

## **1. Abstract:**

In this project we will be using ultrasonic sensors for measuring the waste deposited in respective garbage bin, thus analyzing and reporting the bin divers for collection of the waste. In this project, we are providing statistical report of garbage bins with the help of web user interface, notify the bin divers via SMS. We are also keeping a database in which we will store analyzed data sensed through ultrasonic sensors installed in respective bins. Our aim is to provide optimized path for bin divers (Garbage Collectors), thus providing efficient diving time.

## **2. Introduction:**

Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. In the field of IoT, the objects communicate and exchange information to provide advanced intelligent services for users.

This project deals with the problem of Waste management, where the garbage collection system is not optimized. This project enables the organizations to meet their needs of smart garbage management system. This system allows the user to know the fill level of each garbage bin, to give an efficient and time saving route to the bin divers. Project will be build using Ultrasonic Sensors and raspberry PI breadboard. The Ultrasonic Sensor sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone). The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. The Built-in WIFI module in Raspberry Pi is used for transmitting data over the internet. The Sensors are physically connected to the Raspberry Pi via Breadboard using jumper cables. A breadboard is a construction base for prototyping of electronics. “Breadboard” is also a synonym for “prototype”. Because the solder less breadboard does not require soldering, it is reusable. A jump wire is an electrical wire or group of them in a cable with a connector or pin at each end (or sometimes without them – simply “tinned”), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. This project here is a model of the large-scale application which spans for areas, localities, cities, etc. We are here to display the live working of the model and give an idea about the actual implications.

### **3. Literature Review:**

One of the buzzwords in the Information Technology is Internet of Things (IoT). The future is Internet of Things, which will transform the real-world objects into intelligent virtual objects. The IoT aims to unify everything in our world under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things. In Light of this, present study addresses IoT concepts through systematic review of scholarly research papers, corporate white papers, professional discussions with experts and online databases. Moreover, this research article focuses on definitions, geneses, basic requirements, characteristics and aliases of Internet of Things. The main objective of this paper is to provide an overview of Internet of Things, architectures, and vital technologies and their usages in our daily life. However, this manuscript will give good comprehension for the new researchers, who want to do research in this field of Internet of Things (Technological GOD) and facilitate knowledge accumulation in efficiently.

### **4. Problem Statement:**

To design and implement system for waste monitoring to provide optimal path for bin diving.

### **5. Objectives:**

- To design and build a prototype of a system that could efficiently manage bin-diving.
- To provide the ideal diving schedules.
- To implement this ultrasonic sensors HC-SR04 used attached with each bin forming a layered structure.
- The sensed data is then forwarded over the cloud to the database.
- Then this data will be processed using algorithm.
- Algorithm provides optimized path for collecting waste from the bin.
- Optimal diving schedule is forwarded to respective waste management organization and data is then displayed on web interface.

## 6. Proposed Work:

### 6.1 System Architecture Diagram:

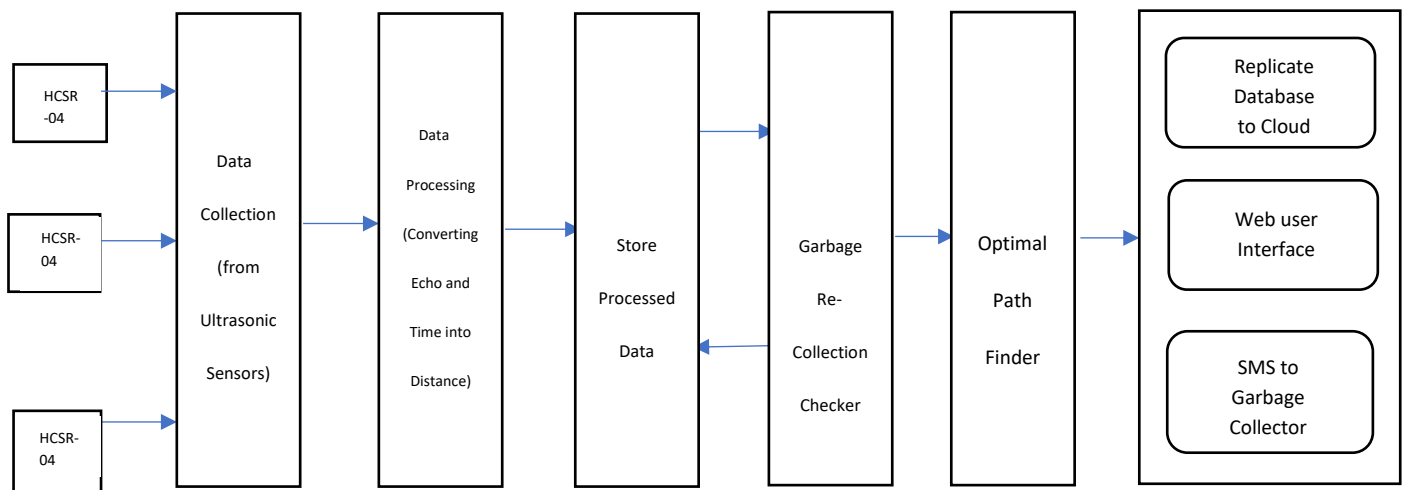


Fig. 6.1: Proposed system architecture

The Proposed system architecture shown in fig 1 consists of two phases. The first phase involves collection and processing of data. The processed data is then stored in cloud database. In the second phase, the stored data is used by garbage collection checker. It decides whether the recollection is required or not, if yes then optimal path finder calculates the shortest path based on custom algorithm and provides optimal time for garbage collection. All information is updated using a web interface along with provision to notify bin drivers through SMS.

## **6.2 Modules:**

### **i. Designing**

In this module we are setting up raspberry pi and the ultrasonic sensors. First the Raspbian OS is installed on raspberry pi. Then we connect the ultrasonic sensors to the raspberry pi's GPIO via breadboard using jumper cables. The sensors are then attached to the bins. The sensors we are using is HC-SR04 ultrasonic range sensor.

The HC-SR04 Ultrasonic sensor we'll be using in this project for the Raspberry Pi has four pins: ground (GND), Echo Pulse Output (ECHO), Trigger Pulse Input (TRIG), and 5V Supply (Vcc). We power the module using Vcc, ground it using GND, and use our Raspberry Pi to send an input signal to TRIG, which triggers the sensor to send an ultrasonic pulse. The pulse waves bounce off any nearby objects and some are reflected back to the sensor. The sensor detects these return waves and measures the time between the trigger and returned pulse, and then sends a 5V signal on the ECHO pin. ECHO will be "low" (0V) until the sensor is triggered when it receives the echo pulse. Once a return pulse has been located ECHO is set "high" (5V) for the duration of that pulse. Pulse duration is the full time between the sensor outputting an ultrasonic pulse, and the return pulse being detected by the sensor receiver.

### **ii. Data Collection (From Ultrasonic sensors)**

The python program is implemented for collecting the data from the sensors as they are connected to raspberry pi using GPIO pins. So, the data sent by the sensors need to be collected by that python script and sent to the next Module for processing.

### **iii. Data Processing (Converting Echo and Time into Distance)**

The data received from these sensors is in form of pulses and time so we need to convert that to actual distance using some formulas. The data is processed using python script. For this script we are using some python libraries such as Rpi and Time.

### **iv. Store Processed Data**

Then the processed data is stored to the database for further analysis. The database we are using is cloud MySQL instance on amazon web service. For this we are using the library

MySQL db. The stored data is used to plot the graph for monthly analysis of garbage collection.

### **v. Garbage Recollection Checker**

In this module we are analyzing data from the database. We are calculating if the recollection of garbage is required or not using the program we are developing.

### **vi. Optimal Path Finder**

If the recollection is required then we are calculating optimal path using custom algorithm. Algorithm is customized using shortest path algorithm. The path is provided based on collection of garbage for particular bin at optimal time.

### **vii. Updating Web UI**

In this module we graphically represent of waste collection stats with the help of Web User Interface. This stored data is continuously fetched from database and updated on Web UI after periodic time. The information provided by Web UI will be very helpful for respective waste management organizations.

In development of this module we are using some of the scripting and programming languages. For developing Front-End of Web UI we are using HTML, CSS, JavaScript languages and their respective frameworks such as Bootstrap 4. For developing Back-End we are using Python programming language and its framework Flask.

## 6.3 System Requirements:

### i. Hardware

HC-SR04 Module

Resistors: 330Ω and 470Ω

Jumper wire

Breadboard

RAM : 1 GB

Processor : Pentium 4 onwards

### ii. Software

Languages : Python, HTML, CSS, JavaScript, Bootstrap

Database : MySQL

Operating system : Windows

Compiler : Python Interpreter

## 7. Implementation:

SR NO.	Packages/ Functions/ Classes Members	Description
1.	Rpi.GPIO	This package allows us to control and interact with GPIO pins.
2.	time	This package allows to control time related functions with the script.
3.	mysql.connector	MySQL driver written in python.
4.	random	For randint() function.
5.	requests	For sending HTTP request form python script.
6.	Flask	Flask is web micro framework written in python.
7.	gunicorn	For deploying local flask app to web.
8.	Click	Flask;s dependency.
9.	itsdangerous	Flask;s dependency.
10.	Jinja2	Templating engine for python.



## 8. Results and Analysis:

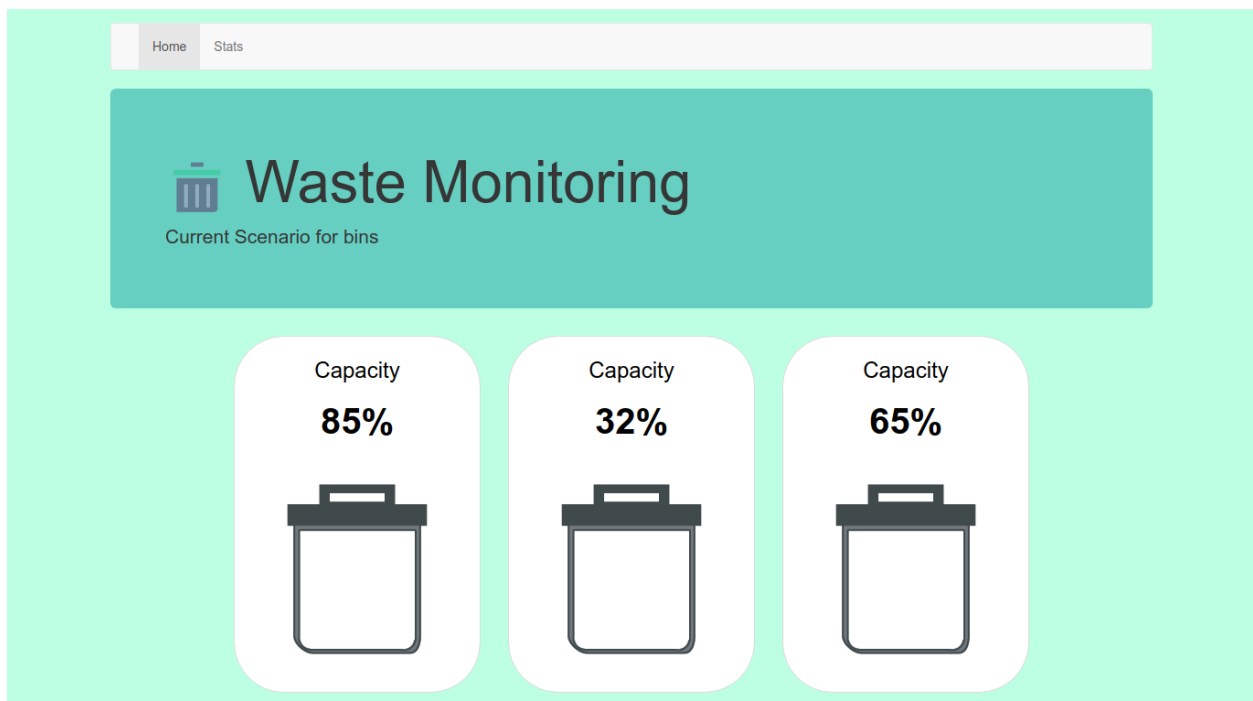
```

pi@raspberrypi:~/Desktop/wm
pi@raspberrypi:~/Desktop/wm $ cd Desktop/wm
pi@raspberrypi:~/Desktop/wm $ source bin/activate
(wm) pi@raspberrypi:~/Desktop/wm $ python final.py
final.py:20: RuntimeWarning: This channel is already in use, continuing anyway. Use GPIO.setwarnings(False) to disable war
nings.
  GPIO.setup(PIN_TRIGGER, GPIO.OUT)
Waiting for sensor to settle
Calculating distance
63
1 record inserted.
Please Collect The Garbage From bin2
{"return":true,"message":["SMS scheduled successfully to NonDND numbers at 9AM (in morning)"],"request_id":"dnobu9i876w4gme
"}
Waiting for sensor to settle
Calculating distance
64
1 record inserted.
Please Collect The Garbage From bin2
{"return":true,"message":["SMS scheduled successfully to NonDND numbers at 9AM (in morning)"],"request_id":"wz47fpr5imakt6x
"}
Waiting for sensor to settle
Calculating distance
71
1 record inserted.
Please Collect The Garbage From bin3
{"return":true,"message":["SMS scheduled successfully to NonDND numbers at 9AM (in morning)"],"request_id":"4eyg3v81t9zqbc6
"}
Waiting for sensor to settle
Calculating distance
53
1 record inserted.
Waiting for sensor to settle
Calculating distance
Waiting for sensor to settle
Calculating distance
85
1 record inserted.
Please Collect The Garbage From bin1
{"return":true,"message":["SMS scheduled successfully to NonDND numbers at 9AM (in morning)"],"request_id":"ko98gj7lp0q1aue
"}
^CTraceback (most recent call last):

```

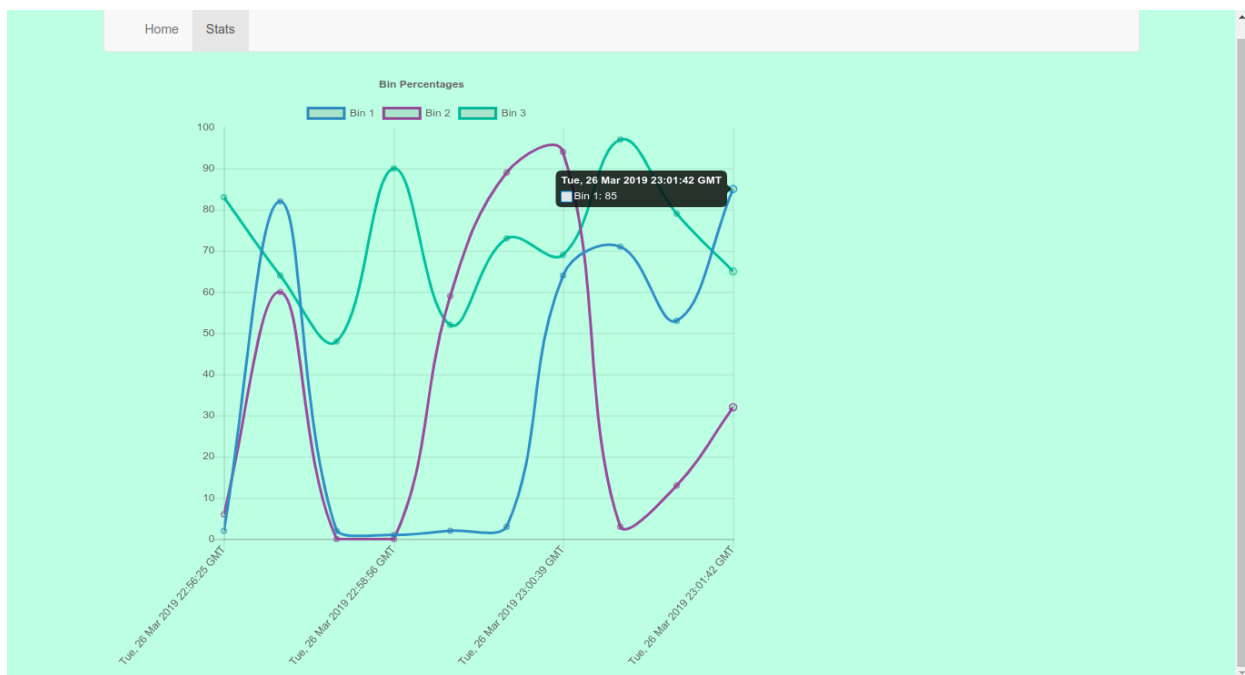
**Fig 8.1**

In Fig 8.1, First the local script is run on raspberry pi to measure the garbage level filled in bin. Hence pushing the scanned data to cloud database.



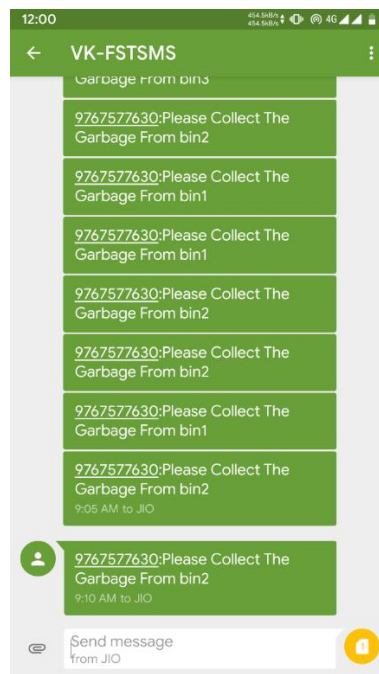
**Fig 8.2**

In Fig 8.2, the data retrieved through cloud database is provided to user in the form of graphical interface on web.



**Fig 8.3**

In Fig 8.3, the user is provided with statistical view in the graphical form for better analysis of bin monitoring



**Fig 8.4**

In Fig 8.4, when any of the bin exceeds 80% of bin capacity, respective authorities are notified with a SMS with bin number.

## 9. Conclusion and Future work:

This Domain Specific Mini Project is developed to provide the optimal path for garbage collectors which results in efficient waste collection. This also helps to reduce overflow of garbage from container which causes health issues. The provided survey will help in planning of better waste management schemes for organizations.

The Project was decided with a vision to expand the prototype model currently implemented on a larger scale. This model would be implemented over the areas in cities, thus providing a system for efficient management of waste.

## 10. References:

### a. Books:

- i. Raspberry Pi 3 Cookbook for Python Programmers-Dr. Steven Fernandes
- ii. Beginning Python from novice to professional – Magnus Lie Hetland

### b. Websites:

- i. <https://tutorials-raspberrypi.com/>
- ii. <https://www.geeksforgeeks.org/probabilistic-shortest-path-routing-algorithm-optical-networks/>
- iii. <https://stackoverflow.com/>
- iv. <https://developer.mozilla.org/en-US/docs/Web/HTML/Element>
- v. [www.geeksforgeeks.com](http://www.geeksforgeeks.com)
- vi. <https://www.python.org>

