

# IoT Based Garbage Monitoring System

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## Abstract:

The IoT Garbage Monitoring System is designed by ease the problems people or Organization face while managing their waste. The system allows the user to keep watch on the garbage bins by utilizing buzzer and IoT service. The system has a buzzer on it which sets off an alarm on fulfillment of the garbage bin, other than this the user can also watch over the bins from anywhere using IoT service. The system is constructed using a Raspberry Pi Pico, which works as the brain of the system. To keep watch on level of garbage in the bins, the system consists of a couple of Ultrasonic Range Finder Distance Sensor Module. The Ultrasonic sensor is designed to measure the distance using ultrasonic wave to determine the distance of an object from the sensor. The sensor helps the system to sense the level of garbage in the bins. The Raspberry Pi is equipped with Wi-Fi connectivity, thus making it suitable to watch the system using IoT, from anywhere. As so the system works towards ease the garbage management.

**Key words:** *Raspberry pi Pico, Ultrasonic sensor, Node MCU, LCD Display, Buzzer.*

## I. INTRODUCTION

According to research, the population growth is directly proportional to waste generation. Clean environment is the most important part of a healthy life. We have developed internet of things(IoT) based waste management system for streets which managed the disposal of garbage from garbage bins on time and efficiently. When to street garbage bin is about to be full, the notification in the form of a text message and email will be sent to municipality office, which shows exact location of garbage bin in a street that needs to be clean. This paper presents an efficient street waste management system for a healthy environment. IoT based intelligent waste management system is developed by using Raspberry pi Pico, ultrasonic sensors and other electronics. This system will continuously monitor the garbage level in a garbage bin and will prompt an altering signal to the respective garbage collection team in a municipality office in the scenario of a nearly filled garbage bin. Solid waste management dispute is the major contest to the local administration of both small and large cities.

## II. LITERATURE REVIEW

A Smart Dustbin based on IoT in which the smart bin was built on a platform which was based on Raspberry pi Pico which was interfaced with an ultrasonic sensor. The sensor was placed on the top of the bin. A threshold level was set as 5cm. As the garbage reaches the level of threshold, the sensor

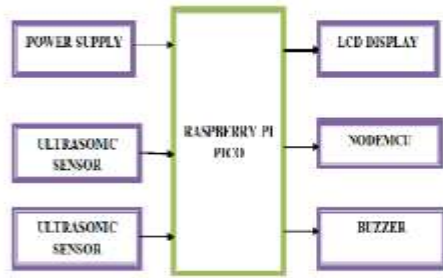
alerts the associated authority till the garbage in the bin is emptied. The bin was interfaced with a system based on microcontroller with a central system that showed the current status of the garbage in the bin. The status was seen on a mobile based SMS and an email. The author proposed a method for organizing the collection of the garbage in the commercial and residential areas of the cities. In this system, the level of garbage in the bin was detected by the ultrasonic sensor which will send the data to the control room using the GSM module. A GUI was also developed to check the information that was related to the garbage for different locations, GUI was based on MATLAB so it was different. This paper proposed Decision Support System which would be used for garbage collection in the cities. This system handled the ineffective waste collection in the inaccessible areas of the city. Various bins were placed around the cities which were provided with an embedded device which was low in price and helped in tracking the garbage level in the bins. A different ID was provided to each bin so that it could be easier to detect that which is bin is full and ready to be emptied. The project is divided into two sections one being the transmitter section and other the receiver section. The transmitter section consists of a microcontroller and sensors which check the level of the garbage and the data is passed onto the system with the help of the RF Transmitter, then RF Receiver receives the data and sends it to the client associated so that the bin can be emptied quickly.

### **III. PROPOSED SYSTEM**

In the proposed practical method for Municipality office waste management system, the garbage bins are transformed into intelligent garbage bins. Then by applying the proposed IoT protocol,

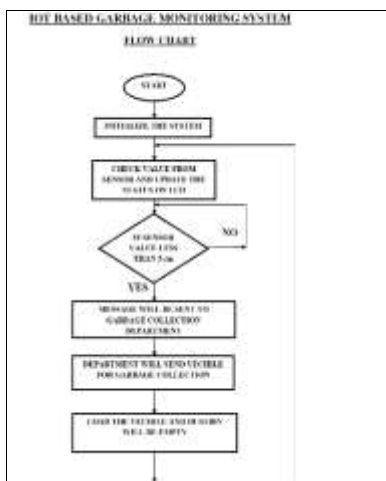
this garbage's can communicate with the office to update the real time status of themselves. By the status information updating, a sweeper can collect the garbage once it gets filled. IoT integrate all the garbage bins of streets to main Municipality office using internet. With having and arranging all the concerned data on a dashboard, it is more appropriate ease and more feasible solution to handle the street waste management. An ultrasonic sensor is installed in each garbage bin throughout the street and power supply of 5V is provided. The duty of sensor is to detect the level of garbage in a garbage bin continuously and reports its status to the municipality office by communicating with them by using ESP8266 Wi-Fi module connected to the Raspberry pi Pico. This is the efficient procedure and it will be applicable and acceptable in the society. An approach of using IoT protocol for communicating the garbage bins with municipality office by using wireless mode through university campus Wi-Fi network has been adopted as shown in Fig. 1. The sensor will get the information about the capacity of the bin. The information is transferred to the Raspberry Pi Pico and then to the communication module for further action. ESP8266 Wi-Fi module has been selected for this purpose along with Raspberry pi Pico as shown in Fig. 2. The selection is based on the computation complexity, receive time and the availability of the module.

#### **System Architecture:**



The level of wastage material in a garbage bin is detected by an ultrasonic sensor, which is HC-SR04. It is connected with the microcontroller, which is Raspberry pi Pico as shown in the Figure of the proposed system model in our scenario and ESP8266 Wi-Fi module is used to transmit the detected signal from the sensor to the Municipality office.

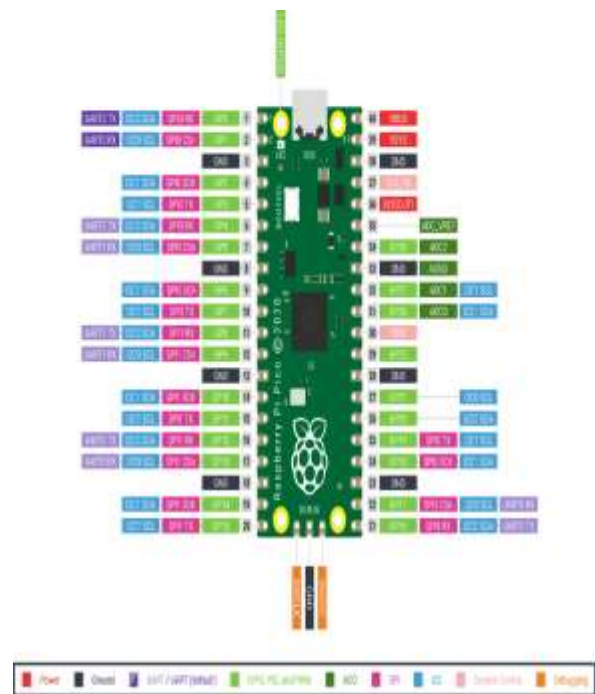
**B. Flowchart:**



The flowchart of our proposed IoT based embedded system can be described in Figure. It shows the complete flow of information and the compactness of the proposed algorithm. The procedure is very fast and efficient. The sensor will detect the need of change and the change will be administered by the Municipality office.

**C. Raspberry pi Pico:**

The Raspberry pi Pico is a platform based on microcontroller and is an open-source platform as shown in Figure. Since it is open source and is easily available to use and apply for any research work, it is, therefore, mentioned in the proposed research. It is a 40 pin IC which is most suitable for the project like us, as it contains much GPIO connections to make complete project. Arduino IDE software is also a user-friendly interface to Raspberry pi Pico microcontroller. We just need to plug in the USB cable to connect this platform with personal computer (PC) having Arduino IDE software.



**D. Ultrasonic Sensor:**

An ultrasonic sensor module with specific model number of HC-SR04 shown in Figure, is used to measure the quantity level of waste garbage collected in the garbage bin. It operates by transmitting a pulse of ultrasonic sound wave at a specific frequency which is not hearable to human ear and then receives it after that sound wave reflects back by striking any solid waste. This sensor

calculates the level of garbage in garbage bin by calculating the time duration in millisecond between transmitting a sound wave and receiving it.



#### **E . LCD Display:**

It displays the garbage level and connecting to internet to sending garbage level data. The LCD is paired to an I2C adaptor module which reduces the number of wires that connects to LCD from Raspberry pi Pico. The LCD display shows real time garbage level locally without the need for internet. The whole circuit is power from a micro USB power cable.

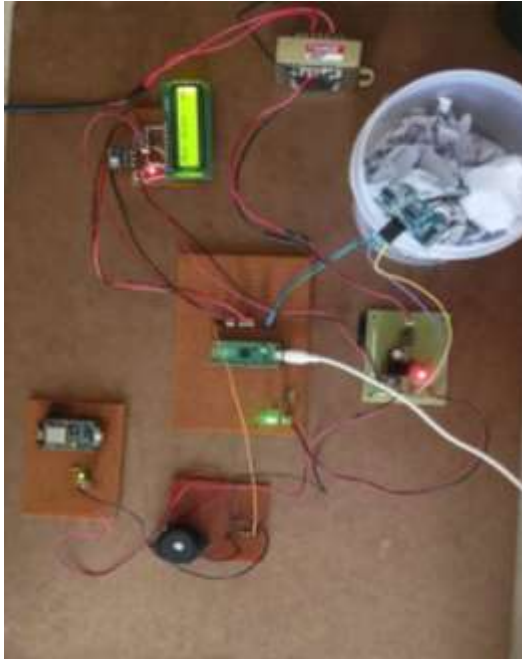


#### **F. Buzzer:**

Buzzer is an audio signal in device electromechanical. It typically includes alarm devices, timers, and confirmation of user input. The buzzer used here is to produce sound when the garbage reaches its maximum level in the garbage bin. The Municipality office will then send garbage level.

### **IV. RESULTS AND DISCUSSION**

The experimental setup of IoT based intelligent garbage bin is shown in Figure, which is the compilation of all different hardware modules in real life. As shows in Figure, ultrasonic sensor is located at top of the bin, facing downwards inside the bin, which can continuously detect the presence and level of garbage inside the bin. Once the full level is reached it will generate a signal for the Municipality office. The signal is communicated to the office using the communication module, which is also operation in the freely available frequency band. The other components are also attached with the prototype bin. Each component is easily available on the shelf and these components are not expensive, which increases the acceptability of the project by the consumer. The garbage level inside bin increases then the space in the bin decreases. The same status should be seen in mobile application with the help of IoT. The accurate detection results in an efficient monitoring system and ultimately provide a clean and healthy environment to the people. The real time view of the system shown below.



## V. CONCLUSION

An IoT based intelligent garbage bin is formulated for the accurate monitoring and managing of waste management in the Municipality office. This system alerts the Municipality office for the particular garbage bin throughout the street to help the sweepers to collect the garbage from bin and clean it respectively, so that garbage won't spill out of the bin and we can control the spread of diseases by improving the manual system to the IoT based system. Thus, this system becomes useful as an efficient solution in improving the street environmental maintenance.

## VI. FUTURE SCOPE

WORK In future, the waste management of street can be managed properly by integrating all the garbage bins of streets with IoT based system and connecting it to Municipality office. Furthermore, we can connect different streets al together and we can also detect the quality of garbage being inserted by the people, and then separate it autonomously. Also, the extended version of this paper could include better or enhanced sensors with more accurate detection of garbage in garbage bins.

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