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SMART UNDERGROUND DUSTBIN

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Abstract: Every single day, garbage is always produced and sometimes, due to the unbalance between high volume produced and the garbage volume transported to the landfill; it then leads to the build-up. To prevent any negative impact on environment, a system is needed to support the waste management process. Smart Garbage Monitoring System consists of two parts: portable garbage can and monitoring application using android smartphone. The use of ultrasonic sensor, GPS and GSM Module on the garbage can aims to provide the data on the garbage and send it to the real time database, in which the data will be processed by the monitoring application on smartphone to determine the time of garbage transport purposely to prevent any build-up. The system doesn't need a server to process, because the entire process of will be run by android application on a smartphone. Test results showed the capability of the system in monitoring the garbage can with the minimum distance between the wastes by three meters. The information on the height level of garbage can be synchronized in real time to smartphone, with an average delay on the EDGE network of 4.57 seconds, HSPA+ of 4.52 seconds and LTE of 3.85 seconds.

Index Terms **– Smart Bins, Ultra Sonic Sensor, GPS and GSM Module.**

➢ Introduction

Now a day's every system is automated in order to face new challenges in the present-day situation. Automated systems have less manual operations, so that the flexibility, reliabilities are high and accurate. Hence every field prefers automated control system. Especially in the field of electronics automated system are doing better performance.

Waste management is an important issue that needs to have a concern in every country including Indonesia. As reported by the Report of Study from Ministry of Environment and Forest, that only 38,653 million tons of waste handled in 360 cities, and garbage increased 7% from 2015-2016. Waste management in Indonesia at this time, is still limited and manually, the officer will clean up at a specified time according to the schedule, this is very ineffective because the trash can have been fully before the garbage collection schedule, the delay of garbage collection will cause the garbage on the trash can overflow and smell. Waste volume produced by inefficient waste management would cause insects, bacteria and viruses multiply rapidly that can infect humans. Traditional waste management through a garbage burning system would cause air pollution produced, which can be health problems to the surrounding community. With a large amount of waste, Indonesia certainly needs a system to assist the waste management process properly and efficiently.

Internet of Things (IoT) refers to a technology that can connect the embedded system devices to run various functions that can be used and controlled through internet connectivity. It has been widely used to support Smart City Management in transportation. In the health sector, IoT is used to monitor the patients' health by means of smartphones. Other research using smart devices to support the health industry, and in E-commerce it is used for the company's business development. IoT-based research on waste management has been largely conducted, say Smart Garbage System (SGS). Another study proposed a waste management system using the method of grouping the garbage location. Then, a design of smart management system for waste management has been done, but still not coping with the problem occurred in the suburb area or outside the

urban. Also, the system does not provide any information about the time limit of waste transport and the location of the garbage can to the users.

➢ OBJECTIVE:

The basic idea in this project is to design a smart garbage detection system which would automatically notify the officials about the current status of various garbage bins in the city, with the real time monitoring capabilities, under remote controlled IOT technique, which is depicted in fig1.

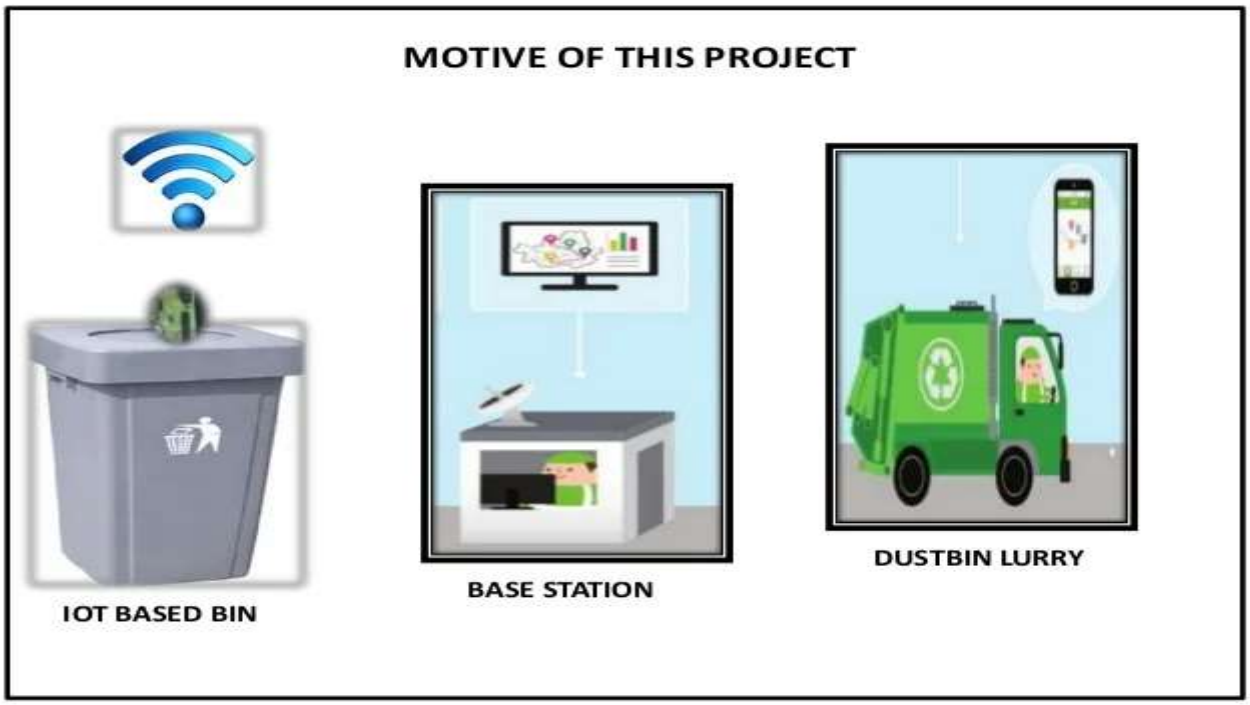


Fig.1 IOT Based Bin

All cities current waste collection considered here as a case work, logistics is carried out by emptying containers according to predefined schedules and routes which are repeated at a predefined frequency. Such a system has major disadvantage:

Time consuming, high costs, Greater traffic and congestion, unnecessary fuel consumption, increased noise and air pollution as a result of more trunks on the road.

All the above disadvantage are a result of lack of real time information resulting in unsuccessful collection of waste. The government itself finds this as a big problem and a big hurdle in between smart city. There is an urgent need to optimize the management of this service. In this system, ultrasonic sensor is used to monitor the level of garbage level. Ultra-Sonic Sensor is used to monitor the nearby persons and automatically drivers the DC Motor to open the lid of the dustbin. The dustbin is uploaded to the cloud using IOT. These helps for clearing the wastage from dustbin.

➢ LITERATURE SURVEY:

In the above-mentioned papers, we notice different studies that emphasize on the need to be able to manage the amount of waste being generated and what percent of people actually take up the responsibility and take steps to ensure this. Also, we can see how IOT modules are used to detect or track the waste for different waste bins or locations to be specific. We can also observe how with the use of IoT we can communicate between different devices and provide better solutions. Fromand we can observe that a major percentage of waste is generated by building in different forms. This tends to put forward a simple observation that a very minor percentage of people actually take up the responsibility and regulate the amount of waste being generated from these main sources. Therefore this issue needs a proper solution.

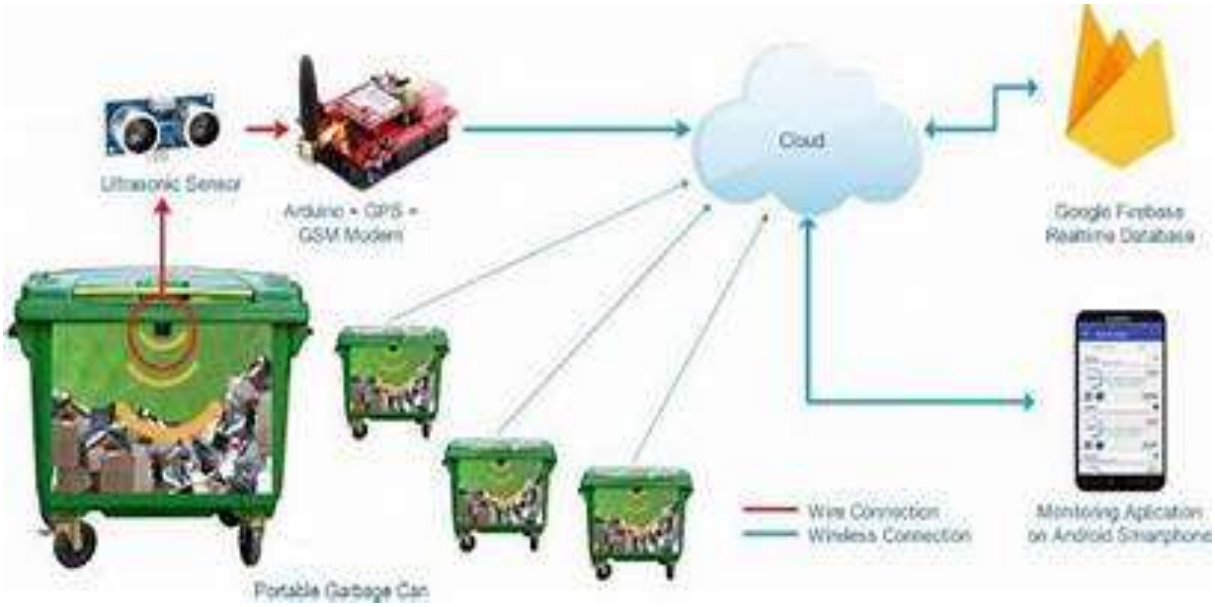
In and we can see how the Ultra sonic sensors placed at appropriate position and ideal conditions can help detect the level of the waste generated and so be used to detecting the amount generated and equally take action on the same. Also in we can observe that minimal number of sensors placed at appropriate places can prove cost effective and very efficient but still a way for proper real time notification is not present. The paper explains us how the wifi chip can be used to communicate between different

devices and therefore bring about many solutions in embedded systems. Therefore our literature survey identifies

- Need for solution to manage the amount of waste generated by buildings and other large sectors
- Detection using load sensors present but no method of real time action to be taken on the same.
- Occupancy detection system present but no flexible security feature present
- An integrated system for room light control and real time occupancy monitoring is not available

➢ RESEARCH MEHOD:

The design of the garbage can system is shown in below Figure where the system is divided into two parts: portable garbage can and monitoring applications on android smartphone. The garbage can used was the garbage with a cover, and a number of hardware including ultrasonic sensor, GPS module, GSM/GSM Modul SIM808 850/900/1800/1900 MHz Quad-Band and Arduino UNO microcontroller were installed at the upper part or on the cover of the garbage can.



Ultrasonic sensor is a sensor that uses echolocation, the sensor was placed attached on the inside cover of garbage can purposely to calculate the height of garbage volume in the garbage can, as shown in above Figure. A Microcontroller would send pulse to ultrasonic sensor and transmitted the ultrasonic wave. The transmitted ultrasonic wave would be reflected from the garbage object and received by the ultrasonic transducer. Thus, the volume of garbage height was possible to be calculated. The system would be active when the garbage can was in a closed position and the ultrasonic sensor detected any changes in the height of the garbage volume. The data of garbage height was then be processed by the Arduino uno microcontroller along with the data of the garbage can location (latitude and longitude) provided by the GPS module. Then the data was sent to firebase real time database with HTTP protocol, using GSM SIM808 module via cellular network.

The database used was Firebase Real time database stored in cloud in which the data was stored as JSON and would experience a synchronization process in real time to each client connected either to the garbage can or to the application on the Android smartphone. Thus, every smartphone installed in the garbage monitoring application would automatically receive data update at any time, when connected to the database via the internet network. The program code of data synchronization process from the android application to the database is presented as follows.

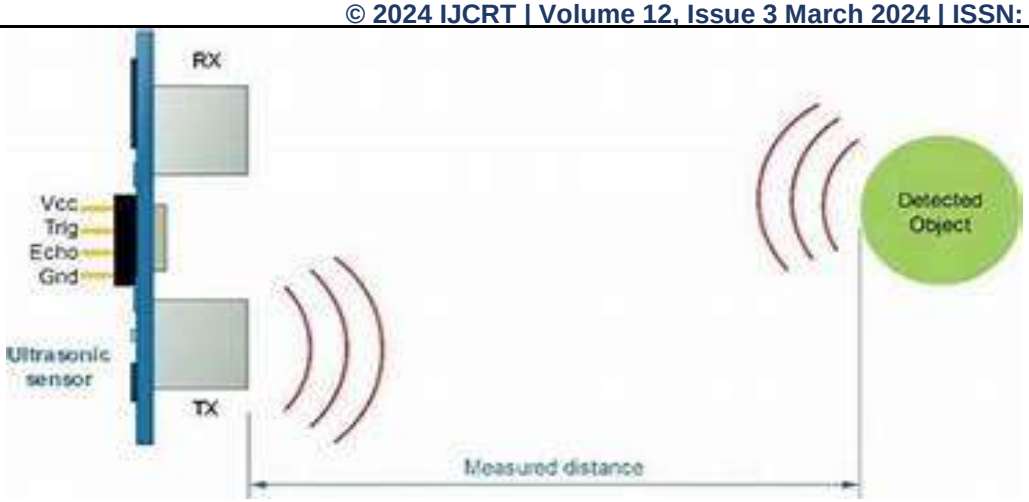


Fig.Working of ultra-sonic sensor

Application on android smartphone functioned to receive information from the database that included the location and level of garbage height in each garbage can. If the height level or time is in certain condition, the status notification would appear on the smartphone to the waste transport officer to immediately process the garbage transport. The flowchart of the system can be seen in Figure . Each garbage can has been made with the time limit and maximum height level of garbage as illustrated in Figure. This time limit is functioned to make the garbage not piled up for so long. If the time set by the time limit has been reached, the notification is then sent to the application as a sign that the garbage should be soon transported. Similarly, for the volume of garbage height, if it has met the condition, then the notification would be sent as a sign that the garbage should immediately be transported. The data sent to the application of garbage can is shown in the Data of Flow Diagram in Figure . Information from the garbage can was sent to the system and forwarded and processed on the android application as a real time report. The information from the garbage can would be sent and stored to the database based upon the location and the height level of the garbage can was, then combined with the time to be sent to Android, as shown in Figure .

- **ULTRASONIC SENSOR:-**

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. It is used to monitor the level of garbage level.

It consists of

- Trigger pulse (Input)
- Echo pulse(output)
- 5V supply
- 0V Ground

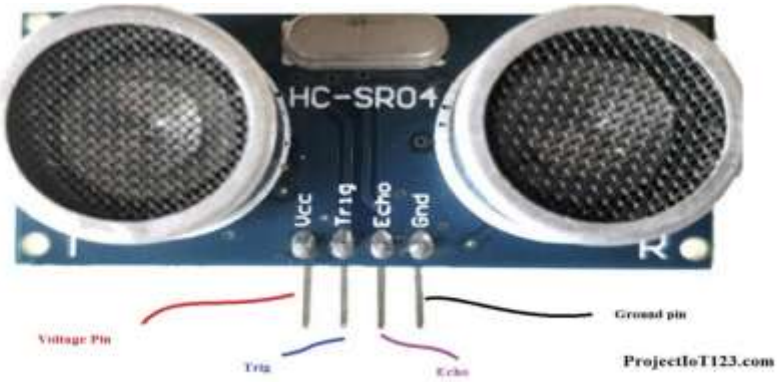
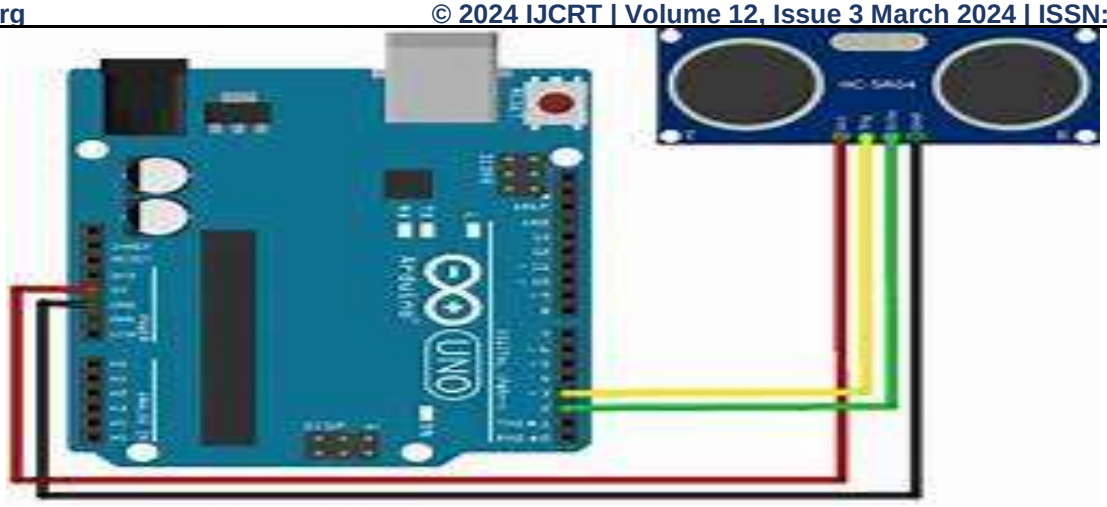


Fig.Ultra Sonic Sensor

Ultrasonic sensor vibrates at a frequency above the range of human hearing. This sensor determines the distance to a target by measuring time lapses between the sending and receiving of the ultrasonic pulse.



- **FLOW CHART:**

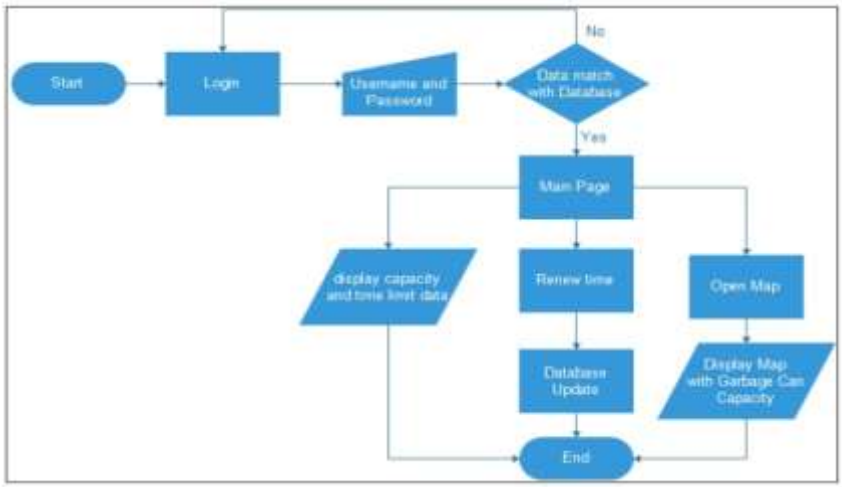


Figure. Flow Chart System

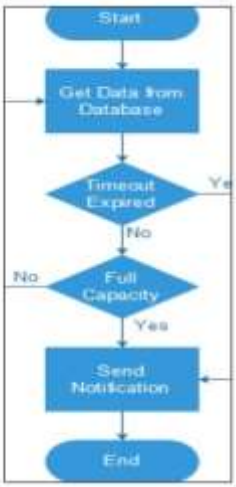


Figure. Flow Chart of the notice of smart garbage can application

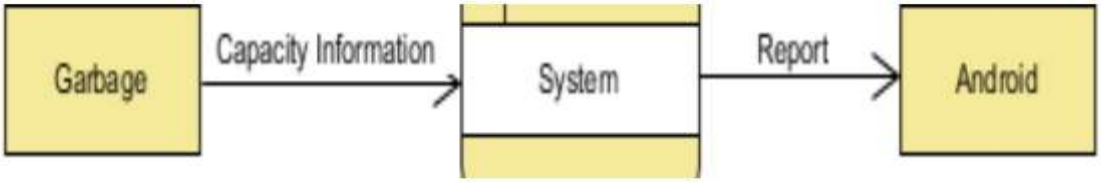


Figure. Data flow of Smart garbage can application diagram

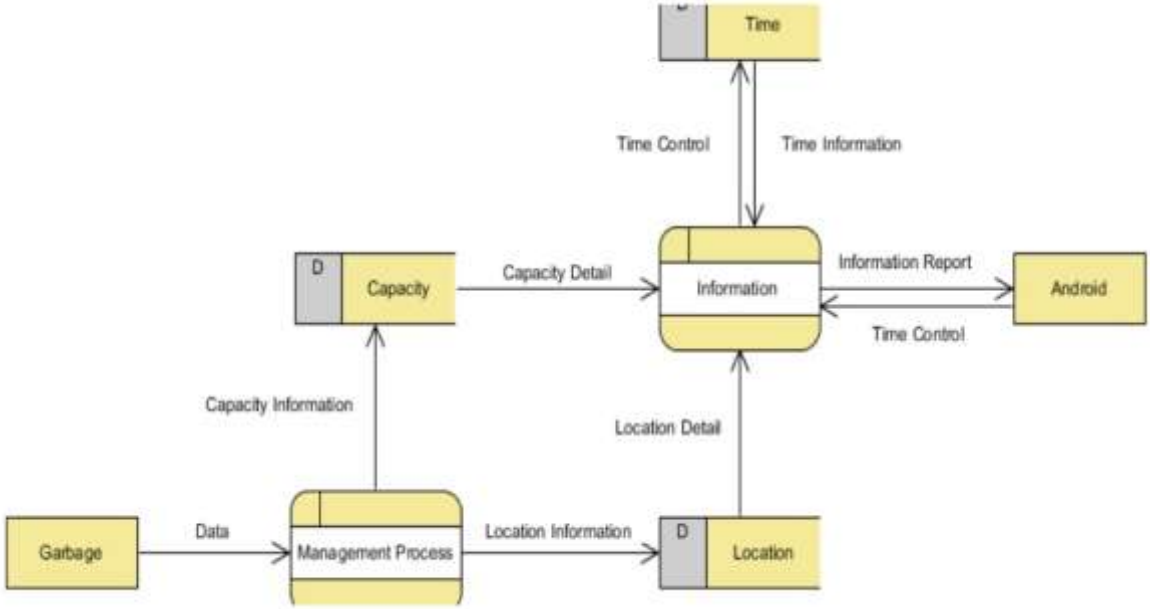


Figure. Data Flow of diagram for the status information of smart garbage

Monitoring application can control the time to determine when the maximum limit for the garbage can must be transported. It is aimed to repeat the time calculation in the limit of transportation as shown in above Figure. The progress bar shows the height level in the garbage can and the button “date” and “clock” would provide the selection of time limit for the next garbage transport. Meanwhile, the button “confirm” is for making confirmation if the garbage can have been transported and to update the time limit of transport, button “go to” will open the location of the garbage can based on the latitude and longitude provided on the database

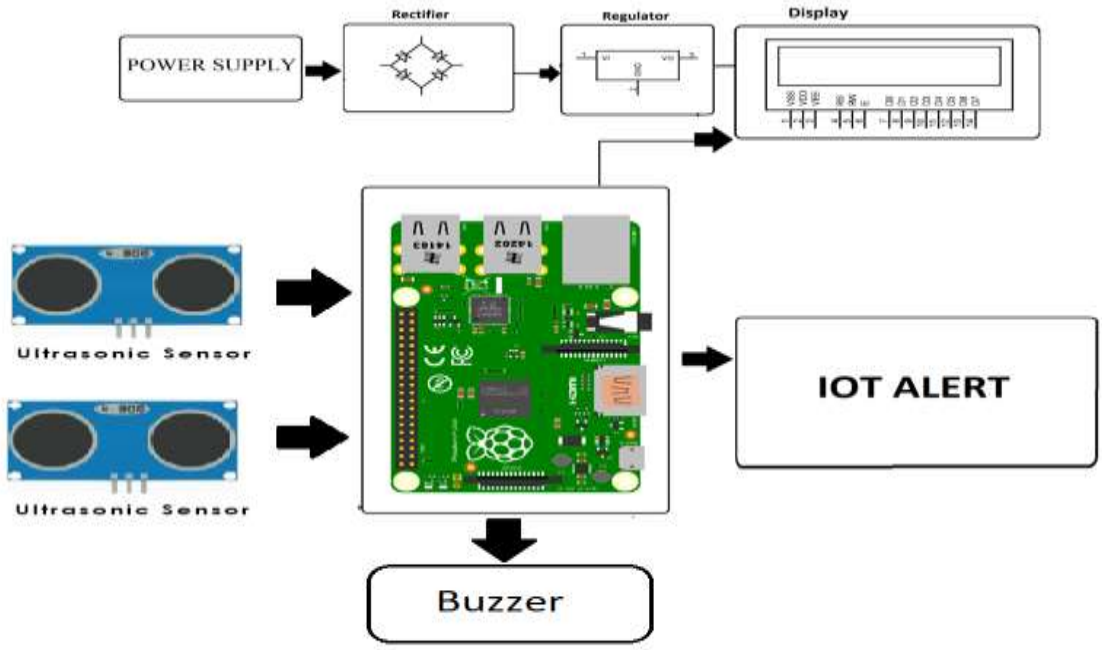
- **WORKING PRINCIPLE**

In IoT based garbage management, we are showing one live garbage bin.Each garbage bin has two slots, one for wet and other for dry. Height of waste in both slots is measured with help of ultrasonic sensors and that information is transferred to server via wifi module to PC server.A four way DIP switch is used to give each dustbin an ID and that ID with predefined location information is stored in database on server PC.Dustbin forwards three type of data using WiFi module to PC,

1. ID of a bin ,
2. Dry waste in percentage,
3. Wet waste in percentage to PC server through wifi module via network (intranet).

C server has display screen which consists of ,Dustbin ID, Location information, Wet waste percentage, Dry waste percentage.Server will send data about the bin to Android app.On Android app, user can view the percentage of Dry bin and percentage of Wet bin.When any bin is about to full , user / driver will get a pop up message on app with text as well as in speech format using TTS.Dustbin side wi-fi , PC and android will be connected to same network, hence it is Intranet communication.

- **BLOCK DIAGRAM:**



- **SMART BINS**

Smart Bins are technologically advanced and innovative underground containers, for differentiated collection of all types of waste with capacity of 3 to 5 cubic meters. These International standard underground vertical waste bins are installed in precast concrete bunker having water proof, closed construction, good quality. The top cover lid is hydraulically fixable in water tight condition with necessary provision to lock the filling lid having inter-genius design, secured garbage storage, longer empty intervals, improved hygiene and space saving above ground profiles with suitable lifting MDPE/HDPE close bottom container suitable for collecting municipal solid waste including paper, glass and organic waste with an opening to receive the mixed solid waste by the user/municipal works at street-level and door-to-door collection from households and commercial establishments with a provision suitable to lift through special lift / crane fitted on the compactor truck for emptying.

The entire bin is free from fire risk, vandalism and safety. The structure above the ground is integrated with the surrounding to improving the urban aspect. By using an electronic system, it is possible to calculate the amount of waste introduced in each single container.

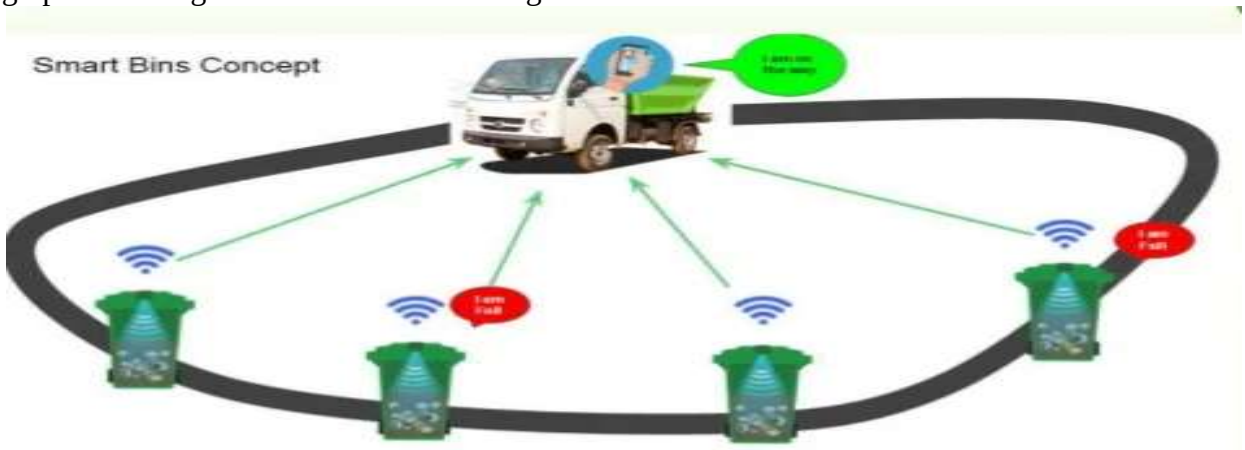
Their large loading flaps allow them to be filled evenly, which cuts costs by reducing the number of times they need emptying. Residents are not disturbed by the sound of waste being thrown in thanks to break-fall devices and a sound-deadening insulation layer which can be fitted inside the container on request. During the emptying procedure, the foundation container is open to begin with. A self-actuating

safety platform with a high load bearing capacity automatically slides over the open pit, providing a safe surface.

- **WASTE COLLECTION PROCESS**

The waste collection process is composed of an innovative lifting system bilateral, automated and mono-operator devices which, able to collect waste from various types of ground level and underground containers/bins.

The technologies being used for waste collection process are Radio Frequency Identification (RFID), Global Position System (GPS), General Packet Radio Service (GPRS), and Geographic Information System (GIS). The collection trucks are embedded with RFID reader which helps in retrieving all the bin information from the RFID tags/ wireless ultrasonic and infrared sensors which also amended with SIM card and a replaceable Lithium battery placed in each bin. These sensors used advanced ultrasonic measurement and digital signal processing techniques for better accuracy to identify the waste fill level in the bin. The sensor can be remotely configured to read the fill levels periodically at set intervals. The sensor can also be configured to store the readings frequently and sent to server whenever it breaches a threshold level. The live alerts in form of SMS and emails will be sent directly from server to centralized system. The location of the bins is identifying by GPS and centralized system will pass this message to truck drivers to initiate waste collection process. A mobile app/ web application for truck drivers shall also be provided where the routes and bins to pick up can be seen by Drivers. This app also has facility to upload real-time photograph of underground bins and exact weight cleared.



This information is regularly transferred in real time through GPRS to a database which is centrally located. A web application is designed so that the users can view the current location of the trucks individually during collection. A map server stores a digital map which displays the positions of the trucks as well as trash bin information. By using this technique, the system can come to know whether the truck has arrived to the bin location or not. The waste filling rate can be determined by the Intelligent Remote Monitoring sensor. Accordingly, waste will be collected from the bins

- **Bin Levelling Sensor including automated software:**

The fill level management and route planning is carried out by a system that uses an ultrasonic sensor and a web portal to provide information on the state of filling in each container. Each sensor is protected against impacts and placed inside the container. In a specific time the system sends by GSM the filling level information to the web platform. Data from the various sensors allow the manager to allocate resources and program the required route with an economic and environmentally sustainable way.

Figure. Sensors for Measuring Waste filling

The mode "Route Planning" shows the containers to collect and the most efficient route. This information can be sent to a mobile device (Smartphone or Tablet) to help the driver. With this system it is possible to produce different reports on filling levels of the different containers: the number of collections, the historical data and other useful information to manage a more efficient collection.

- **Waste Collection Vehicles and its Attachments**

The waste collection vehicles are the trucks with capability to install PTO gear box on chassis for installation of fully automated crane and mobile compactor Unit. There are two types of waste collection vehicles Rear-loading vehicles and Top-loading vehicles are used for waste collection purpose.

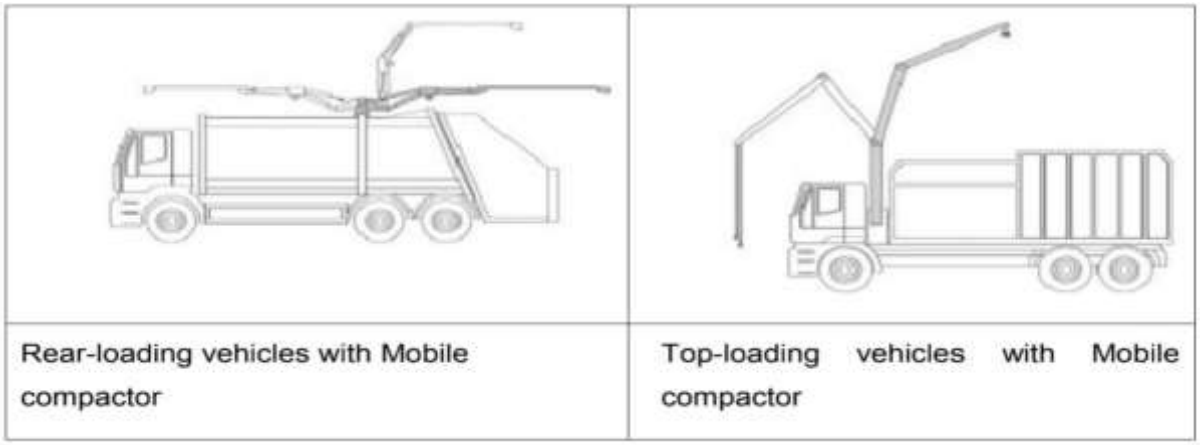


Figure. Waste Collection Vehicle

Its Special purpose Vehicle Mounted Refuse Compactor Machine, Mounted on 16 Ton to 25 Ton GVW Chassis with PTO and Hydraulic Assembly. It also includes 20 ton/meter crane which can be mounted on truck which can be operated directly from driver cabin. A Crane with Lifting Hook, Radio Remote Control, Overload Protection, 3- Section Hydraulic Boom, Telescopic Outriggers medium as per the attached Technical Specifications.

- **PROGRAM:**

```
#define BLYNK_TEMPLATE_ID "TMPLIXzQXJ8E"
#define BLYNK_DEVICE_NAME "IOT Garbage Monitor"
#define BLYNK_AUTH_TOKEN "cVmjHBoAPNLfnVESsrz0uTYvyn-tuuCw"

#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#define trig D1   // Trig pin
#define echo D2  // Echo Pin
// Comment this out to disable prints and save space
char ssid[] = "9096902083";  // type your wifi name
char pass[] = "12345678";  // type your wifi password
int tankdepth =40 ;   // Change  according to your tank depth

BlynkTimer timer;

char auth[] = BLYNK_AUTH_TOKEN;
void PGM()
{
  digitalWrite(trig, LOW);
  delayMicroseconds(2);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);
  long t = pulseIn(echo, HIGH);
  long cm = t / 29 / 2;
  Serial.println(cm);
  long level= tankdepth-cm;
  if (level<3)
  level=0;
  level = map(level,0,tankdepth-4,0,100);
  Blynk.virtualWrite(V0, level);
  Blynk.virtualWrite(V1," Garbage Level");
  Blynk.virtualWrite(V2,"By VAPM,LATUR  ");
}

void setup()
{
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(10L, PGM);
  pinMode(D4,OUTPUT);
  digitalWrite(D4,HIGH);

}

void loop()
{

  Blynk.run();
  timer.run();
   }
```

➢ CONCLUSION:-

This paper is the implementation of smart garbage management system using ultrasonic sensor, microcontroller 8266 and Wi-Fi module. This system assures the clearing of dustbins soon when the garbage level reaches its maximum. In major cities the garbage collection vehicle visit the area's everyday depends on the population of the particular area and sometimes these dustbins may not be full.

Our System will inform the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full. It ultimately helps to keep cleanliness in the society. Therefore, the smart garbage management system makes the garbage collection more efficient. Garbage may consists of the unwanted material left over from City, Public area, Society, College, Homes etc.

This paper is related to the "Smart City" and based on "Internet of Things" (IOT). So for smart lifestyle, cleanliness is needed, and cleanliness is begins with Garbage Bin. This project will helps to eradicate or minimize the garbage disposal problem

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