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IoT Based Smart Dustbin

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ABSTRACT: Waste management is a worldwide problem faced by humans. Growing population and urbanization lead to exponential growth in waste. The traditional approaches to waste management have not been able to keep up with this, which has resulted in resource depletion, environmental contamination, and health risks. The idea of “Smart Dustbins” has come to light as a potential solution to address these problems and transform waste disposal procedures. This Efficient Waste Disposal or Management System is regarded as critical for Modern Smart Cities that use the Internet of Things (IoT). Our motivation behind this project is also to give our contribution towards the ongoing campaign “SWACHH BHARAT ABHIYAN” (Clean India Movement) initiated by PM of India.

KEYWORDS: Waste management, Smart dustbin, IoT, Waste disposal, Waste segregation, Rain drop sensor, Waste tracking.

I. INTRODUCTION

Every day, large cities throughout the world face the same problem, how to properly manage municipal garbage without making the city dirty? Today’s waste management system involves a huge number of people being assigned to a specific number of dumpsters on a daily and periodic basis. This results in a terribly inefficient and unsanitary system in which some dumpsters are overflowing while others are just half filled. The goal of this project is to decrease human resources and efforts while also improving the concept of a smart city. People would continue to throw their trash in the trashcan even though it is totally full, which will result in filthy conditions. Even when the dustbin is entirely full and there is no room for the rubbish in it, it is not always emptied. As they must constantly check to see if the garbage is full or not, the workload of the authorities will rise. Every time the authorities look for a trash can to clean up, they lose time, money, and effort. When the trash can is this filthy, nobody wants to even touch it. Sometimes the waste inside of it is left unattended for a longer period of time, leading to a foul smell.

With increased urbanization and population expansion, the ever-increasing standards of living have made proper solid waste disposal increasingly challenging. For both individuals and communities, improper waste disposal poses significant risks to physical health. The growing number of viral diseases ranks among the most urgent issues. A breeding ground for disease carrying vectors including mosquitoes, flies, and rodents emerges when waste is not correctly taken care of. These vectors have the ability to spread numerous fatal illnesses, which can cause large scale outbreaks among the populace. The decline of biodiversity, deterioration of natural ecosystems, and loss of green spaces can all have an impact on people’s general well-being and quality of life. Inadequate waste management can harm one’s mental health in addition to their physical health.

Living in places with poor waste management, such as places with open dumps or overflowing landfills, can result in a hazardous atmosphere that is unpleasant and foul smelling. Residents experience anxiety, stress, and a diminished sense of well-being as a result of these diseases. The psychological well-being of an individual may suffer as a result of ongoing exposure to waste since it can make a person feel hopeless and helpless. In a nation like India, waste management is now a challenging issue. The waste management issue is attempted to be solved with “SMART DUSTBIN”. The system’s objective is to develop a reasonably priced smart garbage bin that will significantly contribute to the cleanliness of the imagined future of smart cities. Cleanliness is the most crucial component of a reasonable lifestyle, and it all starts with the trashcan. A society can only effectively dispose its waste if the trashcans are placed in strategic locations and the rubbish is collected in a well-organized way.



II. LITERATURE REVIEW

The data from the surveys only includes cases and occurrences that have been legally reported; there are numerous unreported and unattended survey data that are not included in this document.

- As of 2021, the world generated over 2.01 billion tons of municipal solid waste annually. At least 33% of that waste was not managed in an environmentally safe manner [14].
- Out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted [15].
- Less than 20% of global waste is recycled each year and rich countries often export recyclables to poorer nations [16].
- Each year around 92 million metric tons of textile waste is generated around the world [16].

The traditional method is extensively used around the world; however, it is unhygienic and puts people who lives nearby in danger. All types of garbage are mixed together in this method and it lacks environmental awareness in society [7]. The standard trashcan is normally open most of the time and is so unsanitary that no one will close the lid and it will remain open until and unless some authority arrives to collect the waste. Under the current system, even when the waste bin on the main road isn't completely full, it will still be periodically collected, adding to the authorities' duty. In contrast, dustbins in tiny streets are rarely emptied. Keeping track of the dustbins will be a time-consuming task.

The IoT based Smart Dustbin, which is often used to separate dry and moist garbage, is also described [11]. In this, only one container is used to store both dry and moist garbage. It identifies garbage and places it on the appropriate side. It displays the dustbin's level. Since this trashcan lacks a lid/cover, individuals may simply toss rubbish everywhere, for example, dry waste into one section and moist waste into another. It can also be affected by the weather, and the rubbish will decay because the dustbin lacks a cover.

To keep track of all truck drivers' activities and trash management, a system with an IoT and ML based solution and a dumper truck database has been built. It makes use of Arduino Uno, various sensors, and GPS to monitor the precise location of its assets [8]. The primary function of this system is to utilize ultrasonic sensors to measure the level of trash in the trash can, save that data in the cloud using Thingspeak, inform the user when the trash can is full, and suggest the quickest route to the trash can [9].

Name	Object Detection	Garbage Level	Segregation	Technology	Database	Protocol	Controller
"Efficient IOT Based Smart Bin for Clean Environment" [1]	Yes	Yes	No	HTML	No	SPI	Arduino UNO
"IOT Based Smart Garbage alert system using Arduino UNO" [2]	No	Yes	No	Android App	Yes	MQTT	Arduino UNO R3
"Iot Based Smart Dustbin" [3]	Yes	Yes	No	Blynk App	No	No	NODEMCU
"IoT based solid waste management system for smart city" [4]	No	Yes	No	No	No	Ethernet shield	PIC controller
"Eco-Friendly IOT Based Waste Segregation and Management" [5]	No	Yes	Yes	Yes	Cloud	No	STM32

Fig. 1 Comparison Table

III. PROPOSED SYSTEM

We present “SMART DUSTBIN”, an IoT based smart trash management solution. The trashcan is included with a monitoring system that alerts the relevant authorities once it becomes full. People would not have to touch the smart trashcan to open it. When the smart dustbin detects an item within its specific radius, the lid will open automatically. This is because of the ultrasonic sensors installed throughout the trashcan. When the lid is opened, it will detect the sort of trash, whether dry or moist, and dispose it accordingly. A GPS chip will also be used to track the location of the trash can. In addition, an LCD monitor will be affixed to the trashcan to show the amount of waste in it. When the trash is full, it will not open and an error notice will appear on the LCD screen. The Arduino IDE will be used to program the board so that it will work correctly with all of the sensors. Additionally, the tool will be utilized to inform the authorities regarding the clean-up process.

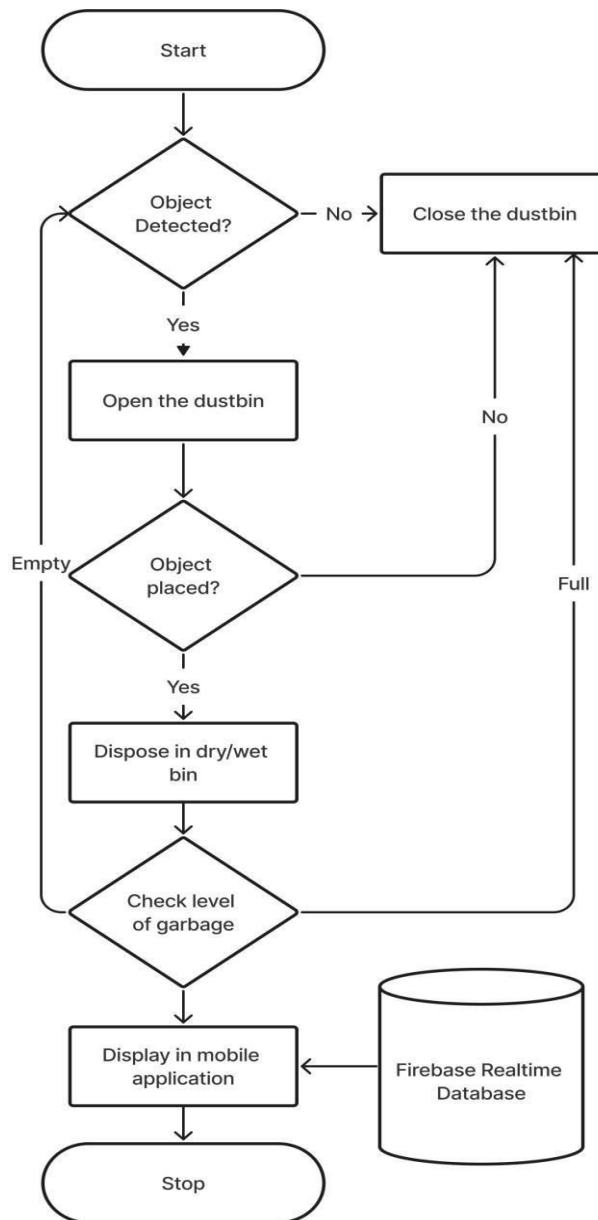


Fig. 2 Flowchart

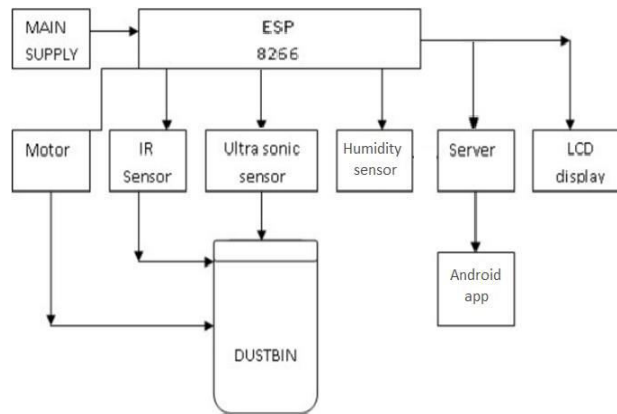


Fig. 3 Proposed System

IV. SYSTEM DESCRIPTION

A. ESP 8266 (NodeMCU)

NodeMCU is a micro-controller board that is based on the ESP8266 Wi-Fi module and is suitable for Internet of Things (IoT) projects. NodeMCU can play a vital role in enabling the bin to interact with other devices and the internet in a smart dustbin system. The data from the sensors will be saved in NodeMCU before being transmitted to Google Firebase over the HTTP/MQTT [6] protocol. NodeMCU includes 17 General Purpose Input/Output (GPIO) pins that may be utilized for both digital and analog input and output. Sensors, actuators, and other devices can be connected to the NodeMCU board using these pins. In addition to the GPIO pins, NodeMCU features one analog input pin (A0) for reading analog signals from sensors. Similarly, there are several power and ground pins available.

B. Ultrasonic Distance Sensor

The ultrasonic sensor is an electronic device used to measure distances. Because, measuring distance is an essential factor in many applications such as robotic control, vehicle detection etc., [12]. An ultrasonic distance sensor is mostly used for two purposes: First, if someone approaches a certain distance, the motor is instructed to open the trash lid. Second, it detects the amount of garbage within the dustbin, whether it is empty, half-filled, or full. If the level is displayed as full, the lid will not open. Similar to echolocation, ultrasonic sensors determine the distance between an item and you using sound waves.

C. IR Sensor

When the trashcan lid is opened, an IR sensor is activated in Smart trashcan. It is used to determine if waste was placed in the dustbin or whether the dustbin was just opened without being utilized. As a result, the segregation system's workload is reduced. There is no need to inspect which sort of waste is tossed if the person does not throw any garbage. Infrared sensors work by detecting reflected light waves. Light produced by objects or transmitted by an infrared remote or beacon. Infrared sensors can also be used to calculate distance and proximity. The observed reflected light is used to calculate the distance between the sensor and the object.

D. Rain Drop Sensor

The rain drop sensor module is a smart and low-cost rain sensing device. It has two parts i.e., a rain sensing pad and a control board [13]. It is used to differentiate between dry and wet garbage based on humidity levels. Because wet garbage contains moisture, this sensor can easily distinguish it from dry waste. The moisture sensor is linked to the NodeMCU's analog pin A0. If the analog pin reading is less than 95, it is deemed WET; otherwise, it is considered DRY. A rain drop sensor is just a board with nickel lines coated on it. It operates on the resistance concept. When there are no raindrops on board, the resistance is high, resulting in a high voltage according to $V=IR$. Rain drops lower resistance because water is an electrical conductor, and the presence of water joins nickel lines in parallel, resulting in reduced resistance and voltage drop across it.

E. TowerPro MG-90S Motor

TowerPro Servo Motor is mostly used to open and close the garbage lid when someone approaches it. It is also used to dispose the garbage in the appropriate container based on whether it is wet or dry. It has one bearing and a metal gear. It is small and light, yet produces a high output power. Metal gears offer strength and endurance to this servo. Servos are smaller versions of conventional kinds that can rotate around 180 degrees (90 degrees in each direction).

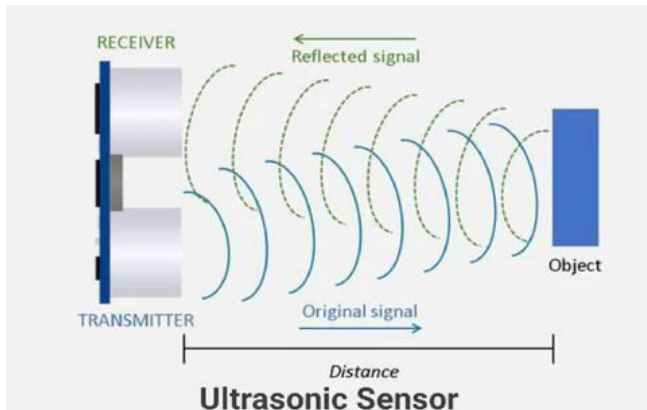


Fig. 4 Ultrasonic Sensor [14]

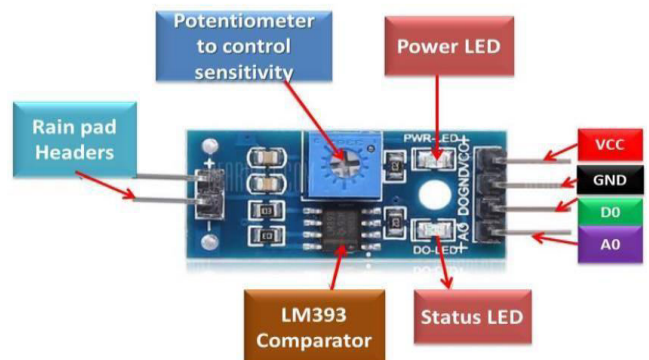


Fig. 5 Rain Drop sensor [13]

V. GRAPHICAL USER INTERFACE

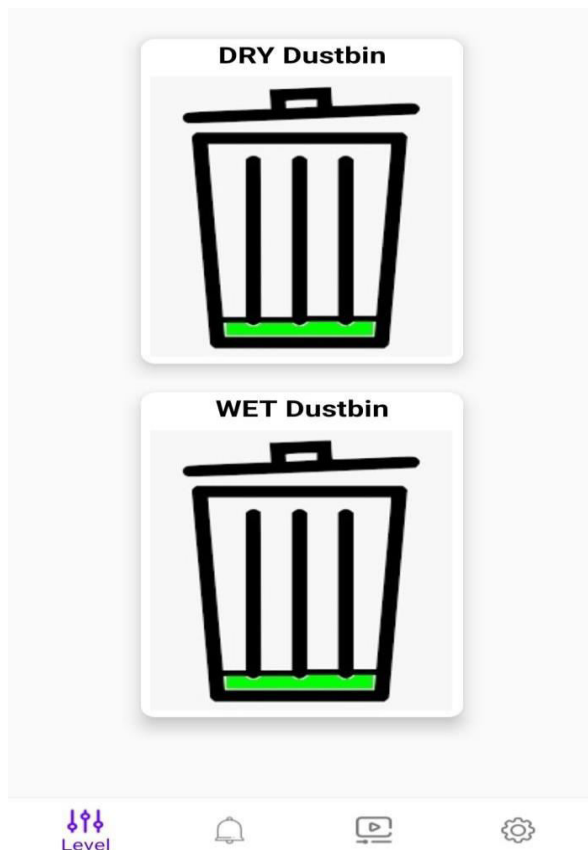


Fig. 6 GUI-1

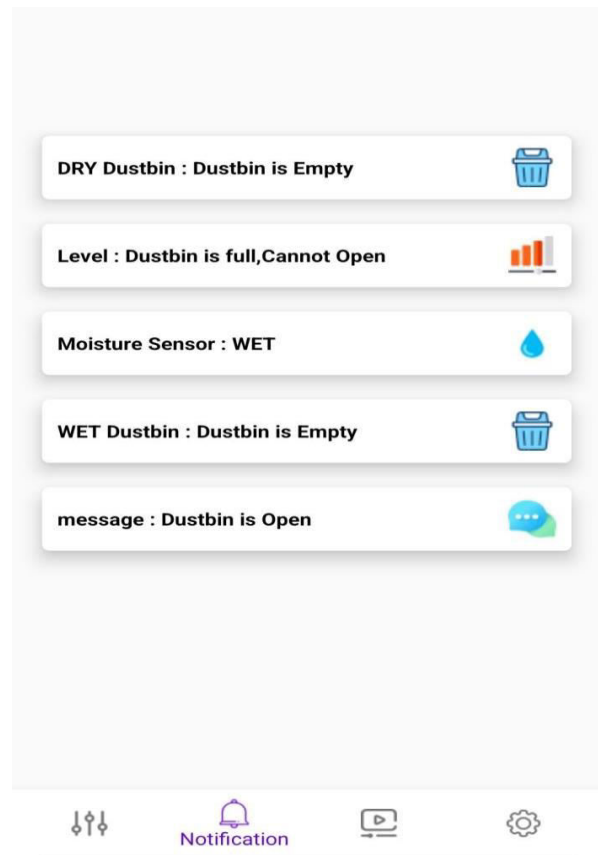


Fig. 7 GUI-2

VI. CONCLUSION

In conclusion, the IoT based smart dustbin project has shown to be a potential option for addressing waste management concerns in a smart and effective manner. The smart dustbin system has showed considerable improvements in garbage collecting, sorting, and disposal procedures by using the power of Internet of Things (IoT) technology. The combination of sensors, connectivity, and data analytic has allowed for real-time monitoring of fill-level, optimization of collection routes, reduction of operating expenses, and reduction of environmental effect. Furthermore, the smart dustbin system has shown the ability to encourage sustainable waste management practices and raise public awareness about trash reduction and recycling. The use of smart trash cans enables people to actively participate in garbage segregation and recycling, which leads to enhanced environmental awareness and good waste disposal behaviours.

However, there are still issues that must be addressed, such as guaranteeing dependable connectivity, data security, and system scalability. There may also be worries about the expense of implementation and maintenance, as well as the requirement for sufficient infrastructure and regulatory compliance. Despite these obstacles, the Internet of Things based smart dustbin project shows enormous promise for converting traditional trash management practices into a more efficient, sustainable, and ecologically friendly method. As technology advances, the smart dustbin system has the potential to become a vital element of smart city efforts, contributing to the development of a cleaner, greener future for our communities.

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