

# SMARGAR –An IoT based Smart Garbage Monitoring System for Preserving Historic College Campuses

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**Abstract:-** Internet of Things facilitates the realization of the sustainable growth of numerous smart systems and devices. Smart IoT based Garbage Monitoring System is an indispensable part in building clean college campuses. Garbage bins are kept at various places in the college campuses. Manual checking of each of these bins kept at various places inside the college campuses, might consume more time and energy sometimes leads to overflowing of garbage bins. Overflowing of garbage will cause air pollution which in turn will affect the historical college campus buildings. To overcome the drawbacks in the traditional way of garbage monitoring, SMARGAR -an IoT based SMART Garbage Monitoring System is proposed to monitor the garbage bins constantly and to inform sweepers about the level of garbage collected in the garbage bins at regular intervals via a mobile app.

**Keywords—***IoT; smart systems; Garbage Monitoring*

## 1. INTRODUCTION

IoT based Garbage management is one of the most noteworthy concepts deployed for preserving the historical college campus buildings through intelligent monitoring. The effective remote monitoring of garbage levels anytime and anywhere is an important factor [1]. Excess garbage causes air pollution which in turn will affect the historical college campus buildings. The existing garbage collection and management system is not flawless. It depends on a vast amount of human resources and material resources. Poor monitoring and lack of efficient management policy lead to excessive piling up and even spillage. This phenomenon will not only cause air pollution, but also will affect the historical college campus buildings. As a result, it is significant to deploy an IoT based Smart Garbage Monitoring System for preserving historic College Campuses.

SMARGAR – an IoT based Smart Garbage Monitoring System proposed in this paper will save historical resources and time. In Section 2, an overview of related works is presented. Section 3 presents the proposed SMARGAR – an IoT based Smart Garbage Monitoring System for preserving historic College Campuses. Section 4 elaborates the system requirements. In Section 5, architecture of the proposed An IoT based Smart Garbage Monitoring System for preserving historic College Campuses. Finally, Section 6 concludes the paper.

## 2. REVIEW OF LITERATURE

Yanglu et al. [1] proposed a wireless garbage monitoring system with IoT to monitor garbage at regular intervals remotely without human intervention. Himadri Nath Saha et al. [2] proposed the IoT based smart garbage monitoring and clearance alert system in which RGB led lights attached with the bins indicated the garbage level of bin at that moment and eventually reduced the human labour of monitoring. Saadia Kulsoom Memon et al. [3] developed an IoT based cost effective system that monitored garbage in real time by using smart technology with the help of WeMos and Ultrasonic sensors which consumed meagre resources of the waste management authorities. It was claimed that the proposed system monitored garbage inside garbage bins more accurately.

Chun-Yen Chung et al. [4] developed an integrated LoRaWAN communication networks developed using the Internet of Things with garbage sorting equipment to create a system used electrostatic capacitance-type proximity sensors to determine the types of garbage deposited in garbage cans. This system deployed a C# graphical monitoring interface to remind users to remove the garbage. Shashank Shetty et al. [5] presented a Smart Waste segregation and garbage level monitoring System which could be monitored remotely and built at a very low cost. Paavan Lakshmana Chowdary S et al. [6] proposed an IoT based Smart Garbage Alert System to trigger an alert message to the people concerned when the container was filled to avoid the over spilling of garbage. Amit Sundas et al. [7] discussed the state-of-art technologies that have been deployed for waste management. In this paper a novel architecture for waste management was proposed that utilized the concept of IoT and image processing. The proposed architecture acted as a surveillance monitoring system to monitor the overflow of the garbage and sent alert message to the concerned authorities to take the essential and instantaneous action. Aswin

Raaju et al. [8] presented a smart garbage collection management solution based on ZigBee technology. This system could read, collect, and transmit huge amount of data over the adhoc network to dynamically supervise garbage collection mechanism. Sudharani Ashok Ghadage et al. [9] proposed garbage management system made up of ultrasonic sensor, infrared sensor, Arduino UNO, microcontroller and Raspberry Pi for detecting the level of waste. In this system through the deployment of Global system for mobile (GSM), the concerned persons were informed through SMS.

Zainal Hisham Che Soh et al. [10] presented an Internet of Things (IoT) based Smart Waste Collection Monitoring and Alert System to monitor the waste material at the selected site of garbage collection area. The presented system was implemented using an ultrasonic sensor connected to Arduino UNO to monitor waste bin garbage level.

In this system, waste bin depth level was sent via Arduino Ethernet Shield with an Internet connection to the Ubidots IoT Cloud. Namakambo Muyunda et al. [11] proposed smart garbage monitoring system to facilitate the city authorities to better manage their resources in the collection of garbage and provided a platform for efficient garbage collection system.

Muhammad Nasir Khan [12] proposed the IoT based University Garbage Monitoring System which showed the status of each basket and notified wirelessly.

### 3. PROPOSED SYSTEM

IoT sensors are fixed at the top of the garbage bin to monitor the level of garbage inside the bin. Ultrasonic sensor fixed at the garbage bin is connected to the Arduino board which in turn is connected to the ESP8266 Wi-Fi module and the entire system is connected to every single bin inside the college campus. When the Garbage bin is less than 10 cm empty, the status of the bin will be shown as filled, otherwise the current garbage level of the bin will be shown.

When the garbage reaches the maximum level, a notification will be sent to the sweepers concerned. The architecture of the proposed IoT based Smart Garbage Monitoring System is shown below

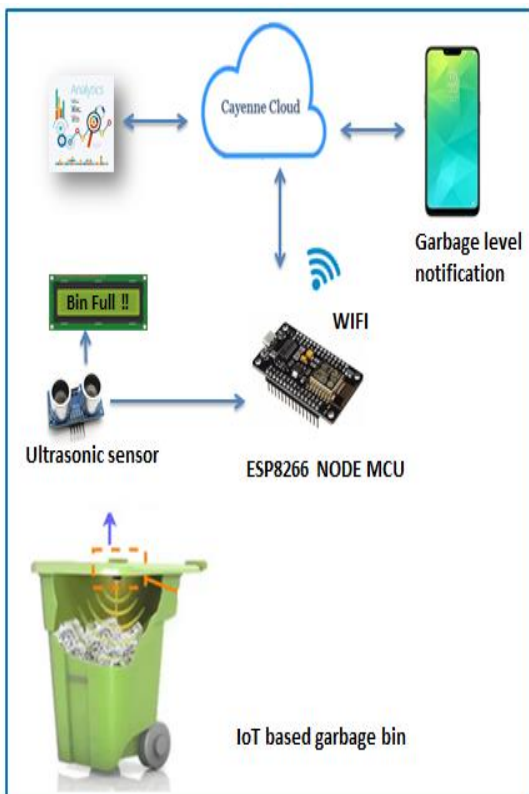


Figure 1 SMARGAR – an IoT based Smart Garbage Monitoring System

### 4. SYSTEM REQUIREMENTS

Before deploying the hardware devices the following are the steps that have been explored. The first step is to examine the physical principles involved in the maintenance of garbage bins. The second step is to ascertain the types of wastages. After exploring these points, the hardware devices as shown in table 1 are employed in the Smart historic College Campuses

Table 1: Hardware devices deployed in the Smart historic College Campuses

Essentials of Smart Garbage Monitoring System	Hardware devices
Sensors	HC- SR04 Ultrasonic sensor, IR sensor
User Interface devices	Smartphone, laptop ,computer
Type of networking	Wireless –Bluetooth, Wi-Fi
Centralized control	NODE MCU

The proposed IoT based Smart Garbage Monitoring System will facilitate in preserving historic College Campuses.

### 5. ARCHITECTURE OF THE PROPOSED SYSTEM

The architecture of the proposed IoT based Smart Garbage Monitoring System for preserving historic College Campuses is shown in Figure 1. This architecture facilitates to monitor the garbage bins constantly and to inform sweepers about the level of garbage collected in the garbage bins at regular intervals via a mobile app.

#### 5.1 Sensors

IR sensor and HC- SR04 Ultrasonic sensor are deployed to monitor the level of garbage at regular intervals automatically. These sensors consume less energy; cheaper in compare with other sensors and also good for being deployed in the smart College Campus environment. The digital outputs of these sensors are connected to the ESP8266 GPIO2 pin.

#### 5.2. NodeMCU

NodeMCU ESP8266 deployed for the proposed architecture, is a microcontroller which has an inherent WiFi function by ESP8266 chip. It provides easy and steady internet connectivity. The readings of these sensors are stored for the moment in the EEPROM of the ESP8266.

#### 5.3. Cayenne IoT platform

Cayenne is an IoT cloud platform that delivers numerous cloud services such as data visualization, alerts etc. Once mydevices Cayenne app is installed on the smart phone and configured on Cayenne IoT platform, the ESP8266 microcontroller is connected to Cayenne through MQTT. Through the dashboard of the Cayenne platform, the sensing devices can be monitored and configured. The sensed data are sent from ESP8266 to the Cayenne IoT platform.

#### 5.4. Analytics

Lastly, Analytics is performed on the sensed data to facilitate better decision making.

### 6. CONCLUSION

The proposed SMARGAR system which is an IoT based SMART GARBAGE Monitoring System facilitates to monitor

the garbage bins constantly and prevent overflowing of garbage so as to avert air pollution and subsequent damage to the historical college campus buildings. The proposed system can be extended to handle any emergency situations viz. gas leaks, fire accidents etc. in the historical campus buildings.

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