# Real time monitoring solid waste managenent


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## Abstract:

According to the United Nations' Sustainable Development Goals (SDGs), waste collection and management are essential public services for every community and are also necessary for the protection of public health and the environment. The solid waste can be minimized with the integration of advanced technologies like the Internet of Things (IoT), and the cloud. In this study, we have implemented real-time monitor solid waste from any remote location through Xbee communication and the internet. The zigbee communication is used and the level of garbage in the bin is measured and a alert send through the cloud.

## Introduction:

Waste management is a basic administrative unit in a metropolitan area for monitoring the urban environment by collecting waste and transporting it to the recycling unit. So effective waste management plays a vital role in improving the quality of life and reducing the negative impact on the urban. Improper management, poor trash collection, and open-air dumping adversely impact the environment. To manage this amount of waste, researchers have concluded that technological advancement and intervention in solid waste management are necessary.

## LITERATURE SURVEY :

Imran AS, Kim DH[1]. They have discussed a descriptive data analysis approach, along with predictive analysis, is used to produce in-time waste information. The performance of the proposed approach is evaluated using a real waste dataset of Jeju Island, South Korea. Waste bins are virtualized on its actual location on the Jeju map in Quantum Geographic Information Systems(QGIS) software. The performance results of the predictive analysis models are evaluated in terms of Mean Absolute Error(MAE), Root Mean Square Error (RMSE), and Mean Absolute Percentage Error(MAPE). Performance results indicate that predictive analysis models are reliable for the effective planning and optimization of waste management operations. The QGIS-based visual analysis helps in accurately allocating waste bins and predicting an optimal route for the garbage truck.

Lalit mohan joshi, Rajendra, Rajesh, Praveen[2] . They have discussed the minimization of solid waste is possible with the integration of advanced technologies like the Internet of Things (IoT), and the cloud. In this study, WPAN and cloud-assisted architecture are proposed and implemented to real-time monitor solid waste from any remote location through Xbee communication and the internet. The customized hardware is implemented in real-time by embedding it in the bins. The customized sensor node and coordinator node which are connected with the cloud server visualize the sensor data and also enable real-time monitoring of the bins. Lab view data logger receives the bin status and represents the status of the bin in digital form. The sensor data is visualized on the cloud server via WPAN and internet connectivity.

Daria Cibrario[3]. She gave abrief explanation of waste management and its importance, here is a strong case for all waste workers – be they formal or informal – to seek cooperative and complementary roles in the waste supply chain, joining forces and standing up together in solidarity for decent work across the whole waste workers' spectrum, while promoting a quality public waste service that works in the common interest. It is high time to give back a face, dignity and decent working conditions to all waste workers worldwide. National, regional and local governments, business employers, international financial institutions and agencies, as well as the relevant UN agencies, have the primary responsibility to make sure this happens.

M. Sikarndar, W. Anwar, A. Almogren, I. Ud Din, and N. Guizani[4]. They have computed basic as well as advance topological features by considering the interaction network of human protein complexes in the IoMT environment. In addition, biological features, i.e., discrete wavelet coefficients, length, and entropy from amino acid sequences of proteins have been computed. The supervised learning method based on association rules such as Partial Tree (PART) and Non-Nested Generalized Exemplars (NNGE) are trained to identify human protein complexes on the basis of integrated topological and biological properties. The 10-fold cross validation is exercised to measure the proposed methods. Experimental results show that association rule learners with integrated features outperform other complex mining algorithms, i.e., probabilistic Bayesian Network (BN), and Random Forest, in terms of accuracy and efficiency in addition to provide privacy.

C. Srinivasan, B. Rajesh, P. Saikalyan, K. Premsagar, and E. S. Yadav[5].They have done comprehensive survey on addresses the concerns, challenges, and existing state-of-the-art standards to emphasize and overcome most of the proposed technical solutions and it will deepen the importance of the IoT & The Internet of Everything (IoE) technology, the paper will cover and the domain of the internet of things and several technologies that widely used. The paper covered the architecture of the resulting Cloud-based IoT paradigm, as well as its new application scenarios, which will be discussed. Finally, new research directions and challenges are offered.

Jia-Wei Lu, Ni-Bin Chang, Li Liao, and Meng-Ying Liao [6]. They discussed, a multiconstrained and multicompartment routing problem is modeled with roll-on roll-off scheduling strategies in a two-stage decision-making process to exhibit the highest complexity of its kind in practical implementation. The constraints of time windows, intermediate facilities, multishifts, and split deliveries make an ideal combination of all essential complexities in modeling practices. To overcome the relevant challenges, a unified heuristic algorithm is proposed for addressing node routing and roll-on roll-off routing problems. The proposed heuristic algorithm that concatenates initialization and improvement phases solves the models with numerical efficiency to search for the most costeffective and environmentally benign solutions. Results indicate that differentiated collection increases opportunities to pursue the best routing strategies with sustainable implications through sensitivity analysis at the expense of higher collection costs. The analysis concludes with the perspectives of a smart and green waste collection system designed to create a more sustainable waste management systems in the future.

Rajendiran, B.; Arumugam, A.; Subramaniam, S[7]. They discussed that proposed project evaluates composition of MSW and also identifies the source of waste generation, with extensive use of waste collection technique, treatment method and handling of all the districts of Tamil Nadu. The evaluation includes public-private partnership harnessing benefits, challenges and unrecognised role of rag-pickers. The study concludes that creating decentralised solid waste treatment units in all districts and also encourages waste recycling industry.

Mrs Sarmila SS , Siva Kumar V, Vasanth Kumaur P K [8]In this project, they presented the Smart bin system that identifies hazardous gases and fullness of bins. The system is designed to collect data and to deliver the data through wireless mesh network. To collect data and to obtain bin utilization and bin daily information, With such information, wastage bin providers and cleaning contractors are able to make better decision. The system is designed to collect data and to deliver the data through wireless mesh network. The system also employs duty cycle technique to reduce power consumption and to maximize operational time. The Smart bin system was tested in an outdoor environment. In our system, the Smart dustbins are connected to the internet to get the real time information of the smart dustbins.

T. Anagnostopoulos, A. Zaslavsky[9] They proposed novel algorithms aiming at providing efficient and scalable solutions to the dynamic waste collection problem through the management of the trade-off between the immediate collection and its cost. We describe how the proposed system effectively responds to the demand as realized by sensor observations and alerts originated in high priority areas. Our aim is to minimize the time required for serving high priority areas while keeping the average expected performance at high level. Comprehensive simulations on top of the data retrieved by a SC validate the proposed algorithms on both quantitative and qualitative criteria which are adopted to analyze their strengths and weaknesses. We claim that, local authorities could choose the model that best matches their needs and resources of each city.

## Hardware details:

ESP8266mcu: Low cost open source IOTplatform

Ultrasonic sensor: An ultrasonic sensor is an electronic device that measures the distance of a target object and it emits ultrasonic sound waves which converts the reflected sound waves into electrical signal.


Xbee transmitter

Xbee receiver

XBee is an RF module mainly used as a radio communication transceiver and receiver. It is mesh communication protocols, also XBee supports peer-to-peer as well as point to multi-point network communications wirelessly with the speed of 250 kbits/s, to operate XBee you need a transmitter and a receiver.


Led

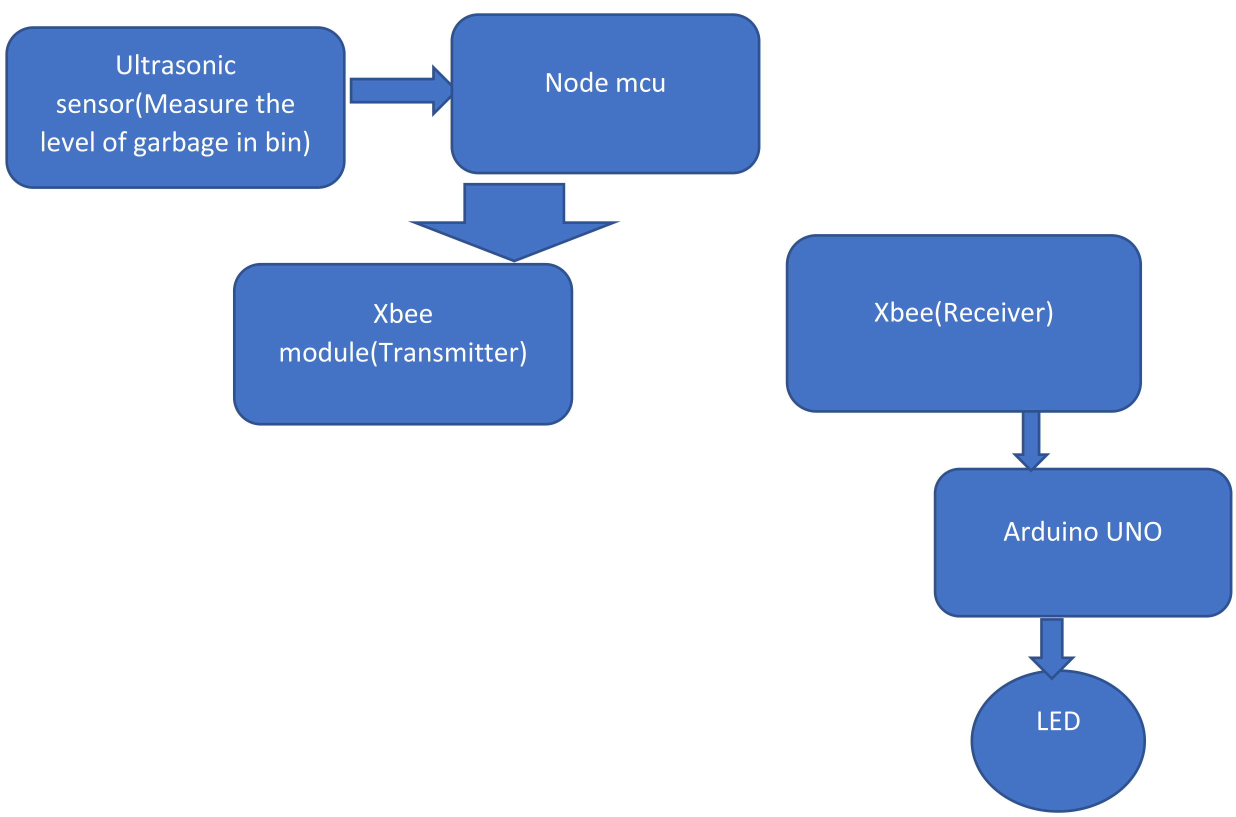
LED stands for light emitting diode, semiconductor which emits light when current flows through it.

Software details:

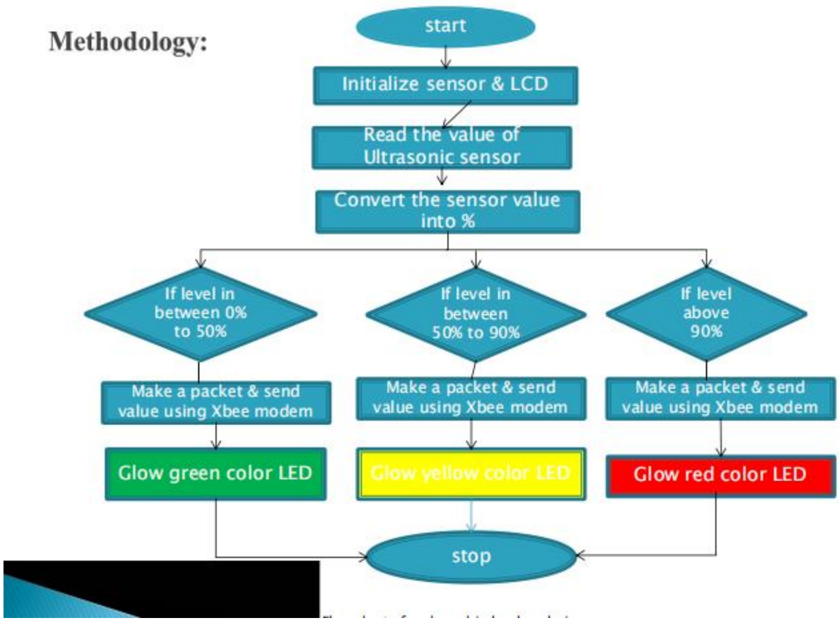
Arduino IDE: Where the code is written and uploaded to the board

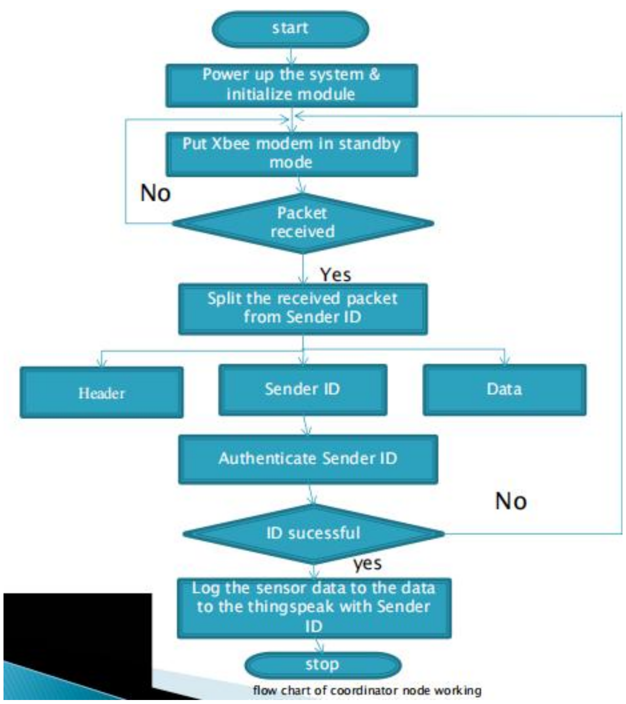
Thingspeak: The cloud which represents the graph that shows the level of garbage in the bin

Block Diagram:



## Methodology:




flow chart of coordinator node working

## Code:

```
#include <ThingSpeak.h>

#include <ESP8266WiFi.h>

char ssid[] = "POCO"; //SSID
```

```
char pass[] = "abcd1234";// Password
const int total_height = 30; // garbage bin height in CM
const int hold_height = 25;// garbage holding capacity (height) in CM
int Minute = 1;
unsigned long Channel_ID = 1933694; // Channel ID
const char * WriteAPIKey = "4OPY3U4NB3OZKMUW"; // Your write API Key
// ---------------------------------------//

const int trigger = 12;
const int echo = 14;
long Time;
int x;
int i;
int distanceCM;
int resultCM;
int bin_lvl = 0;
int snsr_to_max = 0;
const int Field_number = 1;
WiFiClient  client;

void setup() {
  // put your setup code here, to run once:



  Serial.begin(115200);
  pinMode(trigger, OUTPUT);
  pinMode(echo, INPUT);
  pinMode(D2,OUTPUT);
```

```
  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client);
  snsr_to_max = total_height - hold_height;
  delay(2500);
}
  void loop()
{
  internet();
  measure();
//  for (i = 0; i < Minute; i++)
//  {
//    Serial.println("-------------------------");
//    Serial.println("System Standby....");
//    Serial.print(i);
//    Serial.println(" Minutes elapsed.");
//    delay(20000);
//    delay(20000);
//    delay(20000);
//  }
delay(20000);
upload();
}

void upload()
{
  //internet();
  measure();
  x = ThingSpeak.writeField(Channel_ID, Field_number, bin_lvl, WriteAPIKey);
```

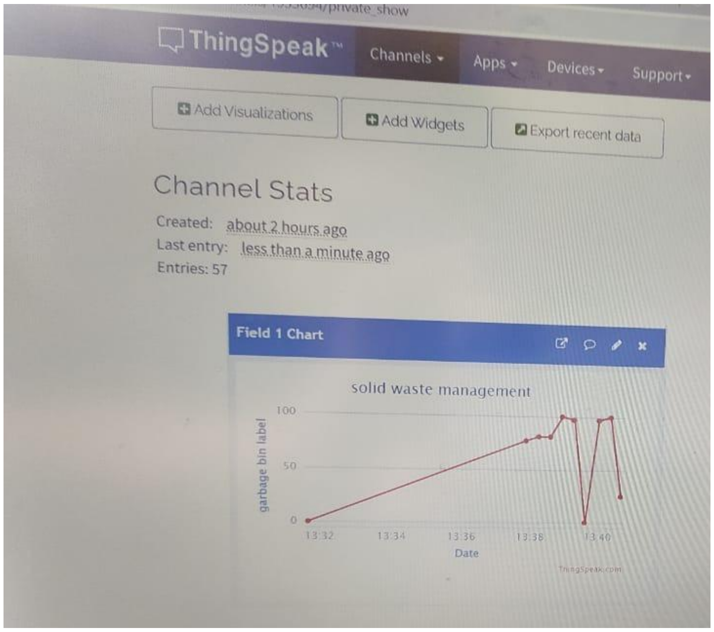
```
  if (x == 200)Serial.println("Data Updated.");
  if (x != 200)
  {
    Serial.println("Data upload failed, retrying....");
    delay(15000);
    upload();
  }
}

void measure()
{
  delay(100);
  digitalWrite(trigger, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigger, LOW);
  Time = pulseIn(echo, HIGH);
  distanceCM = Time * 0.034;
  resultCM = distanceCM / 2;

  bin_lvl = map(resultCM, snsr_to_max, total_height, 100, 0);
  if (bin_lvl > 100) bin_lvl = 100;
  if (bin_lvl < 0) bin_lvl = 0;
  Serial.println(bin_lvl);
  Serial.println(resultCM);
  if(bin_lvl>90)
  {
    digitalWrite(D2,HIGH);
  }
```

```
  else
  {
    digitalWrite(D2,LOW);
  }
}

void internet()
{
  if (WiFi.status() != WL_CONNECTED)
  {
    Serial.print("Attempting to connect to SSID: ");
    Serial.println(ssid);
    while (WiFi.status() != WL_CONNECTED)
    {
      WiFi.begin(ssid, pass);
      Serial.print(".");
      delay(5000);
    }
    Serial.println("\nConnected.");
  }
}
```
**OUTPUT:**




## Result:

The real-time implementation of the system is presented. The XBee-based sensor node is embedded in the bins to check the garbage levels and communicate to the cloud server through the coordinator node, XBee sensor node and coordinator node are embedded with the XBee module. Moreover, the coordinator node is embedded with NodeMCU to communicate the bins' sensory data to the main server via internet connectivity. The garbage level is visualized on LCD; the level of garbage is filled up to 50% and indicated by yellow light. The XBee sensor node perfectly packages with the outer case for avoiding external damage. status of multiple bins, such as the first bin is filled up to 30% and indicated by green light, second bin is empty and showing 0% of its level indicated by green light. The third bin is filled up to 90% of its level and indicated by red light. The fourth bin is filled up to 50% of its level and indicated by yellow light. This indicates that the system is performing in terms of sensing the garbage level and displaying accordingly.

## Conclusion:

Solid waste management is probably the most prominent area where technological advancement is essential to minimize the in fluence of solid waste on the environment and to limit trash overflow from bins. In this study, WPAN and cloud-assisted architecture are proposed and implemented to real-time monitor solid waste from any remote location through Xbee communication and the internet. The customized hardware is developed and implemented in real-time by embedding it in the bins. The customized sensor node and coordinator node which are connected with the cloud server visualize the sensor data and also enable real-time monitoring of the bins.

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