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Raspberry Pi-Based Design: A Smart Bin Revolution

Jagannath Kannale[1]*, Sangappa K Rajeshwar[2], Basavaraj R[3]
[1,3]Asst. Professor, Department of Electrical and Electronics Engineering, Lingaraj Appa Engineering College, Bidar, Karnataka, India
[2]Asst. Professor and HOD Department of Electrical and Electronics Engineering, Lingaraj Appa Engineering College, Bidar, Karnataka, India

Corresponding Author
E-Mail Id: jagannathkannale95@gmail.com

ABSTRACT
India has the second-largest population after China; hence trash collection and disposal are essential in modern living. This study puts forth the idea of a clean city employing Smart Bins and their application through proper networking and one-to-many device interaction. The study describes an innovative approach to garbage collecting and user engagement using a Smart bin that was created using a Raspberry Pi, pressure sensors, and ultrasonic sensors. The suggested system additionally offers the terminal side of the web page interactions with efficient database management and warning system in accordance with the purpose of the bin. The creation of an HTML web page will display different garbage levels in each of the bins found in each ward. GSM transmissions an announcement about the specific bin to the terminal. RFID technology was used for authentication.

Keywords: *Raspberry pi, force sensing resistor, GSM, HTML, Smart bin, RFID, ultrasonic sensor*

INTRODUCTION

Garbage is a terrible problem that humans must cope with when the globe undergoes an upgrade. We frequently see images of garbage cans that are overflowing with trash and spilling out.

Due to the enormous number of insects and mosquitoes that nest there, this increases the number of illnesses. Solid waste management is a major issue in metropolitan areas, not just in India but in most other nations as well.

Therefore, a system that can eliminate this issue or at the very least scale it back to the absolute minimum must be developed. The initiative offers us one of the most effective ways to maintain a clean, green atmosphere. The idea of a smart city is although it has gained much attention in the last few years because our current prime minister proposed the construction of 100 smart cities across India, the concept is still relatively new in that country. Now that there will be many smart cities, there are also many obligations that must be carried out.

Cleanliness is the first requirement of a wise lifestyle, and cleanliness starts with a trash can. In this essay, we have attempted to improve the trashcan, a small but crucial part of the urban waste management system. It is now imperative that we employ technology in waste management systems given the advancement of technology. As we've seen, the use of analytics-based technologies has improved world living standards.[1]

The idea is still relatively new in that country, despite receiving a lot of attention

in recent years because our current prime leader suggested building 100 smart cities across India. There are a lot of responsibilities to fulfill now that there will be numerous smart cities. A sensible lifestyle starts with cleanliness, and cleanliness begins with a garbage can.

This article aims to enhance the trashcan, a modest but essential component of the urban waste management system. Given the development of technology, it is now essential that we use technology in waste management systems. As we've seen, the application of analytics-based technology has raised living standards around the world. Undesirable or pointless, In other words, solid wastes are materials that have lost their value to the initial consumer and were created as a result of numerous societal activities. Domestic garbage is collected using a rubbish container at a common location in a specific location for an area/street.

The practice of verifying trash cans for garbage collection is a very challenging undertaking. The traditional approach requires a person to walk around several locations and look for areas where trash is collected. This method requires some time and complexity. Given the development of new technology, the effectiveness of the waste management system in use today is not as high as it should be throughout the past few years. There is no assurance regarding the handling or removal of garbage at all locations.[2]

An innovative solution, the automatic waste management system, is suggested to solve this issue. It is a step in the right direction toward automating and streamlining the garbage collecting process. The placement of a GSM transmitter at the garbage bin notifies the receiver at the appropriate location in the area or spot whenever the waste bin is full. The monitoring and controlling system's trash bin status is shown by the signal that was received.

In order to best adapt the traditional garbage collection methods to the vast amounts of data being created by the smart bin networks, analytics and electronics have been combined in this article. A single system can trace garbage transportation throughout the entire city and afterwards monitor it effectively and concretely. This method has the potential to completely transform how future smart cities handle their urban trash.[3]

EXISTING SYSTEMS

All trash collecting systems have flaws, including high costs and failure rates brought on by ineffective sensors. Volunteer acts are required in many systems. In India, fully automated systems are not being used.

SYSTEM DESIGN

The proposed system primarily monitors the level and volume data from two sensors. The level of trash in the bin will be determined using an ultrasonic sensor. The weight is obtained using FSR. When the garbage level reaches 90%, the bin will automatically lock and a buzzer will sound an alert.

An LED indicator in the bin will show the level of trash. Additionally, SMS is sent to both the cleaner and the collecting center via the GSM interface. SMS messages are delivered to the collecting center when the cleaner cleans once more. At the Bin Monitoring, you may see the state of every bin.

At the Bin monitoring console, facts regarding collection and analytics are also accessible. The smart bin is managed by a microcontroller. RFID is used for authentication purpose also helps.[4]

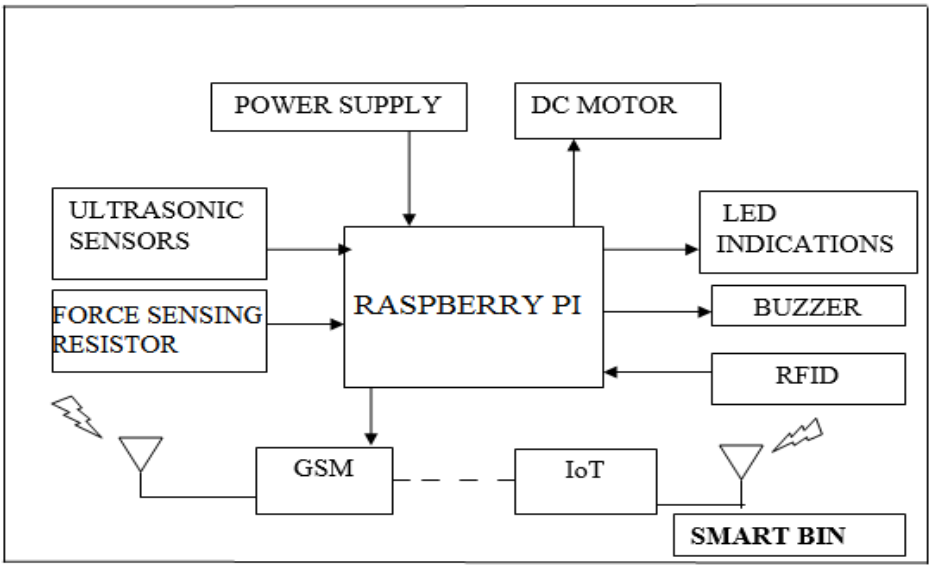

Fig. 1: *Proposed system Block Diagram.*

SYSTEM SPECIFICATIONS[5]

Raspberry Pi 400

In November 2020, the Raspberry Pi 400 was released. It is a contemporary illustration of a keyboard computer and includes a keyboard and 4 GB of LPDDR4 RAM on a custom board adapted from the Raspberry Pi 4. The Raspberry Pi Keyboard's casing served as the model for the case. The Raspberry Pi 400's Broadcom BCM2711C0 CPU is clocked at 1.8 GHz, which is 20% faster than the Raspberry Pi 4 upon which it is built. This is made possible by a strong cooling system and an updated switched-mode power supply.

Ultrasonic Sensor

The utilized sensor, HC-SR04, senses the various levels of the garbage entering and transmits the information to the server. The HC-SR04 module includes an ultrasonic transmitter, a receiver, and a control circuit. It offers range between 2 cm and 300 cm and non-contact distance sensing capabilities.

Radio Frequency Identification (RFID):

It is used to verify both the users who will pick up the trash and those who will place it in the trash can. It can recognize objects without direct line of sight, it has the ability to identify multiple items (up to 1,000s) concurrently, and it can detect items that are close by within a range of a few centimeters to several meters. It uniquely recognizes each individual item in addition to its product kind.

Force Sensing Resistor (FSR)

It is beneficial to measure the weight since the capacity of something is determined by its weight. PSRs are Polymer Thick Film (PTF) devices that show a reduction in resistance as the force applied to the active surface rises. Its force sensitivity is designed for use in touch-sensitive electronic device control by humans. Despite having characteristics comparable to load cells and strain gauges, PSRs are not either.

Global System for Mobile (GSM) Sim 900

The message may be sent to the administrator using GSM; an Android-based phone is not required. It contains RS232 and a Dual Band GSM/GPRS engine called SIM900A that operates at 900 and 1800 MHz. It works well with M2M interface applications for SMS,

voice, and data transfer. You can connect a variety of unregulated power supplies to the onboard regulated power source.

Hyper Text Markup Language (HTML)
To help a website where anybody may log in identify the filed bins, hypertext markup language is used. HTML plays a significant part in enhancing the online user experience since it is so dynamic and interactive. It offers stronger order and structure. By defining our own ideas, layouts, and definitions in an appealing way using HTML, we may create a user-friendly environment.

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CONCLUSION AND SCOPE FOR FUTURE WORK
Successful prototype implementation is achieved. For the purpose of monitoring the level and weight of the bin, an ultrasonic sensor is connected to a force sensing resistor. RFID is utilized for authentication. To open and close the lid, a DC motor is interfaced. LED and LCD displays are offered for the GUI. The interface for the communication is GSM. For the terminal side, a webpage is made. It is graphically updating the status. The message is delivered to the terminal side through GSM.

Separating the rubbish that the user places, giving him at least three chances to separate it properly, and then taking his photo and punishing him if he doesn't can be done as a future improvement.

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