A Project report on

”SMART WASTE MANAGEMENT SYSTEM“

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Eminent College of Management and Technology

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Eminent College of Management and Technology

(in pursuit of knowledge and excellence)

Moshpukur, Barbaria P.O-jagannathpur Barasat, West Bengal, Kolkata-700126

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'SMART WASTE MANAGEMENT SYSTEM'

Under the Domain of IOT INTERNET OF THINGS. Submitted by Debjyoti .Dutta ,Krishanu Chakraborty,Saugata Mondal,Snigdha Basak to the University

: Date

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I am sincerely thankful and indebted to **PROF. SURAJIT GOON academic director of Eminent College Of Management And Technology**. For his constant encouragement and continous valuable suggestions throughout my project work.

Finally, but most importantly, my parents and my seniors and my friends has always been there for me during the ups and downs situations, sharing my experience, excitements and frustrations. Their love and understanding have allowed me to make this thesis successfully.

With Regards,

Debjyoti Dutta(34801221022)

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Saugata Mondal(34801221067)

Snigdha Basak(34801221056)

INDEX

INTRODUCTION

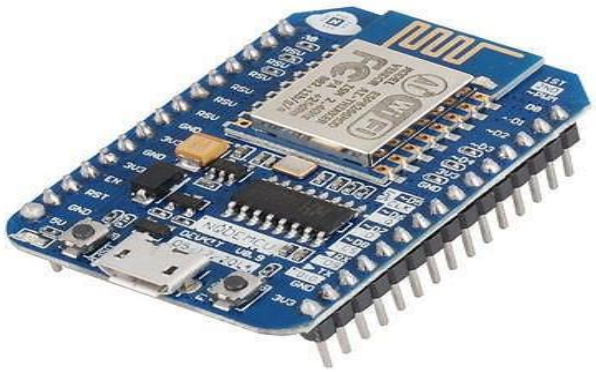
❖ ABSTRACT

This project is itended for construction of a smart garbage management device. The project is based on **NODE MCU** and for the waste detection we are use 2 types of sensors

1. **Ultra Sonic Sensor** : This sensor is used to identify the depth of the dustbin once it has fulfilled the required balance of the waste then it sends the signal to the **IR sensor.**
2. **IR Sensor**: This sensor is used to rectify the signals which we are send or recive by the sensor.

- **About NODE MCU**

  NodeMCU is an open-source LUA based firmware developed for the ESP8266 wifi chip. By exploring functionality with the ESP8266 chip, NodeMCU firmware comes with the ESP8266 Development board/kit i.e. NodeMCU Development board.



❖ NodeMCU ESP 8266 Technical Specifications and features:

- **Wireless Module ESP8266:**With wireless connectivity for Internet of Things applications, the ESP8266 Wi-Fi module is the brains behind NodeMCU.

- **Unit of Microcontroller (MCU):**A 32-bit Tensilica L106 microprocessor is part of the ESP-12E/F module.

- **Speicher Flash:** The firmware and user programs are stored in the 4MB of flash memory that Node MCU normally ships with.

- **GPIO Pins**: General Purpose Input/Output Many GPIO pins on the NodeMCU can be utilized for a variety of purposes, including digital input/output, analog input, PWM (Pulse Width Modulation), I2C, SPI, and more.

- **ADC, or analog-to-digital converter**: It has an ADC that enables the board to read values from analog sensors.

- **USB to TTL Convertor**: The USB-TTL converter that Node MCU incorporates makes it simple to connect the board to a computer for programming and troubleshooting. USB connector included in, There is a on the Node MCU board.

- **Firmware for Node MCU**: For the ESP8266, the Node MCU firmware offers a straightforward and user-friendly programming interface.

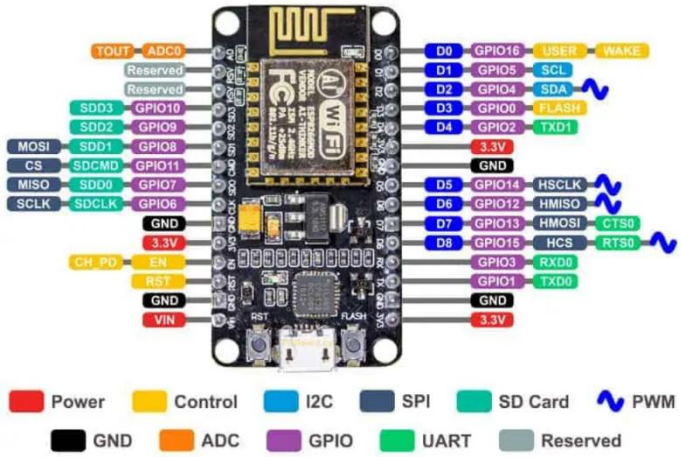
- **IDE Compatibility for Arduino**: The Arduino IDE may be used to program NodeMCU, making it available to a wide range of Arduino developers.

- **Open-Source Hardware**: The design files for Node MCU, an open-source hardware platform, are accessible to everyone.

- **Community Assistance**: With Node MCU, there is a sizable and vibrant developer and maker community that offers assistance, guides, and a plethora of resources.

- **Low Price:** Because Node MCU boards are typically inexpensive, hobbyists and developers on a tight budget often choose them.

    - **NodeMCU ESP8266 Pinout and Functions Explained**



Power: The NodeMCU development board is a popular platform for IoT (Internet of Things) projects, and it is based on the ESP8266 WiFi module. Usually, the NodeMCU board has multiple pins for connections pertaining to power.

Control: The NodeMCU ESP8266 is a popular development board that uses the ESP8266 WiFi module. It is commonly used for IoT (Internet of Things) projects. To control a pin on the NodeMCU ESP8266, you typically use the Arduino IDE and write code in C++.

12C: The following are the default I2C pins on the NodeMCU ESP8266 boardI2C devices are frequently connected to the ESP8266 via these pins. Make sure the SDA and SCL pins on your I2C device are connected correctly if you are using it. For I2C communication, don't forget to include the Wire library in your Arduino sketch.

SPI: The ESP8266 microcontroller, including the NodeMCU development board, supports SPI (Serial Peripheral Interface) for communication with other devices. SPI is a synchronous serial communication protocol commonly used to communicate with sensors, displays, and other peripherals.

SD Card: An SD card module typically includes an SD card slot and a microcontroller that communicates with the ESP8266 through SPI (Serial Peripheral Interface) communication. This module allows you to read and write

data to an SD card, providing a convenient way to add storage to your ESP8266 projects.

PWM: The ESP8266, including the NodeMCU development board, supports PWM (Pulse Width Modulation), which allows you to simulate analog output by varying the duty cycle of a digital signal. On the ESP8266, you can use the **analogWrite()** function to generate PWM signals on certain pins.

GND: The Ground (GND) pins on the ESP8266, including the NodeMCU development board, are the pins that provide the reference voltage for the board and complete electrical circuits. Each of the GPIO (General Purpose Input/Output) pins on the ESP8266 has a corresponding GND pin for ground connection.

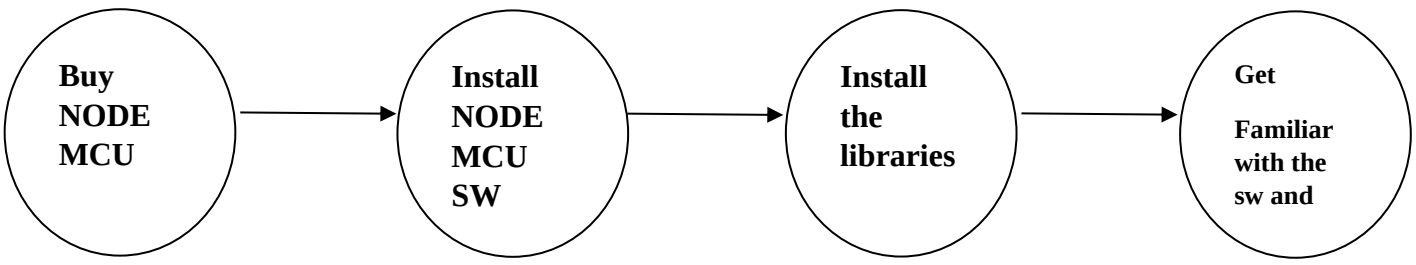
ADC: The ESP8266, including the NodeMCU development board, has an Analog-to-Digital Converter (ADC) that allows you to read analog signals. The ESP8266 ADC is capable of reading analog voltages in the range of 0 to 1.0V.

GPIO: The ESP8266, including the NodeMCU development board, has General-Purpose Input/Output (GPIO) pins that you can use for various purposes such as digital input or output, PWM (Pulse Width Modulation), and more. GPIO pins are versatile and can be configured for different functionalities in your ESP8266 projects.

UART: The ESP8266, including the NodeMCU development board, has UART (Universal Asynchronous Receiver/Transmitter) functionality, allowing communication over serial ports. The ESP8266 typically has two hardware UARTs: UART0 and UART1. UART0 is commonly used for programming and debugging, while UART1 is often available for general-purpose communication.

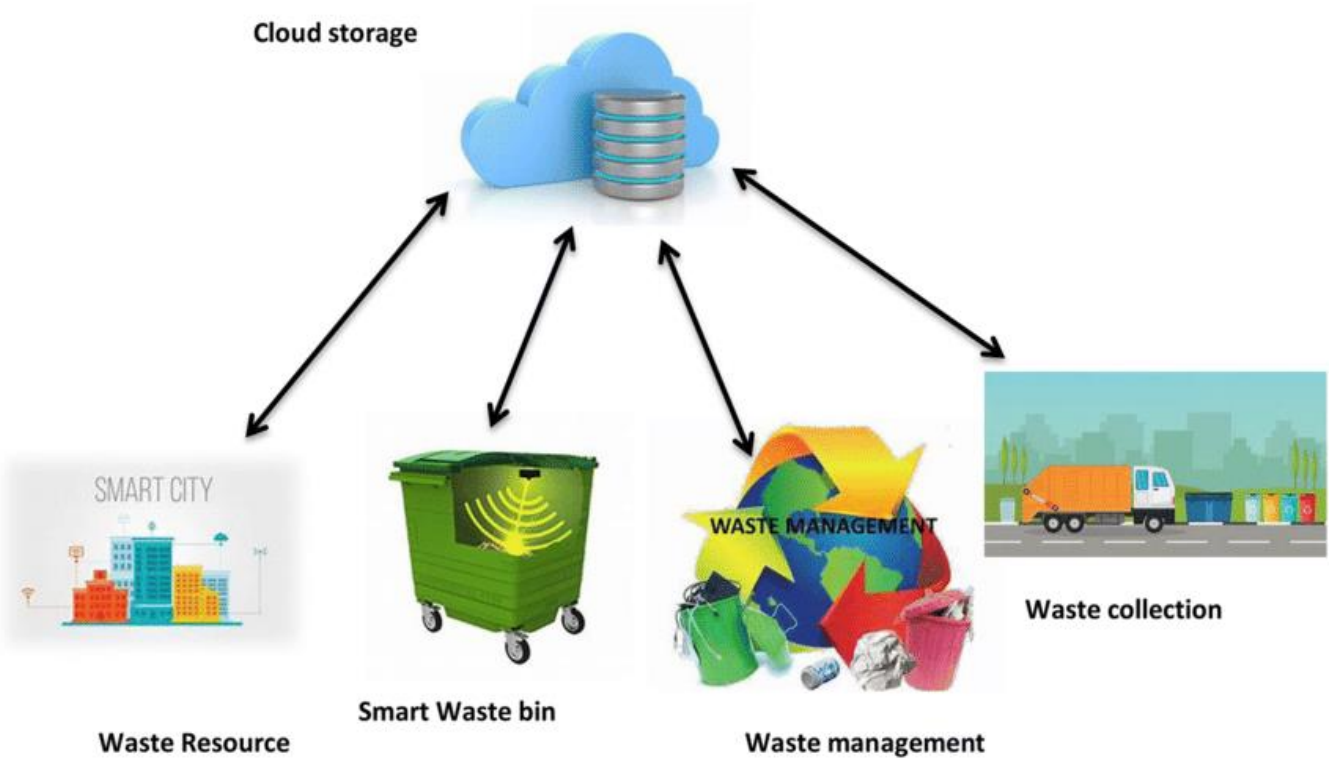
Reserved: the NodeMCU development board, typically refers to certain pins or features that have specific functions or limitations imposed by the hardware design or the firmware. These reserved pins or features may have special purposes or characteristics that differentiate them from general-purpose GPIO (General-Purpose Input/Output) pins.

- **How to get started**



- **Why this project**:

It would open a lot opportunities of using it. It will be used for cleaning the area sequentially. Beside this, as the dustbin is managed by the user depends on the live monitoring system. If the dustbin get filled we got an notification on the app.



Objective

The objectives of a Smart Waste Management System project using IoT (Internet of Things) typically revolve around improving efficiency, reducing costs, and enhancing sustainability in waste management processes. Here are common objectives for such a project:

1.Real-Time Monitoring: Implementing sensors in waste bins to monitor the fill

level in real-time. This helps optimize waste collection routes and schedules, reducing unnecessary pickups and associated costs.

2.Optimized Collection Routes: Analyzing the data collected from sensors to optimize waste collection routes. This reduces fuel consumption, minimizes traffic congestion, and lowers carbon emissions.

3.Cost Reduction: By optimizing collection routes and schedules, the project aims to reduce operational costs associated with fuel, labor, and vehicle maintenance. This can result in significant cost savings for waste management services.

4.Prevent Overflow and Littering: Timely notifications and alerts triggered by sensor data can help prevent overflowing waste bins, reducing the likelihood of littering. This contributes to a cleaner environment and improved public health.

5.Resource Efficiency: Efficient waste management leads to better resource allocation. By collecting waste only when necessary, resources such as fuel and manpower are used more efficiently.

6.Data-Driven Decision Making: Gathering and analyzing data from the IoT devices allows waste management authorities to make informed decisions based on trends, patterns, and historical data. This data-driven approach enhances overall decision-making processes.

7.Remote Monitoring and Management: Providing the capability to remotely monitor and manage waste bins and collection processes. This is particularly useful for large-scale waste management systems where physical inspection of every bin is not practical.

8.Environmental Sustainability: Contributing to environmental sustainability by reducing the carbon footprint associated with waste collection. Optimizing routes and schedules minimizes the impact of waste management activities on the environment.

9.Public Awareness and Engagement: Integrating the system with communication channels to keep the public informed about waste collection schedules, environmental impact, and ways to participate in waste reduction

10.efforts. This promotes public awareness and engagement in sustainable practices.

11.Scalability: Designing the system to be scalable, allowing it to accommodate the growing needs of urban areas and adapt to changes in waste generation patterns

over time.

12.ntegration with Smart City Initiatives: Aligning the Smart Waste Management System with broader Smart City initiatives to create a cohesive urban infrastructure that leverages technology for sustainable, efficient, and intelligent urban living.

By addressing these objectives, a Smart Waste Management System using IoT can contribute to more sustainable and efficient waste management practices in urban areas.

Components

There are basic components of our project :

Hardware

1. Node MCU ESP8266

Software

1. MIT app inventor

2. Breathboard
3. IR Sensor
4. Jumper Wires
5. UltraSonic Sensor
6. Servo Motor
7. Dustbin

2. Arduino IDE
3. Google FireBase



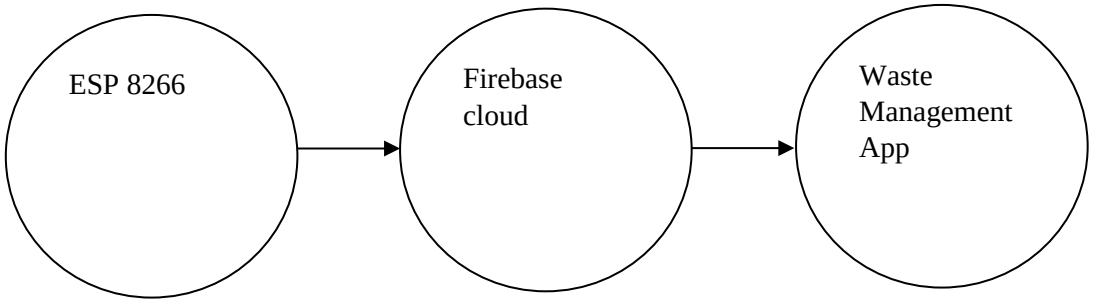



SYSTEM DESIGN

- **ABSTRACT:**

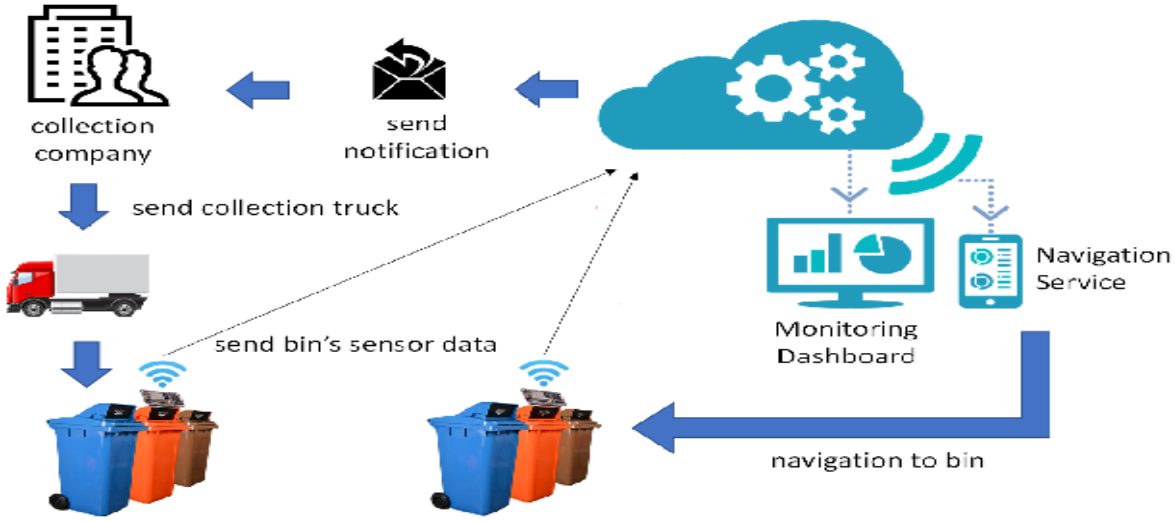
The Smart Waste Management System is a cutting-edge solution that employs IoT devices and technologies to optimize and modernize the waste management process. Traditional waste collection methods often suffer from inefficiencies, leading to increased operational costs, environmental impact, and inconvenience to the public. This project addresses these challenges by integrating smart sensors into waste bins, enabling real-time monitoring of their fill levels. The system collects and analyzes this data to dynamically optimize waste collection routes and

schedules.



BASIC BLOCK DIAGRAM

III METHODOLOGY



- **Node MCU ESP8266:**

The NodeMCU ESP8266 is a popular open-source development board that is built around the ESP8266 Wi-Fi module. It combines the capabilities of the ESP8266 microcontroller with a convenient form factor and ease of use. The NodeMCU board is widely used for Internet of Things (IoT) projects due to its low cost, integrated Wi-Fi capabilities, and compatibility with the Arduino IDE.

1.**ESP8266 Wi-Fi Module:** The ESP8266 is a versatile and low-cost Wi-Fi module that integrates a microcontroller and Wi-Fi connectivity. It allows the NodeMCU to connect to Wi-Fi networks and communicate with other devices over the internet.

2.NodeMCU Firmware: The NodeMCU firmware is a custom firmware that runs

on the ESP8266 and provides a Lua interpreter. This allows developers to write scripts in the Lua programming language directly on the NodeMCU board.

3.Arduino Compatibility: While the NodeMCU firmware supports Lua, many developers use the NodeMCU ESP8266 with the Arduino IDE, which provides an easy-to-use programming environment based on C++. The Arduino IDE simplifies the development process for those familiar with Arduino programming.

4.USB-to-Serial Converter: The NodeMCU board typically includes a built-in USB-to-Serial converter (CH340 or CP2102), allowing easy programming and debugging by connecting the board directly to a computer via USB.

5**.GPIO Pins:** The NodeMCU board has a set of GPIO (General-Purpose Input/Output) pins that can be used for various purposes, such as digital input or output, PWM, and analog input.

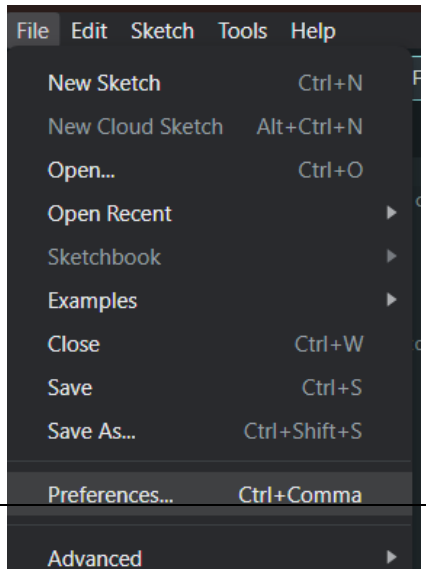
6.Power Supply: The NodeMCU can be powered through the USB port or an external power source. It operates at 3.3 volts, so it is essential to be mindful of voltage levels when interfacing with other devices.

7.Integrated LEDs: The board often includes onboard LEDs that can be used for basic visual feedback or debugging.

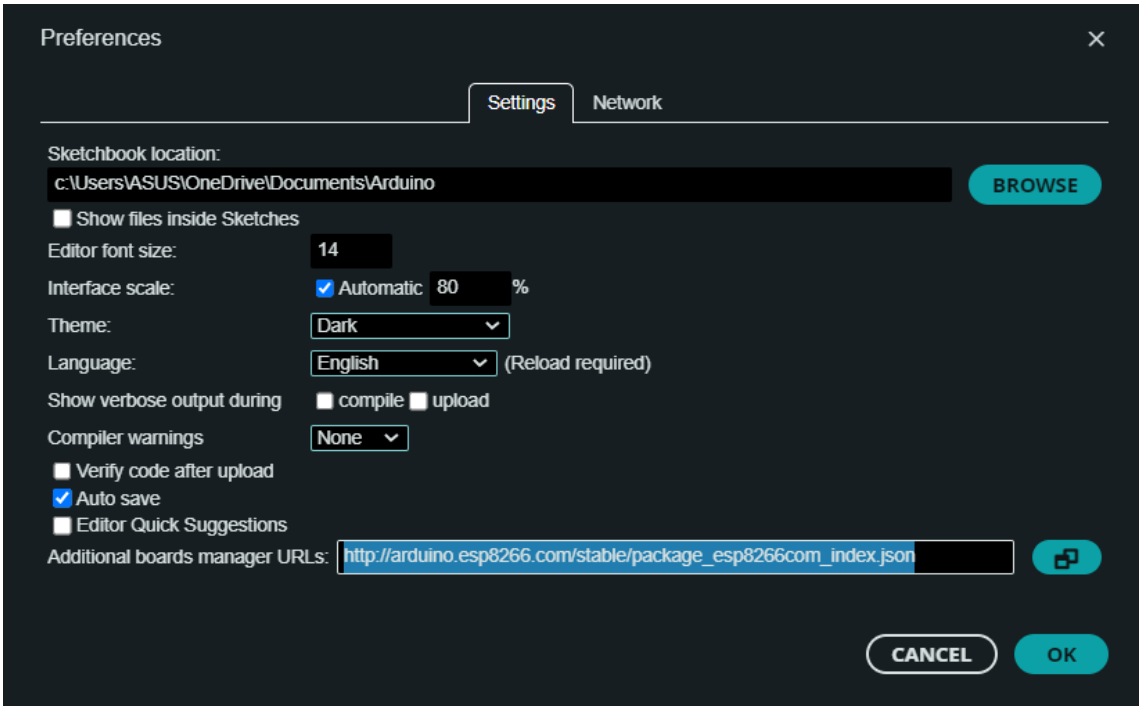
8.Form Factor: The NodeMCU board has a compact form factor that makes it easy to integrate into small electronic projects.

Installing ESP8266 board in Arduino IDE

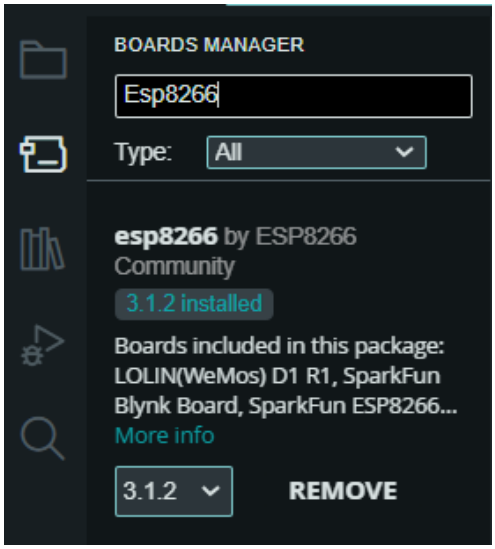
1. In Arduino IDE, go to File > Preferences.



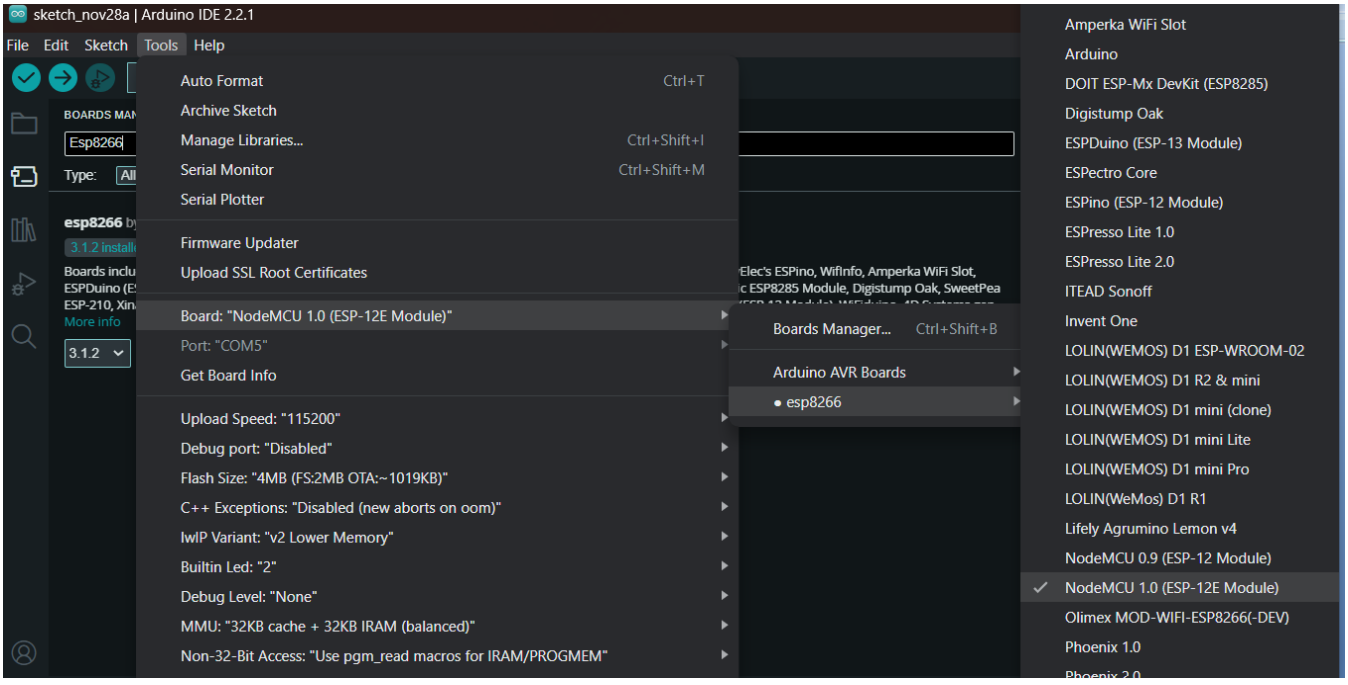
2. Add the json link and click ok.



3. Now ESP8266 Board will be available for installation.



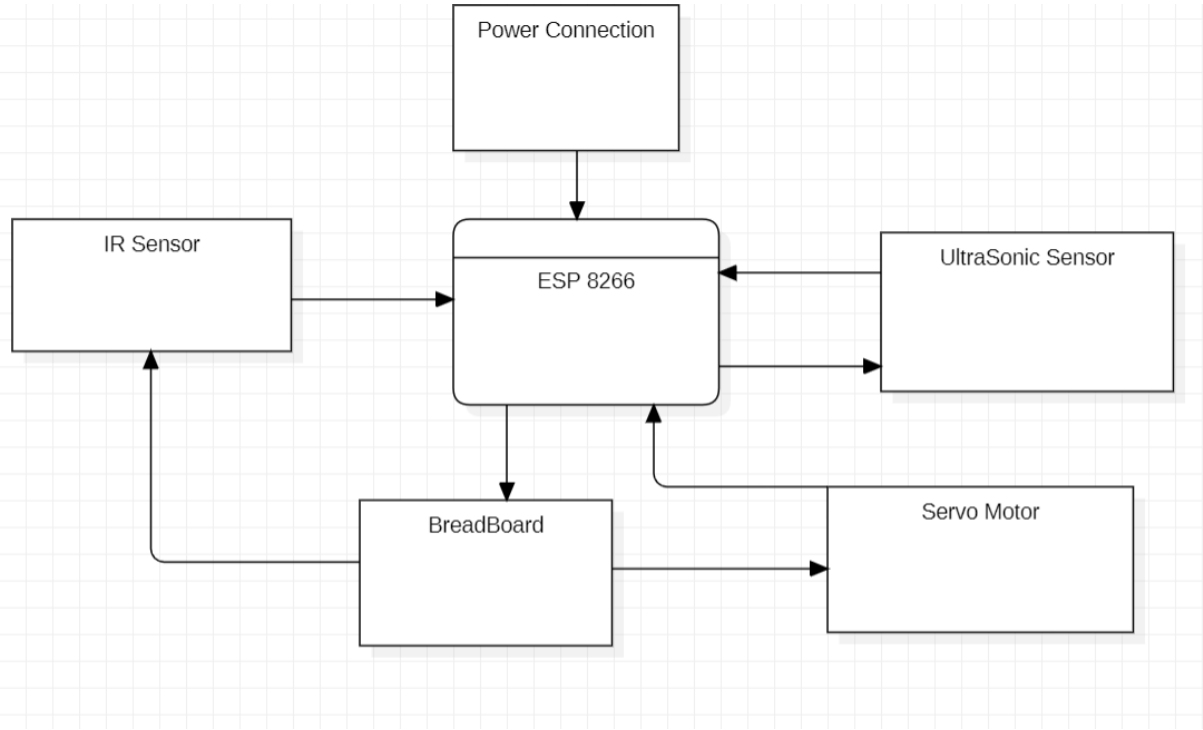
4. After installation ESP8266 board will be available here.



This is how we can easily install ESP-8266 (NodeMcu 1.0(ESP-12E Module) in our Arduino Software.

CIRCUIT DESCRIPTION

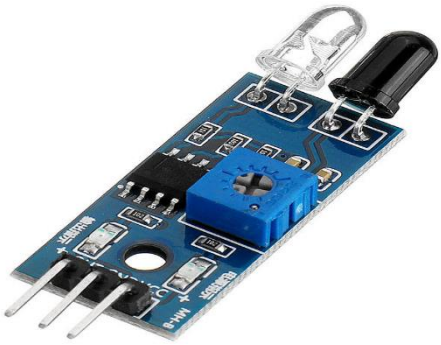
The basic concept involves the sensors measuring the fill level, the microcontroller processing and transmitting the data, a central server analyzing the information, and an alerting mechanism triggering actions when necessary. The system's architecture may vary based on specific requirements and the scale of implementation.



Basic Circuit Diagram

- **IR Sensor**

  This model, Smart Waste Management System (SWM) effectively employs IR sensor to identify dry waste items, and capacitive soil moisture sensor along with IR sensor to differentiate between dry and wet wastes.



- **Servo Motor**

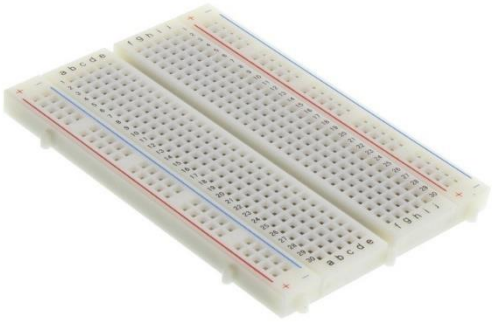
  The servo motor is used to open and close the dustbin automatically, providing a more convenient and hygienic way of disposing of garbage. The system is connected to the internet using Node mcu and is controlled remotely using the Webserver Platform.

- **UltraSonic Sensor**

  Ultrasonic sensor is a device that uses sound waves beyond the range of human hearing (ultrasonic waves) to measure distance, detect objects, or create images of surroundings. It typically consists of a transmitter that emits ultrasonic pulses and a receiver that detects the reflected waves, allowing the sensor to calculate distances based on the time taken for the waves to travel to an object and back. Ultrasonic sensors are commonly used in various applications, including proximity sensing, object detection, and navigation systems.

- **Bread Board:**

A breadboard is a prototyping tool used in electronics to build and test circuits without soldering. It allows for quick and temporary connections of electronic components, facilitating experimentation, testing, and the development of prototypes. Breadboards are widely used by hobbyists, students, and engineers for designing and troubleshooting circuits before finalizing them on a more permanent platform.



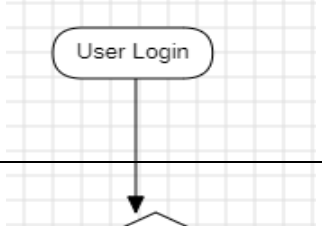
- **Connection of ESP-8266 and IR Sensor**

Pin on ESP 8266 Module	**Pins on IR sensor**
D3	OUT
G	GND
3V	VCC

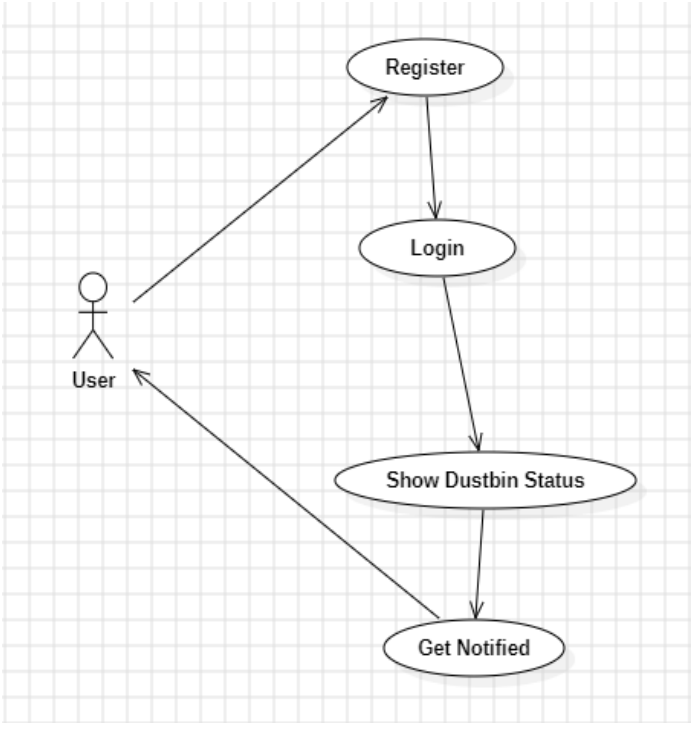
- **Connection of ESP-8266 and Ultra sonic sensor**

Pin on ESP 8266 Module	**Pin on Ultra Sonic Sensor**
VIN	VCC
G	GND
D1	TRIG
D2	ECHO

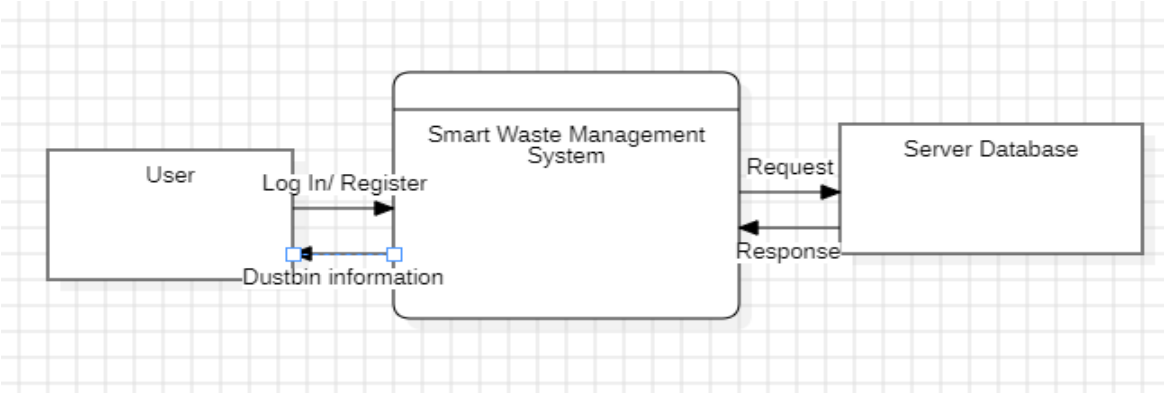
FLOW CHART



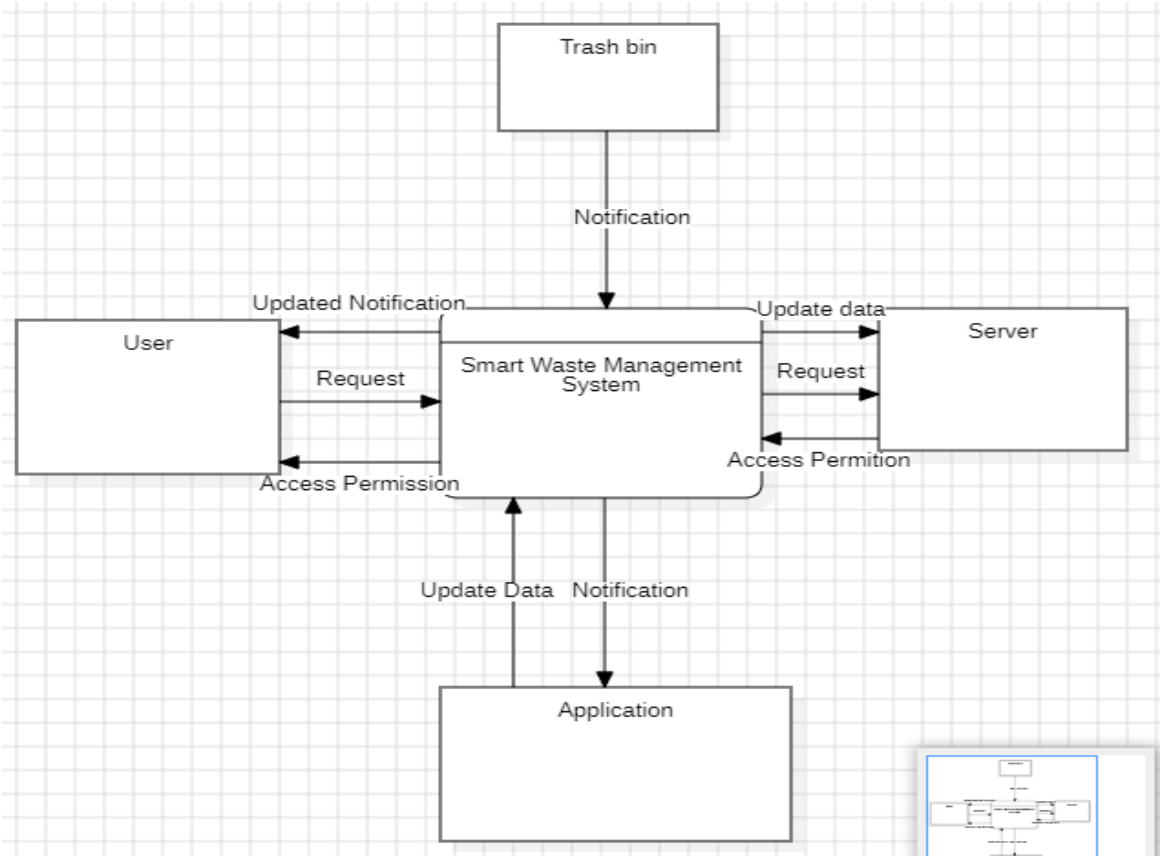
USE CASE DIAGRAM



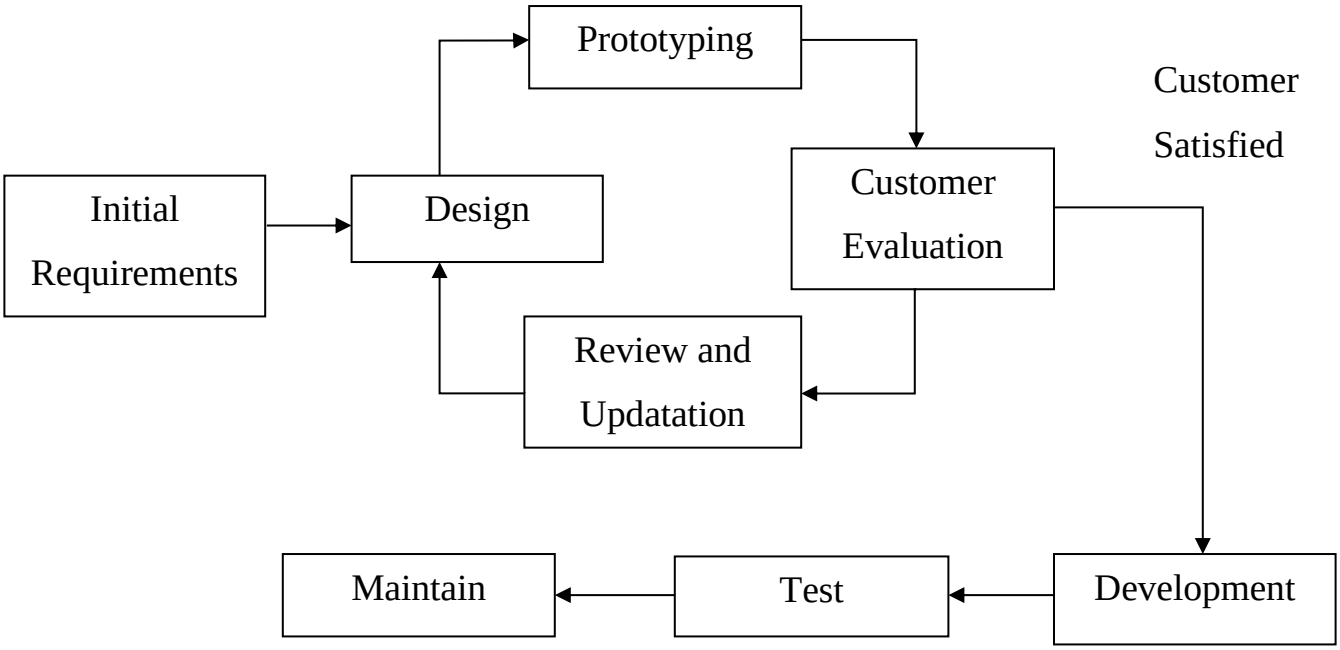
0 LEVEL DFD



LEVEL 1 DFD



Proto Type Model



Advantages & Disadvantage:

- **Time and Cost Saving** : it is a cost saving way to clean our area in a very short time
- **Sustainability**: it can maintain garbage-free and sustainable environment for the public.
- **Improved Efficiency** : Because of Continous data updation the trash bin cleaned sequentially.
- **Transparency**: The area can be cleaned in a transparentable way.
- **Data Analytics**: updated data can be send or may have recived any notification which can be operated by the cloud.

Disadvantage

- **Dependency on Technology**: Growing towards to the future generation everything gonna be smart and we have to depend to the computers
- **Privacy Concerns**: Some smart bins use sensors to collect data about the waste habits of individuals or households. This data can be used to analyze patterns and optimize waste management strategies, but it also raises privacy concerns.

Future Scope

This Project offers a lot of scope for adding newer features

It is probable that in the future, waste management systems will prioritize sustainability by integrating cutting-edge technologies for effective sorting, recycling, and waste-to-energy procedures. While creative educational initiatives could raise public awareness and engagement, astute monitoring and data analytics could optimize collecting routes. The elimination of single-use items and promotion of reuse are two aspects of the circular economy that will probably have a big impact on waste management in the future. Further developments in biodegradable packaging and bio-based materials may help reduce their negative effects on the environment.

CONCLUSION

To sum up, solid waste management is a crucial procedure for safeguarding the environment and public health. Improper disposal of garbage can have far-reaching and long-lasting implications on the planet's health.

We may lessen our influence on the environment and preserve resources for future generations by putting into practice sustainable waste management techniques, such as waste reduction, recycling, composting, and the use of contemporary landfills and waste-to-energy plants.

REFERENCE

Articles

- **ESP 8266 Internet of things Book By Amazon Kindle**
- **Internet of Things With ESP 8266 BY Macro Schwartz**
- **Electronics Projects with the ESP 8266 by Neli Cameron**

Websites

https://www.geeksforgeeks.org

https://www.wikipedia.org/

https://www.arduino.cc/

https://appinventor.mit.edu/

https://chat.openai.com/

Appendix

FirebaseDemo.ino

```
#include <FirebaseArduino.h>
#include <ESP8266WiFi.h>
//#include <ArduinoJson.h>
//#include <ESP8266_ISR_Servo.h>

#define REFERENCE_URL "waste-management-by-sam-default-rtdb.firebaseio.com"  // Your Firebase project reference url
#define FIREBASE_AUTH "fnxTldIYx9VSyjGWeKes8IXpYl5s08qlwUfGYQrX"
#define WIFI_SSID "I1927"
#define WIFI_PASSWORD "AKASH505"
#define DUSTBIN_LENGTH 22  // Assuming dustbin length
const int ULTRASONIC_TRIG_PIN = D7;
const int ULTRASONIC_ECHO_PIN = D8;
double distanceVal = 0;
//#define IR_SENSOR_PIN D3
//#define SERVO_PIN D4

//ISR_Servo lidServo;
```

```
//ISR_Servo lidServo;

void setup() {
  pinMode(ULTRASONIC_TRIG_PIN, OUTPUT);
  pinMode(ULTRASONIC_ECHO_PIN, INPUT);
  Serial.begin(9600);

  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");
  Serial.println(WiFi.localIP());
  Serial.println(DUSTBIN_LENGTH);
  Firebase.begin(REFERENCE_URL, FIREBASE_AUTH);  // Initialize Firebase with custom HttpClient
  //pinMode(D5,OUTPUT);
  //pinMode(D6,OUTPUT);
  if (Firebase.failed()) {
    Serial.print("Firebase connection failed: ");
    Serial.println(Firebase.error());
  } else {
    Serial.println("Firebase Connected");
    Firebase.setString("/Waste_Management/distance", "0");
    Firebase.setString("/Waste_Management/Remaining", "0");
  }
}

//pinMode(IR_SENSOR_PIN, INPUT);

//lidServo.attach(SERVO_PIN);
```

```
void loop() {
  measureDistance();  // Measure distance from the sensor

  int remainingSpace = (DUSTBIN_LENGTH - distanceVal);

  Serial.print("Distance: ");
  Serial.println(distanceVal);

  Serial.print("Garbage Level: ");
  Serial.println(remainingSpace);

  if (remainingSpace <= 8) {
    Serial.println("Empty");
  } else if (remainingSpace <= 16) {
    Serial.println("Half Full");
  } else if (remainingSpace >= 17) {
    Serial.println("Full");
  }

  //if (motionDetected) {
  //openLid();
  //delay(5000);
  //}
  //delay(1000);
  Firebase.setInt("Remaining", remainingSpace);
  delay(1000);
}

void measureDistance() {
  digitalWrite(ULTRASONIC_TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(ULTRASONIC_TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(ULTRASONIC_TRIG_PIN, LOW);

  long duration = pulseIn(ULTRASONIC_ECHO_PIN, HIGH);
  distanceVal = duration * 0.034 / 2;

  Firebase.setFloat("distance",distanceVal);
}
```

```
//void openLid() {
//lidServo.write(90);
//delay(1000);
//lidServo.write(0);
//}
```