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water.

6. GSM Module

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

Fig. 9: GSM module

These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities.

Its function include:

- Read, write and delete SMS messages.
- Send SMS messages.
- Monitor the signal strength.
- Monitor the charging status and charge level of the battery.
- Read, write and search phone book entries.

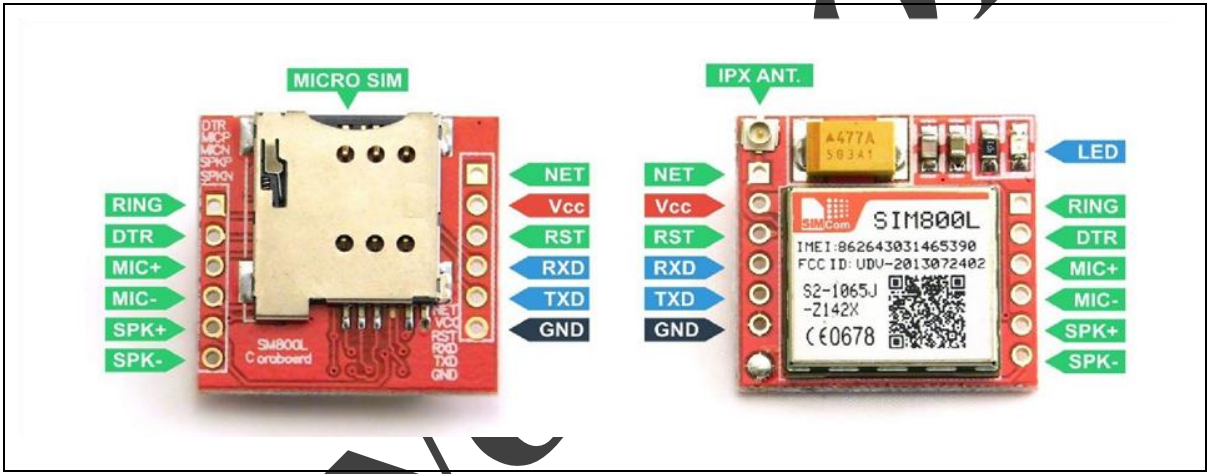

Fig 9.1: GSM SIM800L Pin configuration.

SIM800L Pin Configuration

Sr. No.	Pin	Description
1	RING	LOW state while receiving call
2	DTR	Default in HIGH state. After setting it in LOW the module will wake up.
3	MICP, MICN	Microphone (P + / N -)

4	SPKP, SPKN	Speaker (P + / N -)
5	NET	Antenna
6	VCC	Supply voltage
7	RESET	Reset
8	RXD	Serial communication
9	TXD	Serial communication
10	GND	Ground

Table 7: SIM800L pin configuration

Software Requirement:

1. 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.

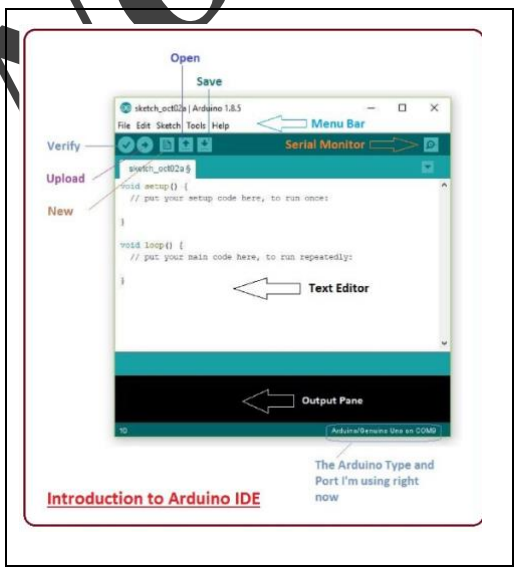

Fig. 10: Arduino IDE.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has

features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

2. Blynk App

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.

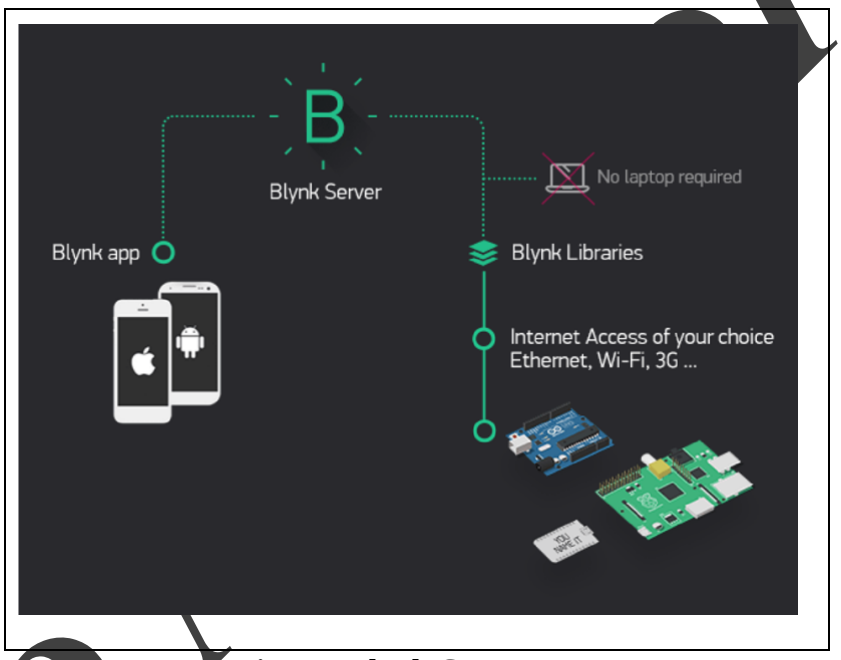

Fig. 11: Blynk Components

There are three major components in the platform:

- Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.
- Blynk Server - responsible for all the communications between the smartphone 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.

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

Features

- 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 SuperChart widget.
- Device-to-Device communication using Bridge Widget.
- Sending emails, tweets, push notifications, etc.

Conceptual Models:

Flow Diagram

A flowchart is a diagram that depicts a process, system or computer algorithm. They are widely used in multiple fields to document, study, plan, improve and communicate often complex processes in clear, easy-to-understand diagrams. Flowcharts, sometimes spelled as flow charts, use rectangles, ovals, diamonds and potentially numerous other shapes to define the type of step, along with connecting arrows to define flow and sequence.

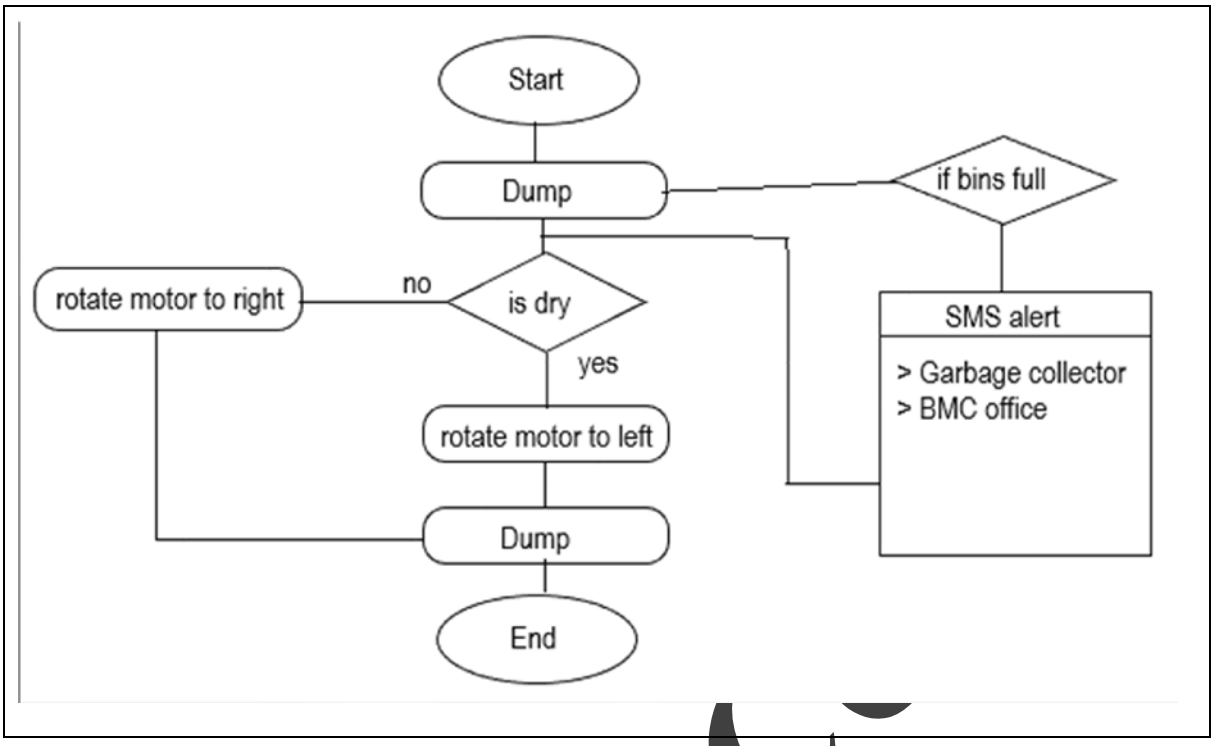

Fig. 12: Flow Diagram

Chapter 4

System design

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.

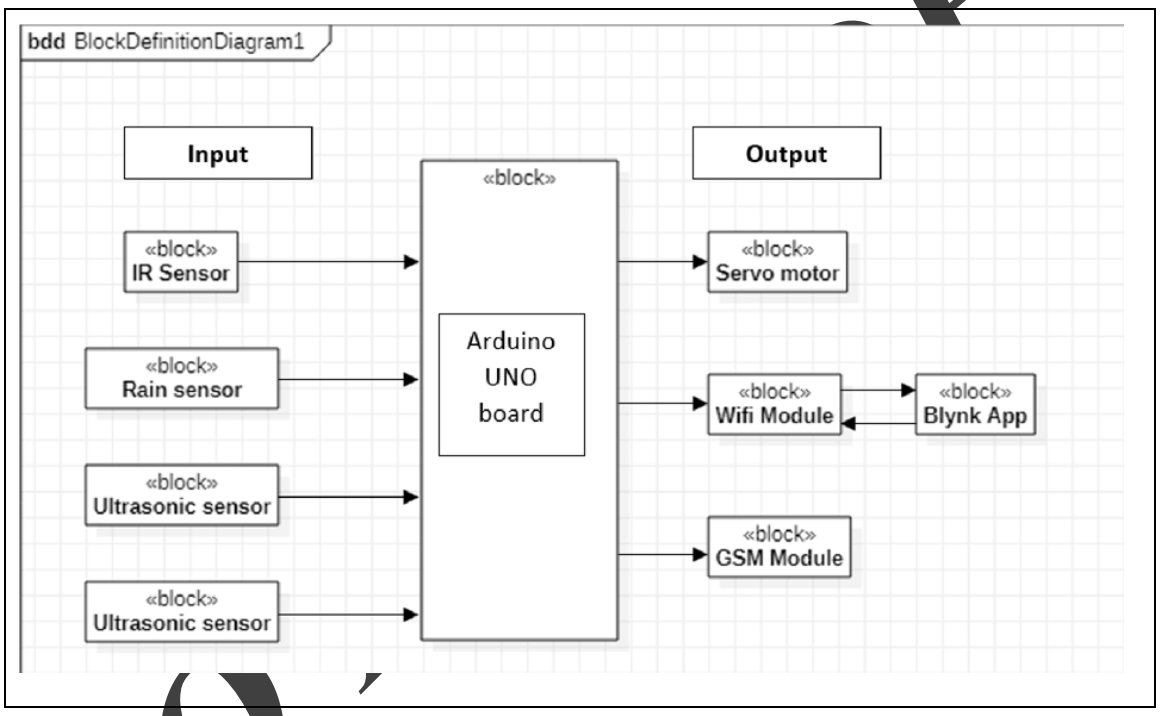

Fig. 13: Block Diagram.

Spiral Model Diagram

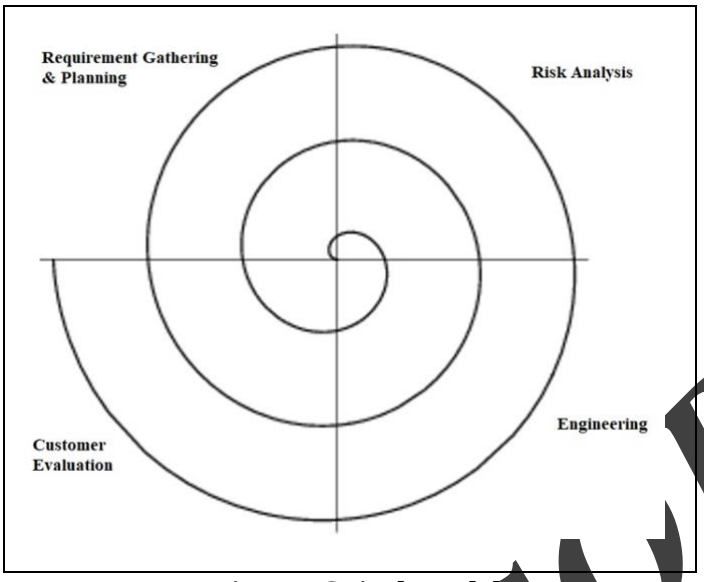

Fig. 14: Spiral Model

The Spiral model is an evolutionary and iterative software process model and it is proposed by Boehm.

Features of Spiral Model:

- Each cycle around the spiral may be like a phase.
- The radius of the spiral represents the cost incurred so far in the process.
- Spiral model is represented in the form of Cartesian diagram with 4 quadrants that represents 4 phases of software development.

Main Objectives of Spiral Model:

- It provides controlled and systematic aspects of the linear sequential model.
- It uses rapid development potential of incremental versions of the software.
- It finds all risks in the project.
- It finds future risks also.

Method

1. Requirement Gathering includes:
    a. Interaction with customer and user.
    b. Problem Identification regarding existing system.
    c. Deciding product specification.
    d. Deciding objectives of the system.

e. Planning decides the project plan. It includes:
    i. Cost measurement of the system.
    ii. Deciding schedule of the system.
    iii. Collecting feedback from the user.
    iv. Adjusted and planned number of iterations required to complete software.

2. Risk Analysis task is involved in each of the iteration of the project. It includes:
    a. Identification of risk areas
    b. Identification of technical as well as managerial risks
    c. Measuring cost related risk
    d. Efforts are taken to resolve the risk
3. Engineering phase immediately designs the prototype of the proposed system depending upon the objectives decided in the planning phase. It also converts design into coding and does the needful testing. it then shifts to deployment phase which includes:
    a. Implementing the developed system
    b. Gives training to users
    c. Collection feedback
4. Customer Evaluation: The product is then evaluated by the customers or end-users to find if any changes are required. If so, then the above phases are repeated again in loops.

Circuit diagram

A circuit diagram is a graphical representation of an electrical circuit. A pictorial circuit diagram uses simple images of components, while a schematic diagram shows the components and interconnections of the circuit using standardized symbolic representations.

Unlike a block diagram or layout diagram, a circuit diagram shows the actual electrical connections. A drawing meant to depict the physical arrangement of the wires and the components they connect is called artwork or layout, physical design, or wiring diagram.

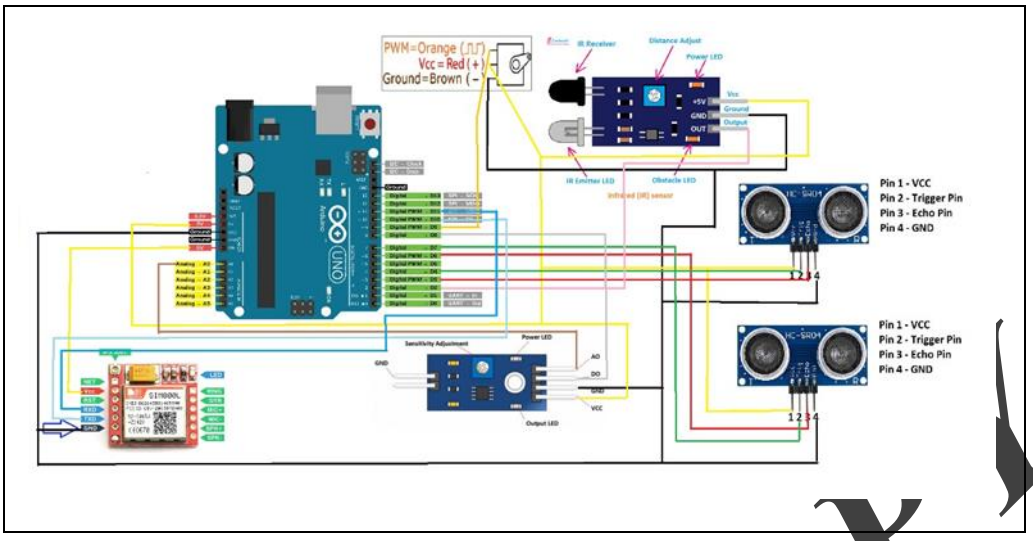

Fig. 15: Circuit diagram (initial)

Use Case Diagram

Use-case diagrams model the behaviour of a system and help to capture the requirements of the system. Use-case diagrams describe the high-level functions and scope of a system. These diagrams also identify the interactions between the system and its actors.

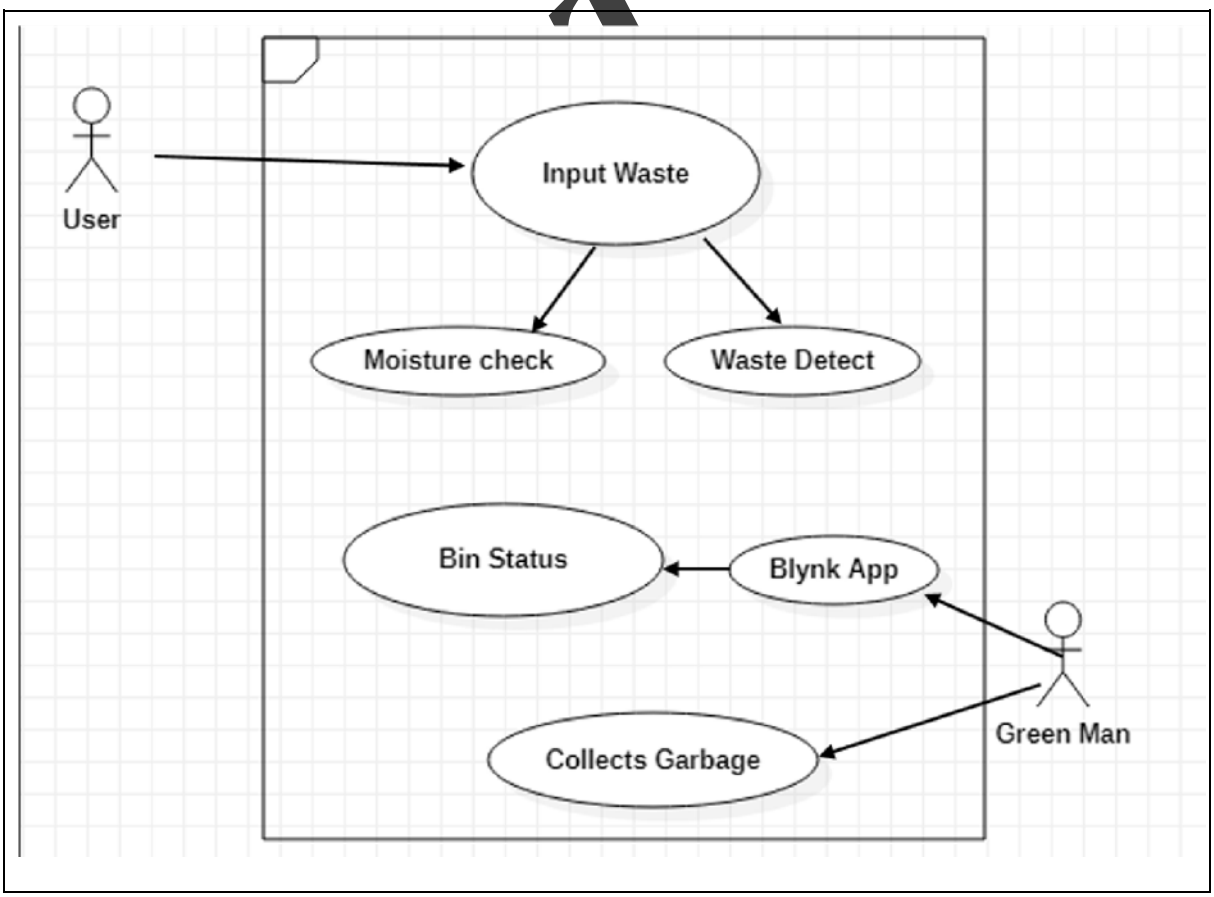

Fig. 16: Use Case Diagram

Sequence Diagram

A sequence diagram is a type of interaction diagram because it describes how—and in what order—a group of objects works together. These diagrams are used by software developers and business professionals to understand requirements for a new system or to document an existing process.

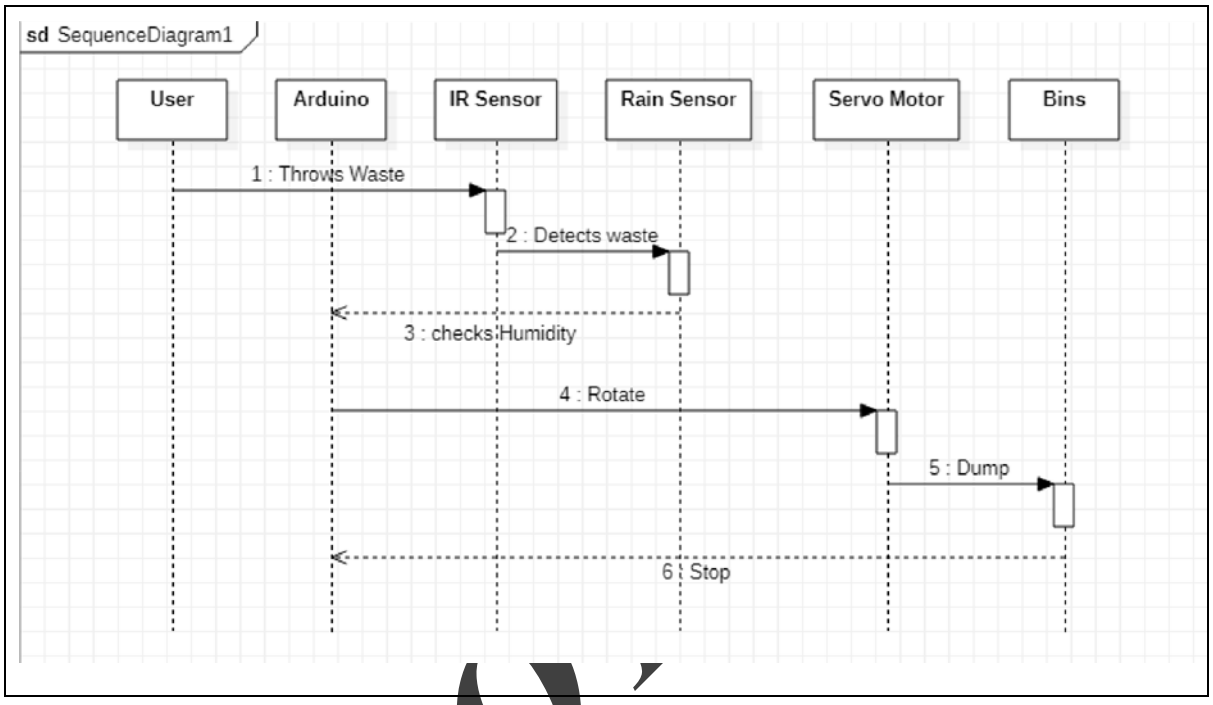

Fig. 17: Sequence Diagram.

State Chart /Activity Diagram

State chart diagram describes the flow of control from one state to another state. States are defined as a condition in which an object exists and it changes when some event is triggered. The most important purpose of State chart diagram is to model lifetime of an object from creation to termination.

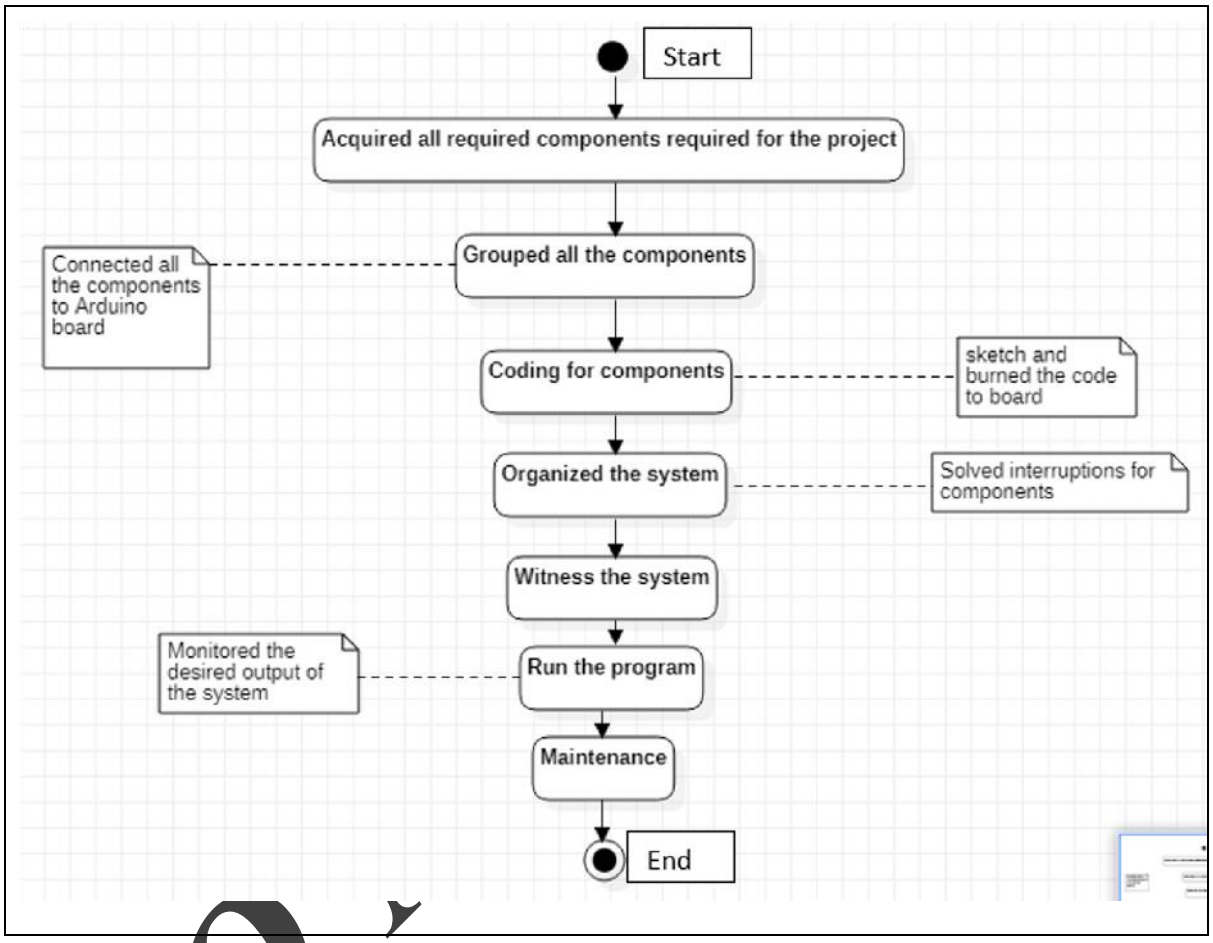

Fig. 18: State Chart

Test cases Design

Testing

Testing is a method to check whether the actual product matches expected requirements and to ensure that product is Defect free. It involves execution of software/system components using manual or automated tools to evaluate one or more properties of interest. The purpose of testing is to identify errors, gaps or missing requirements in contrast to actual requirements.

Testing can be majorly classified into two categories:

- Black Box Testing is a software testing method in which the internal structure/ design/ implementation of the item being tested is not known to the tester.
- White Box Testing is a software testing method in which the internal structure/ design/ implementation of the item being tested is known to the tester.

Testing is Important because if there are any bugs or errors in the software, it can be identified early and can be solved before delivery of the software product. Properly tested product ensures reliability, security and high performance which further results in time saving, cost effectiveness and customer satisfaction.

Testing Strategies

Here are important strategies of testing:

- Unit Testing: This software testing basic approach is followed by the programmer to test the unit of the program. It helps developers to know whether the individual unit of the code is working properly or not.
- Integration testing: It focuses on the construction and design of the software. You need to see that the integrated units are working without errors or not.
- System testing: In this method, your software is compiled as a whole and then tested as a whole. This testing strategy checks the functionality, security, portability, amongst others.

Test Case designing table testing is a testing technique used to test behaviour for different input combinations. This is a systematic approach where the different input combinations and their corresponding system behaviour (Output) are captured in a tabular form.

Test Case Name	**Case Description**	**Expected Output**	**Actual Output**	**Case status**
Arduino Uno R3				
Power consumption	Checking the power required for Arduino to run	Should work within 5-12V		
IR Sensor				

Voltage consumption for IR sensor	Checking the power required for sensor to work	Should work within 3-5V		
Obstacle Detection	IR detectors are digital out - either they detect IR signal and output voltage.	Output should be low (0)		
Rain Sensor				
Voltage consumption for Rain sensor	Checking the power required for rain sensor to run	Should work within 3.3V-5V		
Moisture Detection	Checking the voltage for the sensor so the we can detect moisture of the object	Reduced voltage drops.		
Servo Motor				
Voltage consumption for motor	Checking the power required for servo motor to run.	Should work within 3.3V-5V DC power.		
Rotation	Checking the movements of the flap.	Flap movement left, right and back to its initial state.		

Ultrasonic Sensor				
Voltage consumption for sensor	Checking the power required ultrasonic sensors to run.	Should work within 4.8V-6V DC power.		
Bin level	Checking the level of bins.	Should detect object within 0-8cm for 5 seconds		
GSM Module				
Voltage consumption for module	Checking the power required gsm module to work.	Should work within 3.4V to 4.4V.		
LED Status Indicators	There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network.	Blink every 3s: module has made contact with the cellular network & can send/receive voice and SMS.		
SMS check	Checking the alert sent to authorities.	SMS received to authorities saying "Bins are full please collect the waste"		
Blynk App				

Account	Login/Signup for Blynk account.	Register/Login successful.		
Connection	Check the connection between Arduino and Blynk app using GSM Module	Connection successful and Ready message		
Levels	Check the graphical representation of bins on blynk app	Indicates the level with percent.		

Table 8: Test cases

Chapter 5

Implementation and Testing

Implementation Approaches

Steps for Assembling this Let me Do:

- Getting all the required components

  Such as Arduino Uno board, IR sensor, Rain Sensor, two Ultrasonic Sensors, Servo motor, GSM module, Male to Female wires, Aluminium foil and some Cardboards

- Assembling the components

  In this, I will be placing all the components and completing the fabrication for Let me Do.

  So here, I took a basket and marked the partition for dry and wet part. The partition is made with the help of cardboard, to protect cardboard from getting damaged by wet waste I covered it using some plastic coating with the help of plastic book cover.

  Then I created a flap for moisture detection and to dump waste in respective side, I took a sheet of aluminium foil and pasted on the cardboard of size 19cm by 10cm. For moisture to be detected I removed 0.5cm of aluminium foil pasted on cardboard from the central part.

  After partition and creation of flap, I fixed Servo motor on central side of basket and attached the flap to it. In front of servo motor, I placed IR sensor for the waste/object to be detected. Also, for status of bins I fixed ultrasonic sensors on top of the partition.

  Refer the following prototype for assembling Let me Do.

Fig 19: Prototype

- Connecting components

  Here, I'll be connecting all the sensors and GSM module to Arduino Uno board.

  For all VCC and Ground I'll be making a common connection except the servo motor.

- Programming

  After connecting all the components, I'll now move towards programming with the help of Arduino software or Arduino IDE.

Once code is ready, I'll connect Arduino Uno board with the help of USB cable. On Arduino UNO board a green light will turn on. Make sure you select Arduino Uno board in Arduino IDE. After selection, the Arduino IDE will automatically detect the COM port.

After selection and COM port detection, Upload the code using "Upload" button or simply use shortcut CTRL+U on IDE.

Once the code is uploaded, Let me Do will start its functionalities. It will first connect to network with GSM module then it will start its detection.

GSM will transmit the data of bins to Blynk app and will show the data in your phone. In Blynk app, I have set the Gauge display with respect to its virtual buttons.

Following is the interface of Blynk App.

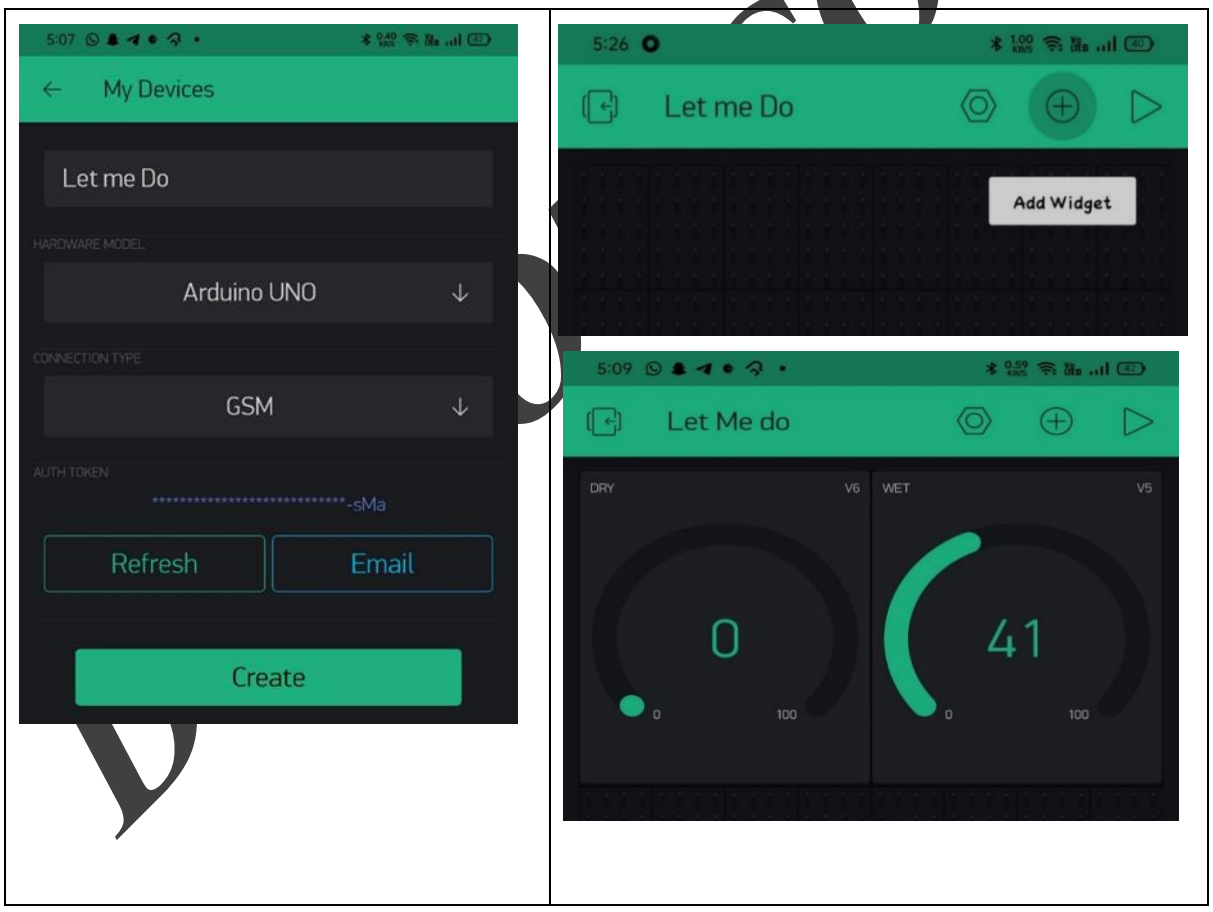

Fig 20: Blynk App Interface

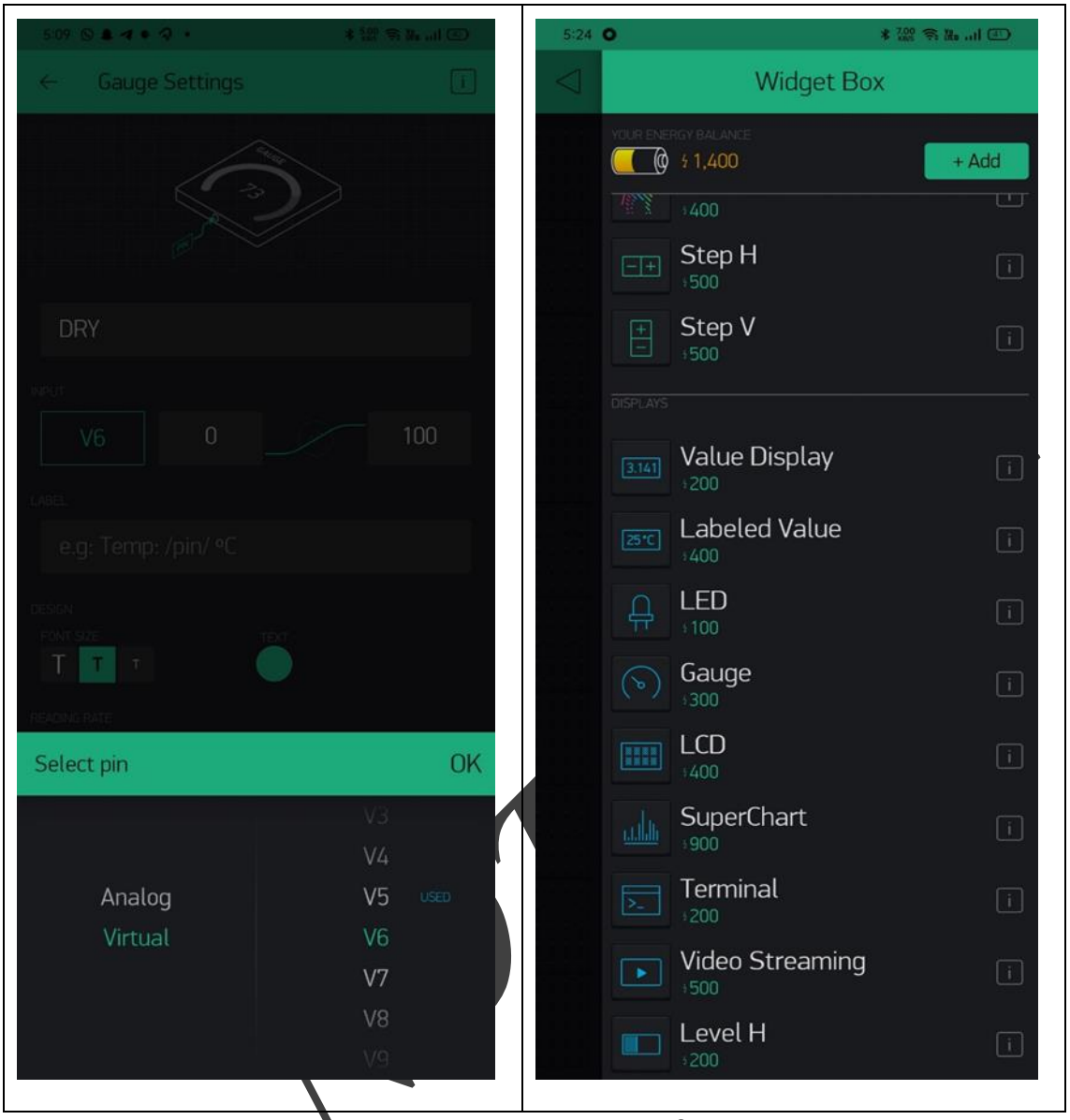

Fig 20.1 Blynk app Interface

Coding Details and Code

Following is the code for Let me Do

```
#define BLYNK_PRINT Serial //Defining Serial Print For BLYNK

#define TINY_GSM_MODEM_SIM800 //Defining GSM MODEL

#include <TinyGsmClient.h> //GSM LIBRARY

#include <BlynkSimpleTinyGSM.h>

//ENTER AUTH TOKEN SENT VIA EMAIL FROM BLYNK

char auth[] = "lp4m3VbnrzpK2w4ju__3w-9uFC-JB5t6";
```

```
//APN SETTINGS FOR SIM CARD USED IN GSM.
char apn[]  = "www";//FOR VODAFONE WE USING WWW
char user[] = "";
char pass[] = "";
#include <SoftwareSerial.h>
//RX, TX PIN FOR SIM800L
SoftwareSerial SerialAT(2, 3);
TinyGsm modem(SerialAT);
//SERVO MOTOR LIBRARY
#include <Servo.h>
#define ir1 A1 //DEFINING IR SENSOR ATTACHED AT PIN A1
#define moist A0 //DEFINING RAIN SENSOR ATTACHED AT PIN A0
//ULTRASONIC SENSOR VARIABLES
long duration, distance, wet_bin, dry_bin, dry = 0, wet = 0;
int moisture = 0, object = HIGH;
Servo myservo; //CREATING SERVO OBJECT
//WET BIN (RIGHT)
#define trigPin_wet A4
#define echoPin_wet A5
//Dry bin (LEFT)
#define trigPin_dry A2
#define echoPin_dry A3
void setup() {
  //GSM INITIALIZATION
  Serial.begin(19200);
  delay(10);
```

```
  SerialAT.begin(19200);
  delay(3000);
  modem.restart();
  Blynk.begin(auth, modem, apn, user, pass);
  //SENSORS PIN CONFIGURATION
  pinMode(ir1, INPUT);
  pinMode(moist, INPUT);
  pinMode(trigPin_wet, OUTPUT);
  pinMode(echoPin_wet, INPUT);
  pinMode(trigPin_dry, OUTPUT);
  pinMode(echoPin_dry, INPUT);
  myservo.attach(9);  //ATTACHES THE SERVO ON PIN 9 TO THE SERVO OBJECT
  myservo.write(76);  //INITIAL SERVO (FLAP) POSITION
}
void loop() {
  Blynk.run();
  //WILL CONNECT GSM TO BLYNK SERVER
  moisture = analogRead(moist);
  Serial.print("moisture = ");
  Serial.println(moisture);
  delay(500);
  ultrasensor(trigPin_wet, echoPin_wet);
  wet_bin = distance;
  delay(10);
  ultrasensor(trigPin_dry, echoPin_dry);
  dry_bin = distance;
```

```
  delay(10);
  Serial.println(wet_bin);
  Serial.println(dry_bin);
  object = digitalRead(ir1);
  moisture = analogRead(moist);
  dry = (12 - dry_bin)*10;
  //ACTUAL HEIGHT IS 12CMS, *10 IS USED FOR DISPLAYING DATA IN PERCENT IN BLYNK APP
  wet = (12 - wet_bin)*10;
  if (object == LOW) {
    moisture = analogRead(moist);
    delay(1000);
    if (moisture <= 800)
    {
      Serial.println("WET WASTE");
      myservo.write(20); //WILL ROTATE FLAP TO RIGHT SIDE BY 20°
      delay(2000);
      myservo.write(76); //GETS BACK TO INITIAL POSITION
      delay(2000);
      Blynk.virtualWrite(V5,wet); //PRINT THE STATUS TO BLYNK APP
      if (wet>80){
       //THIS WILL PRINT ON YOUR SERIAL MONITOR
       Serial.println("Warning WET bin is about to get full....");
       SerialAT.println("AT+CMGF=1");
       delay(1000);
```

```
      //REPLACE x WITH YOUR PHONE NUMBER ON WHICH YOU WANT TO SEND SMS
      SerialAT.print("AT+CMGS=\"+91xxxxxxxxxx\"\r");
      delay(1000);
      SerialAT.println("Kindly Collect WET waste"); //YOUR TXT MESSAGE
      delay(100);
      SerialAT.println((char)26);// ASCII code of CTRL+Z
      delay(1000);
    }
  }
  else if (moisture > 800)
  {

    if (dry>80){
      //THIS WILL PRINT ON YOUR SERIAL MONITOR
      Serial.println("Warning DRY bin is about to get full....");
      SerialAT.println("AT+CMGF=1");
      delay(1000);
      //REPLACE x WITH YOUR PHONE NUMBER ON WHICH YOU WANT TO SEND SMS
      SerialAT.print("AT+CMGS=\"+91xxxxxxxxxx\"\r");
      delay(1000);
      SerialAT.println("Kindly Collect DRY waste");//YOUR TXT MESSAGE
      delay(100);
      SerialAT.println((char)26); //ASCII code of CTRL+Z
      delay(1000);
```

```
    }
    Blynk.virtualWrite(V6,dry); //PRINT THE STATUS TO BLYNK APP
    Serial.println("DRY WASTE");
    myservo.write(130); //WILL ROTATE FLAP TO LEFT SIDE BY 130°
    delay(2000);
    myservo.write(76); //BACK TO INITIAL POSITION
    delay(2000);
   }
  }
}
void ultrasensor(int trigPin, int echoPin)
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH); //GENERATES AN ECHO
  distance = duration*0.034/2; //THIS CALCULATES THE ACTUAL DISTANCE OF
BIN FROM SENSOR
}
```


Code Efficiency:

Code mentioned above is used for the working of Let me Do. It's a simple code as I've mentioned the comments it is quite understandable and is well optimized. The programming is done in Arduino IDE which is an open-source platform allows to code in simplified C and

C++ language. C++ is one of the most efficient programming languages and is very easy to understand.

An organized form has been used to create the code. Simple variables are used to store the data also various simple objects are used. Terms like High and low are used rather than zero and one for better understanding. For stability, delay () function is used for management of time within the code. These define the code is well optimized. The mentioned code can be reused for further modifications.

Testing Approach

A test approach is the test strategy implementation of a project, defines how testing would be carried out.

- Testing

  Testing is the process of executing a program with the aim of finding errors. To make our system perform well it should be error-free. If testing is done successfully, it will remove all the errors from it. There are many ways we can test a model or a system.

  The main two methods of testing are:

1. Manual Testing

   Manual Testing is a sort of checking within which test cases are executed manually by a tester while not using any automated tools. The aim of Manual Testing is to spot the bugs, issues, and defects. Manual code testing is the most primitive technique of all testing types and it helps to seek out crucial bugs within the code application.

   Testers can also test application when the system goes live, bugs or any glitch occurs can easily be tracked so we can call as real time testing or live testing.

2. Automation testing

   Automation testing is the process of testing software and other tech products to ensure it meets strict requirements. Basically, it's a test to double-check that the equipment or code works exactly what it is designed to do. It tests for bugs, defects, and any other issues that can arise with system.

- Unit Testing

Unit testing could be a software development method during which the smallest testable elements of an application, known as units, are one by one and independently scrutinized for correct operation. This testing methodology is completed throughout the development method by the code developers and generally QA workers. the most objective of unit testing is to isolate written code to check and confirm if it works as supposed.

It's an important step within the development method, as a result of if done properly, it may help to detect early flaws in code which can be difficult to search out in later testing stages.

It is an element of test-driven development, a practical methodology that takes a meticulous approach to putting together a product by means that of continual testing and revision. This testing technique is additionally the primary level of code testing, that is performed before different testing strategies like integration testing.

Unit tests are usually isolated to confirm a unit doesn't rely on any external code or functions. Testing can be done manually but is often automated.

A unit test generally contains of 3 stages: plan, cases and scripting and therefore the unit test itself. within the commencement, the unit check is ready and reviewed. succeeding step is for the test cases and scripts to be created, then the code is tested.

Test-driven development requires that the developers should write failing unit tests. Then they write code and refactor the appliance till the check passes.

Unit testing involves solely those characteristics that ar important to the performance of the unit below test. This encourages developers to change the ASCII text file while not immediate considerations concerning however such changes may have an effect on the functioning of alternative units or the program as a full. Once all of the units in a program are found to be operating within the most effective and error-free manner attainable, larger parts of the program is evaluated by means that of integration testing. Unit tests should be performed frequently, and might be done manually or is machine-controlled.

- Integration Testing

An integration testing is outlined as a sort of testing where software modules are integrated logically and tested as a bunch. A typical software project consists of multiple software package modules, coded by completely different programmers. the aim of this level of

testing is to reveal defects within the interaction between these software system modules after they are integrated.

Integration Testing focuses on checking data communication amongst these modules. therefore, it's additionally termed as 'I & T' (Integration and Testing), 'String Testing' and generally 'Thread Testing'.

- Test cases executed
    a. Unit Testing: This software testing basic approach is followed by the programmer to test the unit of the program. It helps developers to know whether the individual unit of the code is working properly or not.
    b. Integration testing: It focuses on the construction and design of the software. You need to see that the integrated units are working without errors or not.
    c. System testing: In this method, your software is compiled as a whole and then tested as a whole. This testing strategy checks the functionality, security, portability, amongst others.

Test Case designing table testing is a testing technique used to test behaviour for different input combinations. This is a systematic approach where the different input combinations and their corresponding system behaviour (Output) are captured in a tabular form.

Test Case Name	**Case Description**	**Expected Output**	**Actual Output**	**Case status**
Arduino Uno R3				
Power consumption	Checking the power required for Arduino to run	Should work within 5-12V	5.5V	Pass
IR Sensor				
Voltage consumption for IR sensor	Checking the power required for sensor to work	Should work within 3-5V	5V	Pass

Obstacle Detection	IR detectors are digital out - either they detect IR signal and output voltage.	Output should be low (0)	LOW (0)	Pass
Rain Sensor				
Voltage consumption for Rain sensor	Checking the power required for rain sensor to run	Should work within 3.3V-5V	4V	Pass
Moisture Detection	Checking the voltage for the sensor so the we can detect moisture of the object	Reduced voltage drops.	Reduced to 2.6V	Pass
Servo Motor				
Voltage consumption for motor	Checking the power required for servo motor to run.	Should work within 3.3V-5V DC power.	3.3V	Pass
Rotation	Checking the movements of the flap.	Flap movement left, right and back to its initial state.	Left 20° Right 130° Initial 76°	Pass
Ultrasonic Sensor				
Voltage consumption for sensor	Checking the power required	Should work within 4.8V-6V DC power.	5V	Pass

	ultrasonic sensors to run.			
Bin level	Checking the level of bins.	Should detect object within 0-8cm for 5 seconds	Object detected	Pass
GSM Module				
Voltage consumption for module	Checking the power required gsm module to work.	Should work within 3.4V to 4.4V.	5V	Pass
LED Status Indicators	There is an LED on the top right side of the SIM800L Cellular Module which indicates the status of your cellular network.	Blink every 3s: module has made contact with the cellular network & can send/receive voice and SMS.	LED blinked every 3 seconds	Pass
SMS check	Checking the alert sent to authorities.	SMS received to authorities saying “Bins are full please collect the waste”	Modified SMS to “Kindly Collect Dry waste” for Dry bin and “Kindly Collect Wet waste” for Wet bin	Pass
Blynk App				

Account	Login/Signup for Blynk account.	Register/Login successful.	Email Login Successful	Pass
Connection	Check the connection between Arduino and Blynk app using GSM Module	Connection successful and Ready message	Arduino connected to Blynk successfully	Pass
Levels	Check the graphical representation of bins on blynk app	Indicates the level with percent.	Gauge is used for representation	Pass

Table 9: Test cases executed

- System Testing

System Testing is applied on the entire system within the context of either system requirement specifications or functional demand specifications or within the context of each. System testing tests the planning and behaviour of the system and conjointly the expectations of the client.

System Testing is also a black-box testing. In this testing, integration testing passed components are taken as input. The goal of integration testing is to notice any irregularity between the units that are integrated along. System testing detects defects inside each the integrated units and also the whole system. The results of system testing is that the determined behaviour of an element or a system when it's tested.

System Testing is essentially performed by a testing team that's independent of the development team that helps to check the standard of the system impartial. it's both functional and non-functional testing.

- Modifications and Improvements:

On completion of testing, I faced some errors some logical calculations errors and were modified into source code.

Following are some errors:

Fig 21: GSM error

Above error is occurred when GSM module was trying to connect the network. It was due to improper VCC RX and TX connections. I was using 3.3V as power supply and I had mistakenly interchanged the RX to pin 3 and TX to pin 2.

The power supply I changed to 5V also changed the RX to pin 2 and TX to pin 3 and then it was working fine.

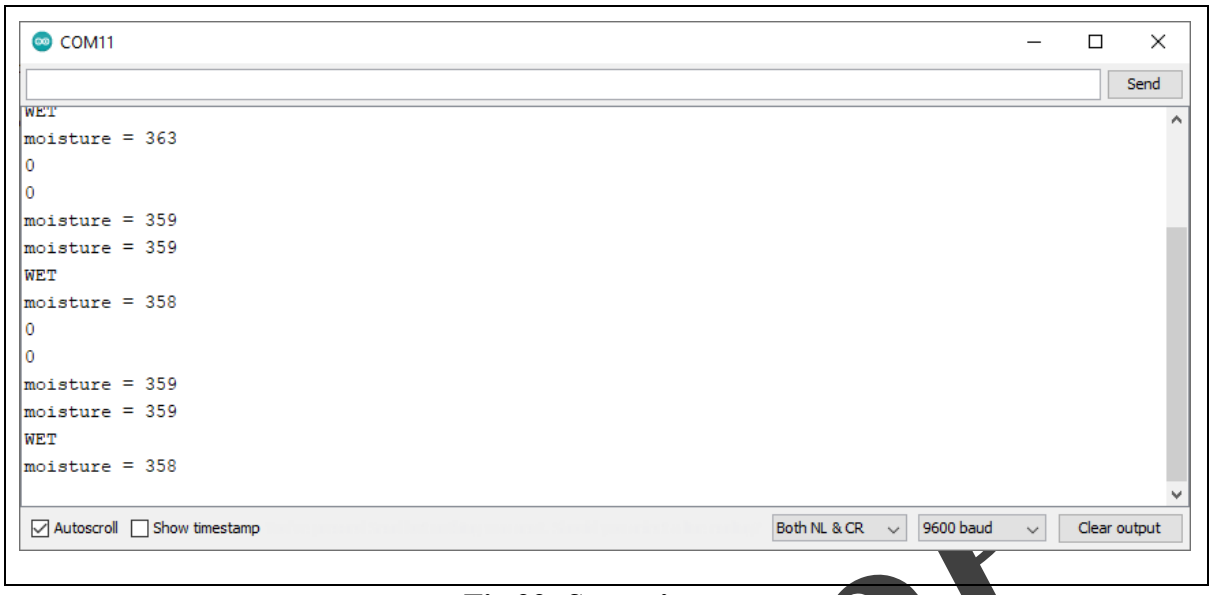

Fig 22: Sensor's error

Above error occurred due to improper calculations and some loop logic. I assigned decimal value to integer and was facing the error. So later I changed the data type to long and then it was working fine.

Chapter 6

Results and Discussions

Test Reports

As per test cases all the components are working properly. Power supply with 12V to Arduino worked fined all components were working as per given conditions and logics. GSM module was able to connect to network and made Arduino to connect Blynk server with the help of its GPRS connection also was able to send SMS when the status of any bin was above the warning level (80%).

Following is Circuit diagram represents the connection with the help of images for the components. It shows all the connections and interconnection using images.

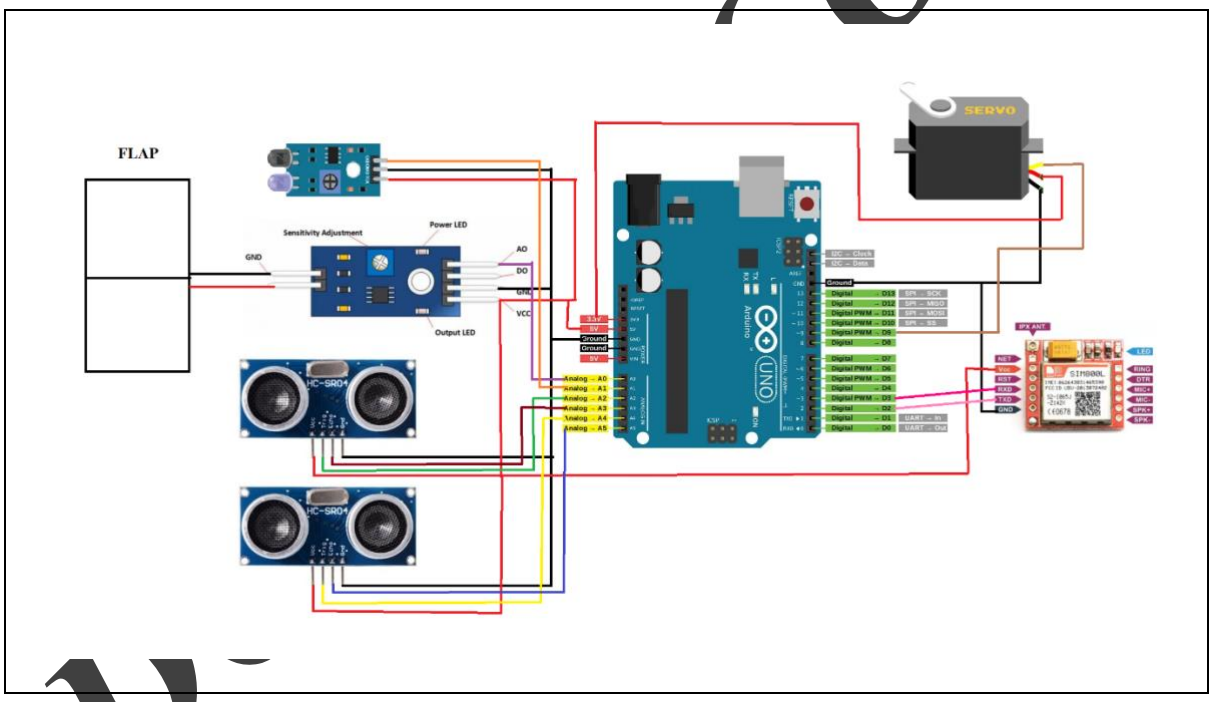

Fig 23: Circuit Diagram (Final)

User Documentation

Waste detection

Fig 24: Waste detection

Flap Movement

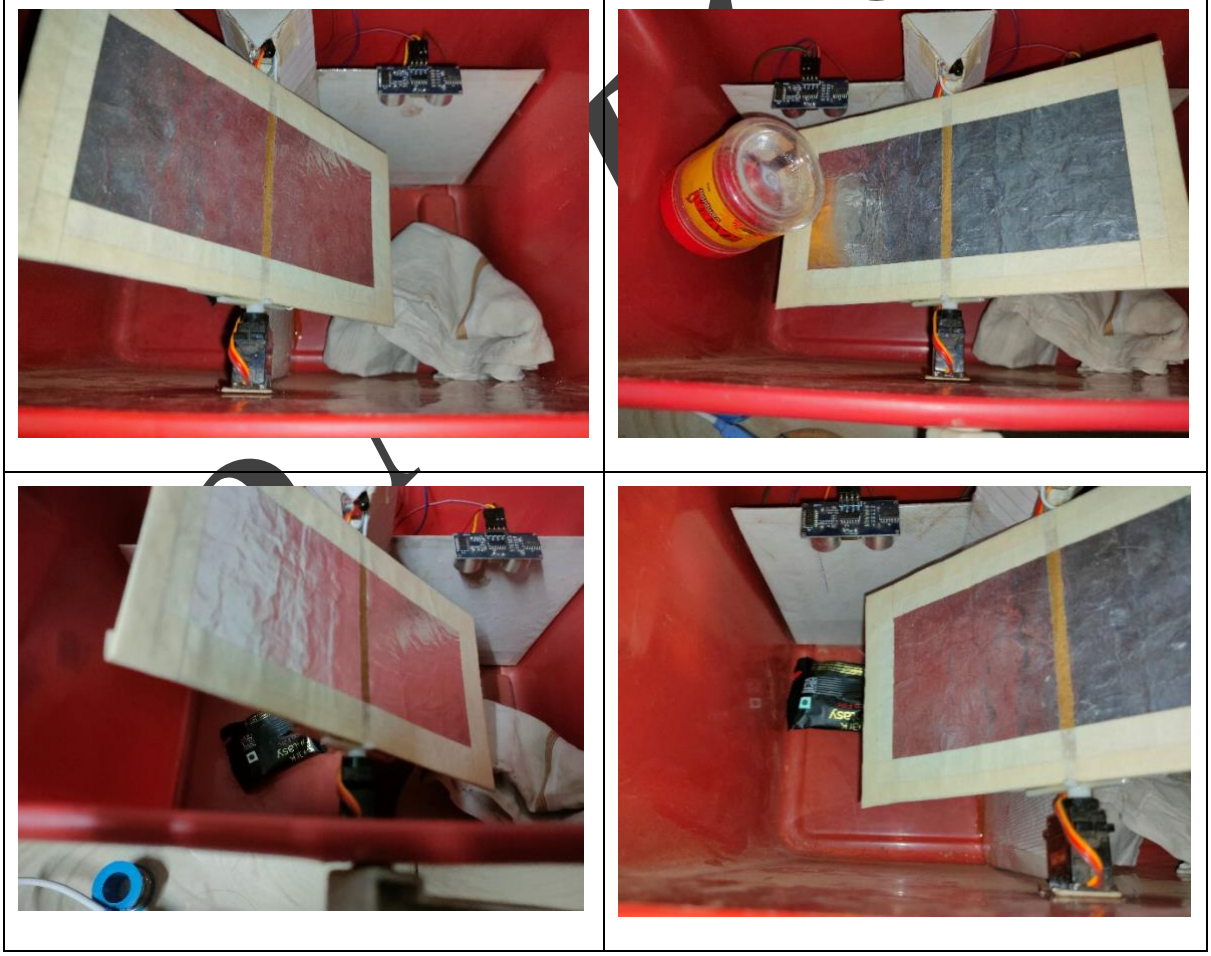

Fig 25: Flap movements

Output for sensors and GSM Module

Fig 26: Outputs for sensors and SIM800L

SMS received from Let me Do

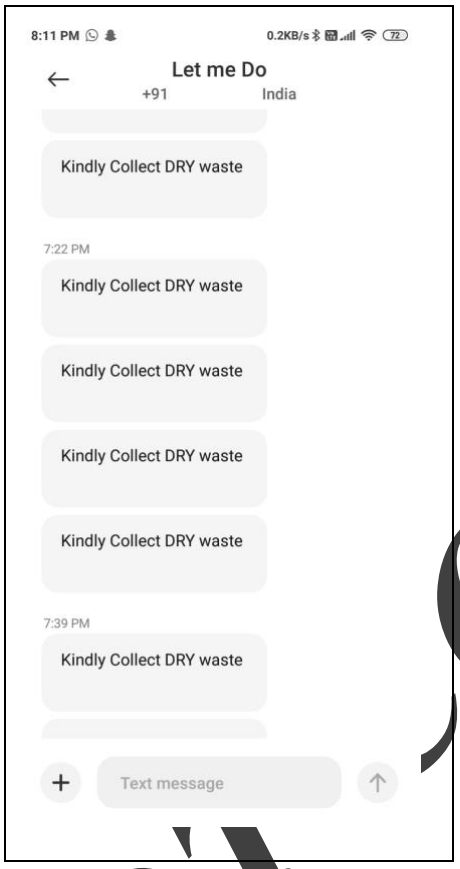

Fig 27: Received SMS from Let me Do

Chapter 7

Conclusions

Conclusion

The foremost goal of this project is to automatically segregate the wastes and to perceive the level of the dustbins which is delivered through wireless mesh network. With such information, litter bin providers and cleaning contractors are able to make better decision for the efficient disposal. IR sensor identifies the objects, Moisture sensors detects the wet waste. Ultrasonic sensor observes the levels of bin. The waste is dropped inside the bin where the sensor identifies the type of the waste. The bin consists of two partitions inside were each bin collects type of waste respectively. The motor then flaps and waste gets dumped into the partition and is collected. From the observation, Let me Do has been developed successfully as the segregation of the waste is done automatically and precisely.

As observe the document, I have tested Let me DO in all possible ways such as placing dry waste like plastic bin, paper, etc and wet waste like wet cloth, and some leftover veggies. The main task was to connect Arduino board to Blynk server which fits in the environment and serves the purpose which has been achieved. But this is not the final design. I tried to cover all the aspects of design and structural analysis in my work. But there is still a large chance of upgrading it. A design uses extremely simple ideas and mechanism to achieve a complex set of actions. The objective of this project has been achieved which was developing an automated Waste segregator and informing authorities before it gets overflow. This Let me Do can put into the place at different location like public places, schools, universities, metro stations, railway stations and so on.

Limitations

- Let me Do can only segregate dry and wet waste.
- It can only send SMS not the location.
- I tried to cover all the aspects of design and structural analysis in my work. But there is more to be done to it.

Future Scope

The design of the system is not that perfect but good efforts and best practices are utilized in developing it. The simplest way of waste segregation is described and explained in this document.

The model can be more optimized by adding GPS system to get accurate location of the bin. Also, can add a feature of rewards system for every time user uses Let me Do.

It can be more optimized in terms of connectivity and networks

After the waste is collected, following can be done on it.

- Bio-methanation could be a resolution for processing biodegradable waste that additionally remains underexploited. It's believed that if we tend to segregate biodegradable waste from the rest, it might scale back the challenges by half. E-waste elements contain harmful materials and are non-biodegradable which present each activity and environmental health threats together with harmful smoke from utilisation processes and natural action from e-waste in landfills into native water tables.
- Installation of waste-to-compost and bio-methanation plants would scale back the load of lowland sites. The waste should be treated as a resource and therefore the formal utilisation sector/industries be developed to recycle non-biodegradable useful elements from the waste thereby providing employment to rag-pickers and absorb them in the thought.
- Manufacturing of non-recyclable polyethylene bags should be banned or research should be initiated to develop biodegradable polyethylene.

In most parts of Asian country, sweepers and rag-pickers are still considered an inferior category of citizens despite many laws in place to bring dignity to their profession. To alter people's views and perspectives, awareness relating to this vital service to the community should be initiated and force engaged in such activities should be named as Green Man/Women or Green Brigade and so on.

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