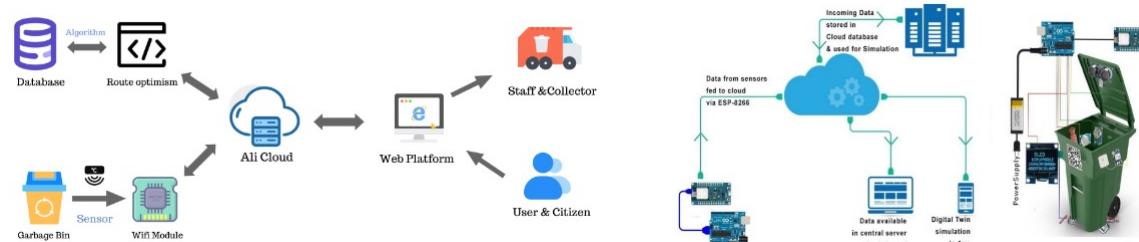


# An IoT Garbage Monitoring System For Effective Garbage Management

Hanlin Cai, Fuzhou University, China





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**Hanlin CAI**

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## About Me

My name is Hanlin CAI. A 3rd year undergraduate student majoring in Robotics and Intelligent Devices at Maynooth International Engineering College (MIEC), **Fuzhou University**, China. MIEC is a joint international partnership between Fuzhou University, China and **Maynooth University**, Ireland.

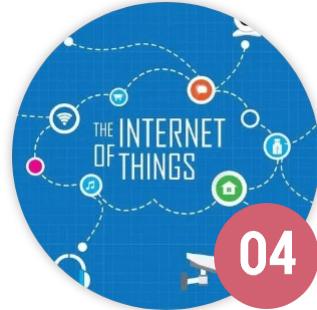
## Research Interests

Currently, I am interested in **IoT (Internet of Things)** and **ML (Machine Learning)**. Also, I a student research assistant of the Key Laboratory of Industrial Automation Control Technology and Information Processing at Fuzhou University.

## Awards of Our Works

Third Prize (Top 8%) in China National College Student Computer Design Competition in Aug 2022 (**Proposed works in this paper**)

# Demo Content



## Background Related Works

## Overview of Our works

## Experiments Results

## Conclusion Future Plan



# PART. 01

## Background

## Literature Review



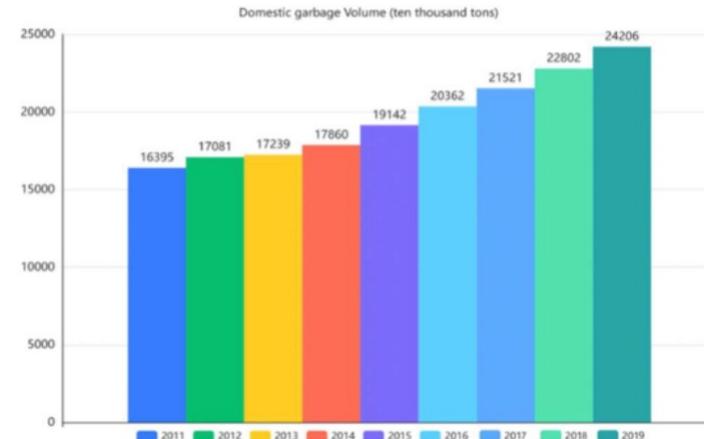
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# Background

Nowadays, pressure on municipal waste treatment is increasing.

**2.01 billion tons** of municipal solid waste annually.

Utilizing low-cost and low-power IoT technology become a popular trend.



# Literature Review

To date, many researchers have focused on the garbage monitoring system based on IoT technology. In our paper, we have reviewed many related literatures works, including **real-time monitoring system, effective garbage management and the relevant applications of machine learning technology.**

An new monitoring Android app proposed by [Vamsi, et al. \(2021\)](#)  
The Zigbee technology is utilized in the works of [Raaju, et al. \(2019\)](#)  
A supervision strategy to avoid safety incidents by [Savla, et al. \(2020\)](#), and so on.

In our work, **a new dynamic web page** that can intuitively display the state of each trash bin for real-time monitoring is developed.

Our design has significantly **improved the efficiency** of waste disposal and **reduced the labour burden.**

## PART. 02

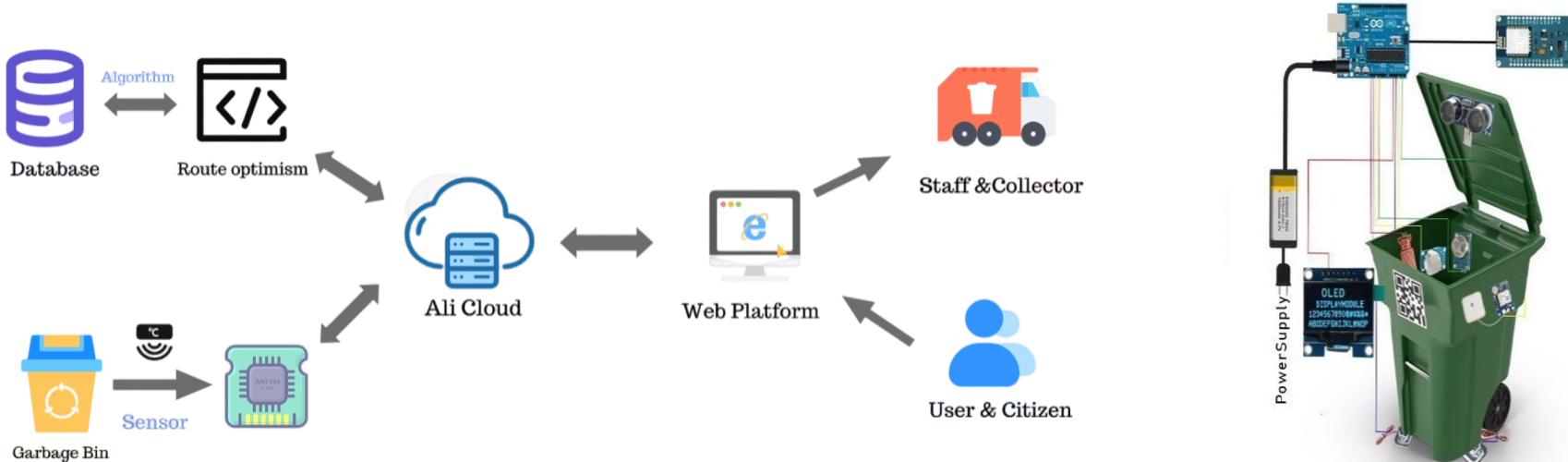
# Overview of Our Works



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# General Process

Our paper proposes an intelligent garbage management system for urban communities: **Garbage Manager**. The Garbage Manager aspires to create energy-efficient and real-time waste detection based on **IoT and data visualization technology**. In our work, the **NodeMCU chip** integrated with a high-precision ultrasonic sensor is used to measure the height of the waste in the garbage bin, and transmits the data to the database through the **Ali-cloud IoT platform**. In addition, a **dynamic web-page** is created as a graphical user interface to display the status of the garbage bins in real-time.



# Specific Information

Sensors: Ultrasonic / Temperature / Humidity Sensors

WiFi Module : ESP-8266 Wi-Fi SoC based on ESP-12

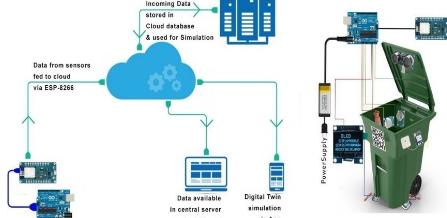
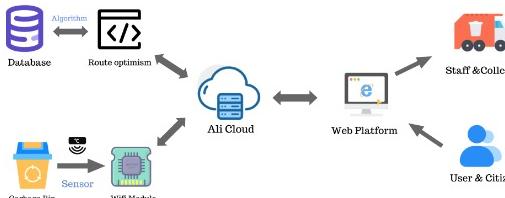
IoT platform : NodeMCU platform

Arduino Uno : to Connect the Hardware & Software

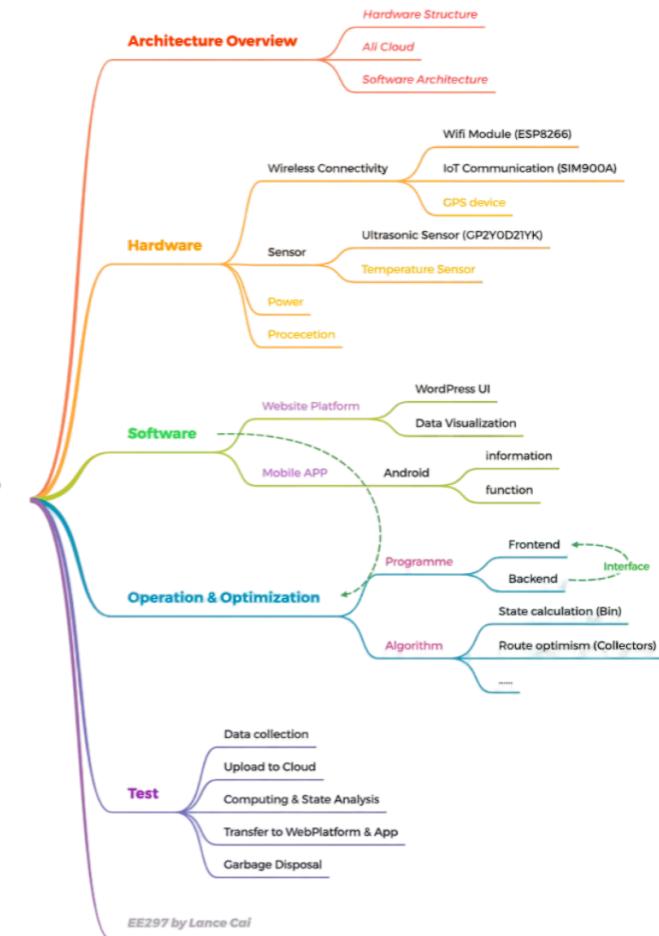
Advanced Server : Ali-Cloud Server

Graphical user interface: java-based Web Page

Development IDE: ArduinoIDE / IDEA / Visual Studio



IoT Garbage Manager

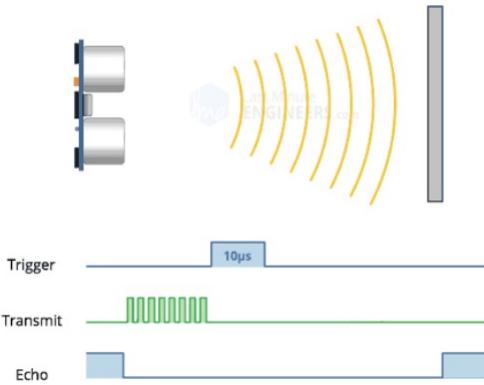
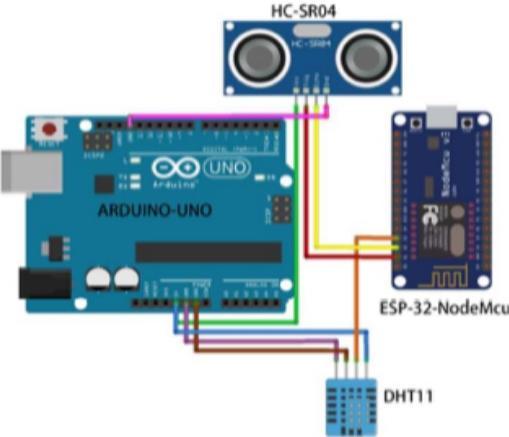


# 1 Hardware

Sensor Module : Ultrasonic / Temperature / Humidity      To collect the data

WiFi Module : ESP 8266 SoC (NodeMCU)      To upload the valid data to Server

Arduino Uno / Arduino IDE : To connect the Hardware & Software



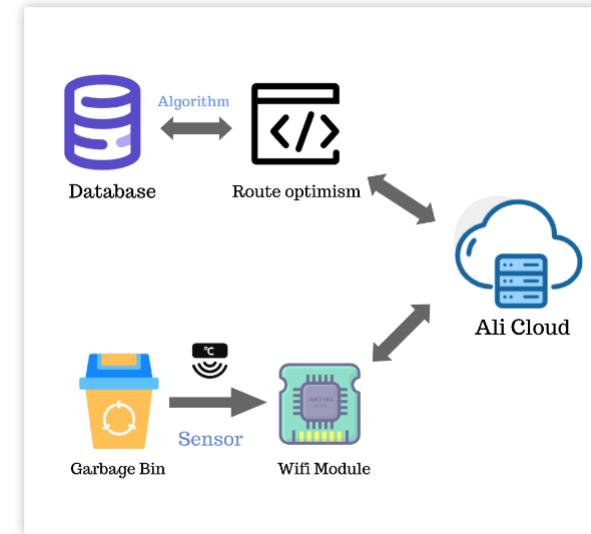
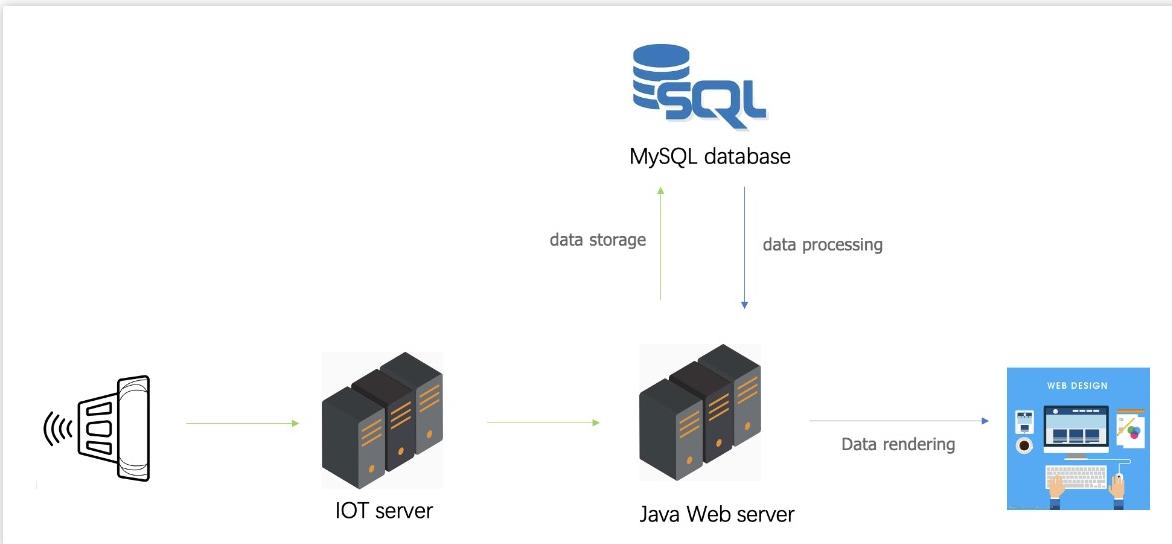
# 2 Back-End

Based on **Java 11**, developed using IDEA

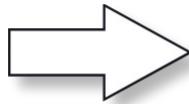
Frameworks: **Springboot + Maven**

Server Database: Ali-Cloud Database.

Also, the API have been constructed to connect with front-end.



### 3 Front-End (Web Page)



Real-time data Acquisition

Intuitive Graphical User Interface

Based on: **Html5, CSS and JavaScript**

Frameworks: **Ajax and Vue**, to call the API, which help realize the connection between the front-end and the back-end.

User interface: a **dynamic web-page** for real-time monitoring

# PART. 03

## Experiments Conclusion



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# Experiments

Experiments in the students' living area at Fuzhou University.

The height of the trash, temperature and humidity in the bins.

When the height in the bin **exceeds 80%**, the website will alert the garbage cleaners by sending a notification.

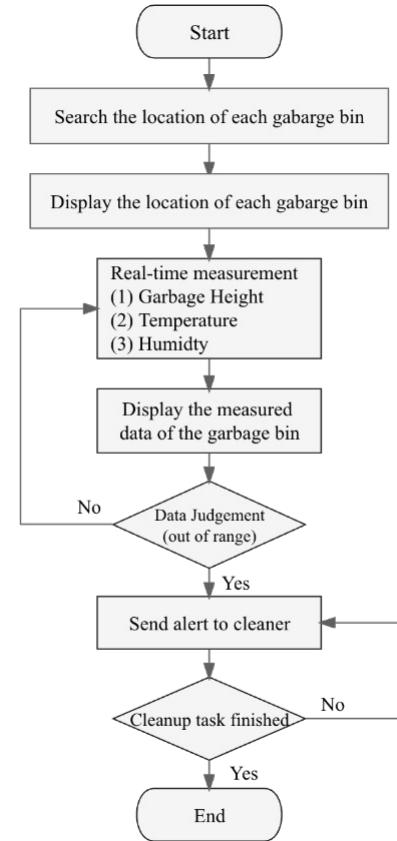
The **cleaning and overflow times** of each garbage bin before and after the installation of the garbage manager are recorded.



Fig. 6 The hardware of the Garbage Manager



Fig. 7 The Trash Bin equipped with Garbage Manager



# Numerical Results

The average number of garbage disopsal tasks decreased from 3.00 to 2.28 times a day, which was reduced by 24.07%.

While the average daily overflow time decreased from 0.67 to 0.11 times a day, which was reduced by 83.33%.

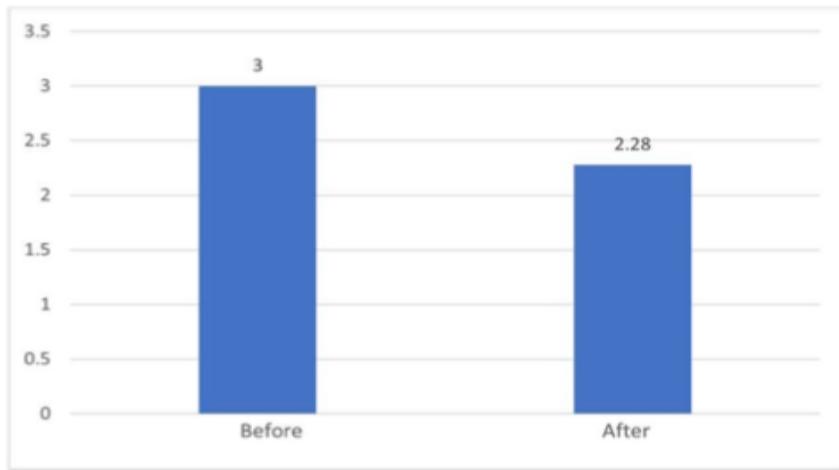


Fig. 8 Average number of cleanings

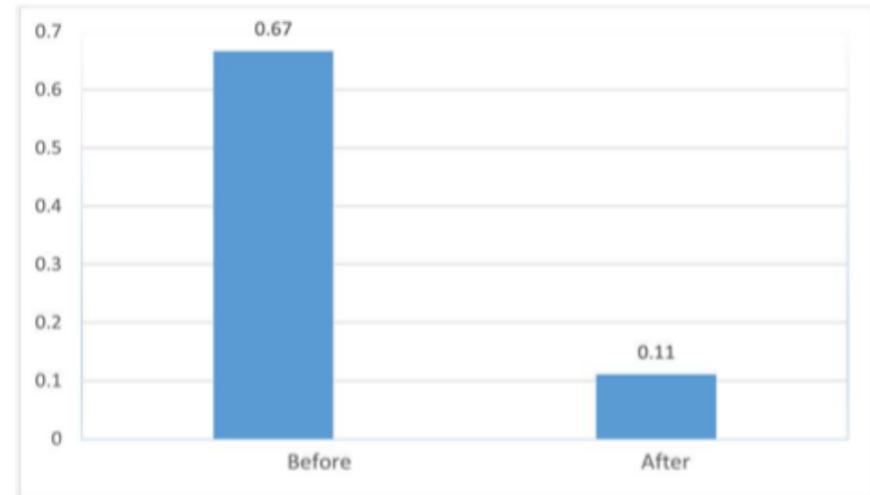


Fig. 9 Average number of overflows



# PART. 04

## Future Plan

## Acknowledgements



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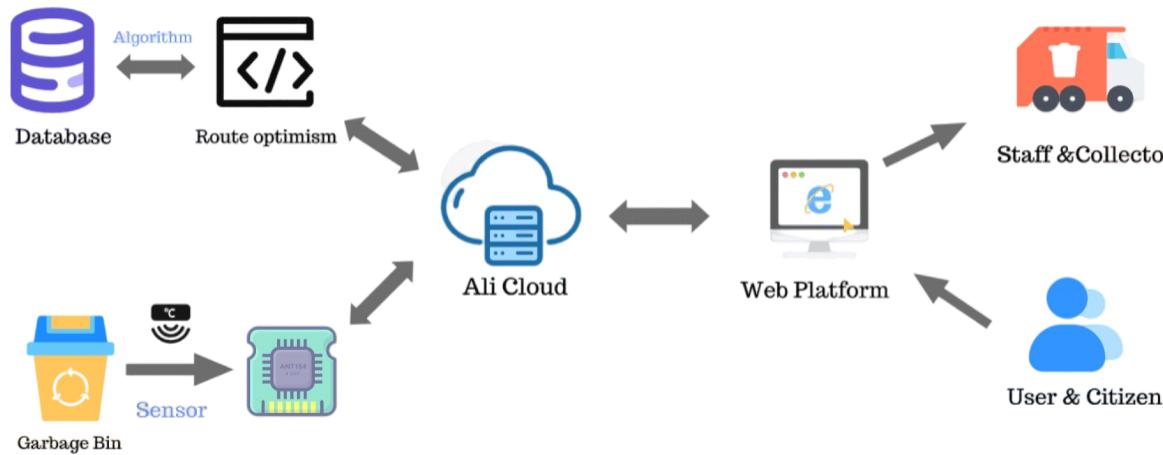
# Conclusion

**Garbage Manager:** a efficient garbage monitoring system for urban communities.

Based on various hardware, an advanced cloud server, and a **graphical user interface**.

The status of each garbage bin can be observed via the dynamic web-page.

Experimental results show the Garbage Manager can effectively **reduce the burden** on the waste disposal tasks and **improve the environment** around the garbage bin.



# Future Plan

Navigation algorithm to provide the shortest path to the collection point.  
Android App for monitoring systems will also be included.

## Acknowledgements

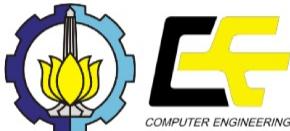
The authors greatly acknowledge the anonymous reviewers for their constructive comments and suggestions to improve this paper. The authors would like to thank the generous support of Maynooth International Engineering College (Fuzhou University, China).

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# Thank you For your Listening

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