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IoT Enable Intelligent Smart Bin for Garbage Monitoring based on Real-Time Data Analysis

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Abstract: ***The amount of waste being disposed of has become an issue due to the world's population growth and rapid urbanization because the infrastructure is not sufficiently established. Malaria, dengue fever, and cholera are just a few of the illnesses that render human life penalized by erroneous monitoring and cleaning of a city's trash bins. Humans suffer as a result in a variety of ways, thus in order to prevent the worst case scenario, waste bins must be monitored remotely so that they may be cleaned on a regular basis, allowing urban residents to live more safely and comfortably. By examining a bin's various components, including its level of trash, indoor humidity, temperature, and any harmful gases that might be produced due to erroneous monitoring, the burning of waste, or the storage of rainwater in a bin, the proposed work determines the interior condition of a waste bin. Here, the idea of IoT is applied to ongoing remote monitoring to ensure that the bins don't overflow, don't emit any dangerous gases or smoke, and don't pollute the environment around people.***
Keywords: Waste Bin, IoT Sensors and devices, Cloud Server, Arduino IDE

I. INTRODUCTION

The principle of IoT can be applied in every industry in the modern world. IoT was first conceptualized by Ashton in 1999 [1]. India produces over 62 million tonnes of rubbish annually, of which only about 60% is collected [2]; the remainder continuously pollutes the environment in various ways. The large amount of trash that is produced by municipal areas cannot be disposed of using the current waste dumping and cleaning methods [3]. A municipal authority's plans for time waste control frequently fail for a variety of reasons, including a lack of manpower, poor transportation, poor time management, and overcrowding. As a result, the garbage poses a serious problem for urban residents in a variety of ways, including headache, lightheadedness, coughing, and respiratory issues. If the disposal materials are not cleaned at the right time with the right procedure, it pollutes the environment and increases the risk of diseases like dengue and malaria. As a result, people may get chronic long-term illnesses. The frequent cleaning of trash bins is one of many modernization initiatives that are used to make cities smarter, yet occasionally this is impossible due to ineffective municipal authorities.

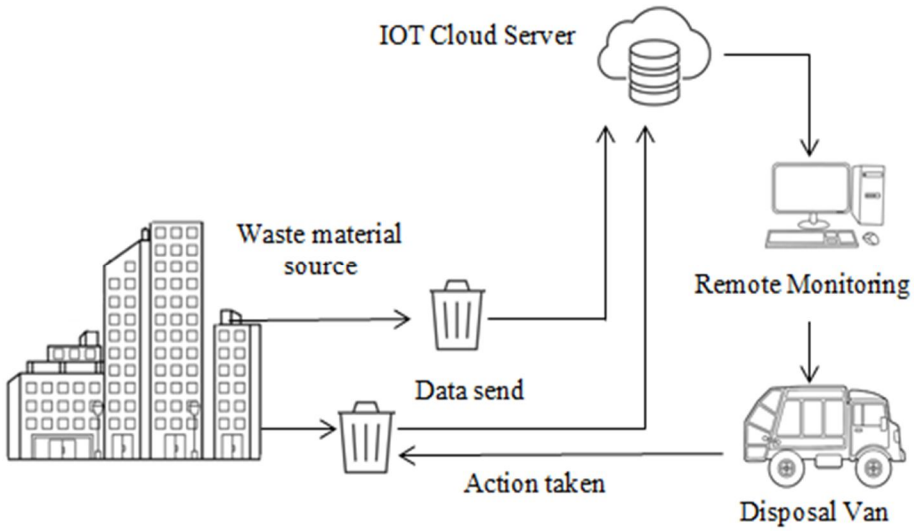


Figure-1: IoT based smart waste bin

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II. RELATED WORK

Many studies have recently introduced the idea of IoT for monitoring rubbish through smart and intelligent trash cans. This section included studies on IoT-based smart garbage bin monitoring along with their goal.

Authors	Year of Publication	Objective
Shiny Duela et al [2]	2022	In order to give urban residents a sustainable lifestyle, this article uses IoT technology to gather heterogeneous information from the fog layer.
B.Balaji Naik et al [4]	2020	Here, numerous sensors are in charge of gathering information in real time from a waste container.
S. Vishnu et al [5]	2021	According to this idea, hybrid network architecture governs the thrash. In essence, the architecture specifies how different devices are connected for the complete operation that is situated at various public locations.
Aniqa Bano et al [6]	2020	In order to give urban residents a healthy environment, this article developed a real-time based system for garbage bin monitoring. The author here refers to the trash can as an intelligent node.
Tariq Ali et. al. [7]	2020	The functionality of this suggested work is divided into three modules: the sensing module, the storage module, and the user module. Each module is responsible for a particular task.
Nisarga T D et al [8]	2018	Here, different sensors that are integrated with the GSM module are in charge of providing real-time information about the trash can. The transmitter and receiver are the main parts of this system, which can be used to check a trash bin's level, smoke level, scent level, etc.
A.Shiny et al [9]	2018	This paper's main objective is to stop garbage overflow utilizing a sensor, a raspberry PI 3, and a GSM module. Here, a US sensor measures the level in relation to the depth of the trash can.
Wrushabh S. Sirsat et al [10]	2021	With the aid of intelligent and smart bins, the goal of this study is to review the methods currently used for garbage recycling across various research projects.
Sumaiya Thaseen Ikram et al [11]	2023	This design uses a fuzzy inference system to interpret live data sent to an Arduino board for waste monitoring and segregation.

III. PROPOSED METHODOLOGY

In the current world, it is crucial to clean up a city in several ways, and trash management is one of them. Due to improper bin maintenance and monitoring, the old waste management model is now all but obsolete. In order to keep cities clean and to give urban residents a healthy atmosphere, the idea of smart garbage bins became popular. In accordance with our suggested methodology, the ESP 32 Microcontroller is responsible to process all the data gathered from various sensors and transmitting it in real time to a cloud server that is continuously watched over by authorized individuals who take the appropriate action in the event of any abnormal conditions of a bin.

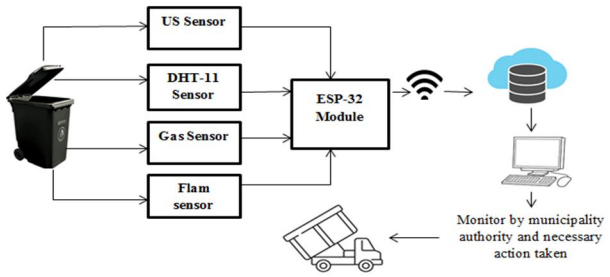


Figure-2: Proposed architecture

A. Requirements

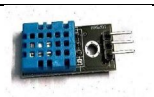
Hardware Requirement		
Component Name	Image	Purpose
ESP-32 Microcontroller		Use as an application processor
Ultrasonic Sensor		Responsible to check the garbage level based on the length of the bin.
DHT-11 Sensor		Measure the Indoor temperature and humidity of waste bin.
MQ-2 Gas Sensor		Detect any harmful gas and also measure the smoke.
Software Requirement		
Arduino IDE		Use as a text editor for writing code which is uploaded to microcontroller.
Arduino IOT cloud module		Store real time data for monitoring.

Table-1: Required components of the proposed work

B. Proposed algorithm:

STEP-1: Start (Initialize the process).
STEP-2: Collect real time data from waste bin
STEP-3: Send the data to ESP-32 for further processing
STEP-4: ESP-32 module resends the data to cloud server
STEP-5: Check real time data individually from cloud server along with threshold
STEP-6: If (Individual value < = Threshold)
go to STEP-2
else
go to STEP-7
STEP-7: Necessary cleaning action will be taken by municipal authority.
STEP-8: Reset the system and go to STEP-1.

C. Process flow Diagram

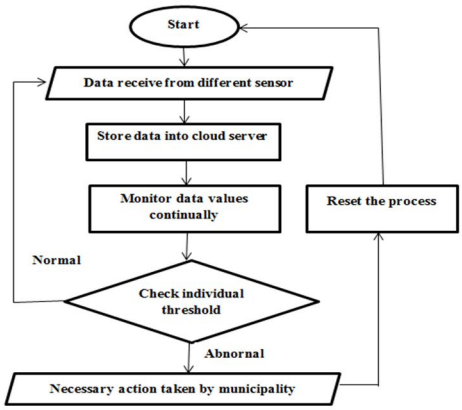


Figure-3: Process flow diagram of proposed work

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IV. RESULT AND DISCUSSION

In the conventional waste collection method, the authorities were never able to physically keep an eye on the bins round-the-clock. Therefore, to tackle this issue, a remote monitoring idea is needed. The authorities may simply check the indoor state of a garbage bin on a regular basis using the remote monitoring system concept, which is more efficient than the conventional way.

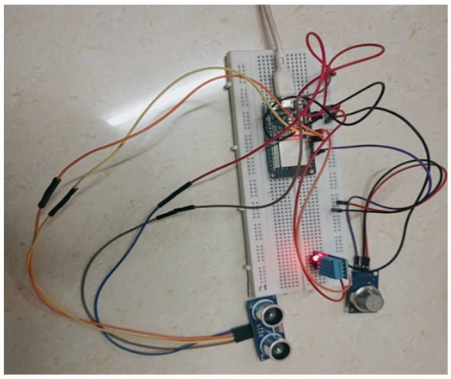


Figure-4(a): Circuit design of our proposed model

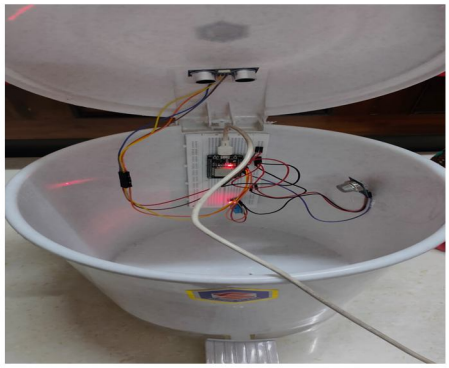


Figure-4(b): Model Implementation

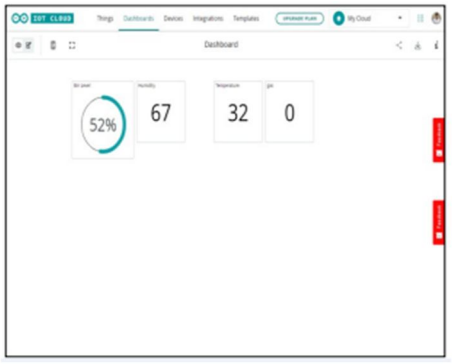


Figure-4(c): Dashboard Image (Web View)

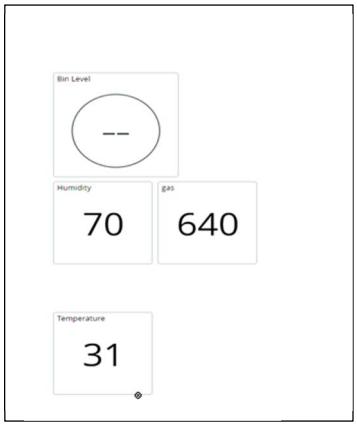


Figure-4(d): Dashboard Image (Mobile View)

V. CONCLUSION

Waste is growing quickly as a result of the increase in urbanization. Therefore, waste management is a crucial requirement for environmental protection. Waste is any object that has been brought into a party, a crowded space, a social gathering, a school, or a flat. With this way of implementation, level sensing by humans can be done faster and more affordably for home applications. By creating a sanitary atmosphere, this smart dustbin prototype will benefit society. The project focuses on "IoT technology" and the applications that it can serve in smart cities.

The primary goal of this job is to keep the trash can clean by continuously monitoring the amount of trash, the humidity, temperature, and gas emissions (caused by the combustion of waste materials). A mail notification can be issued right away to the appropriate authorities for any aberrant value.

VI. ACKNOWLEDGEMENT

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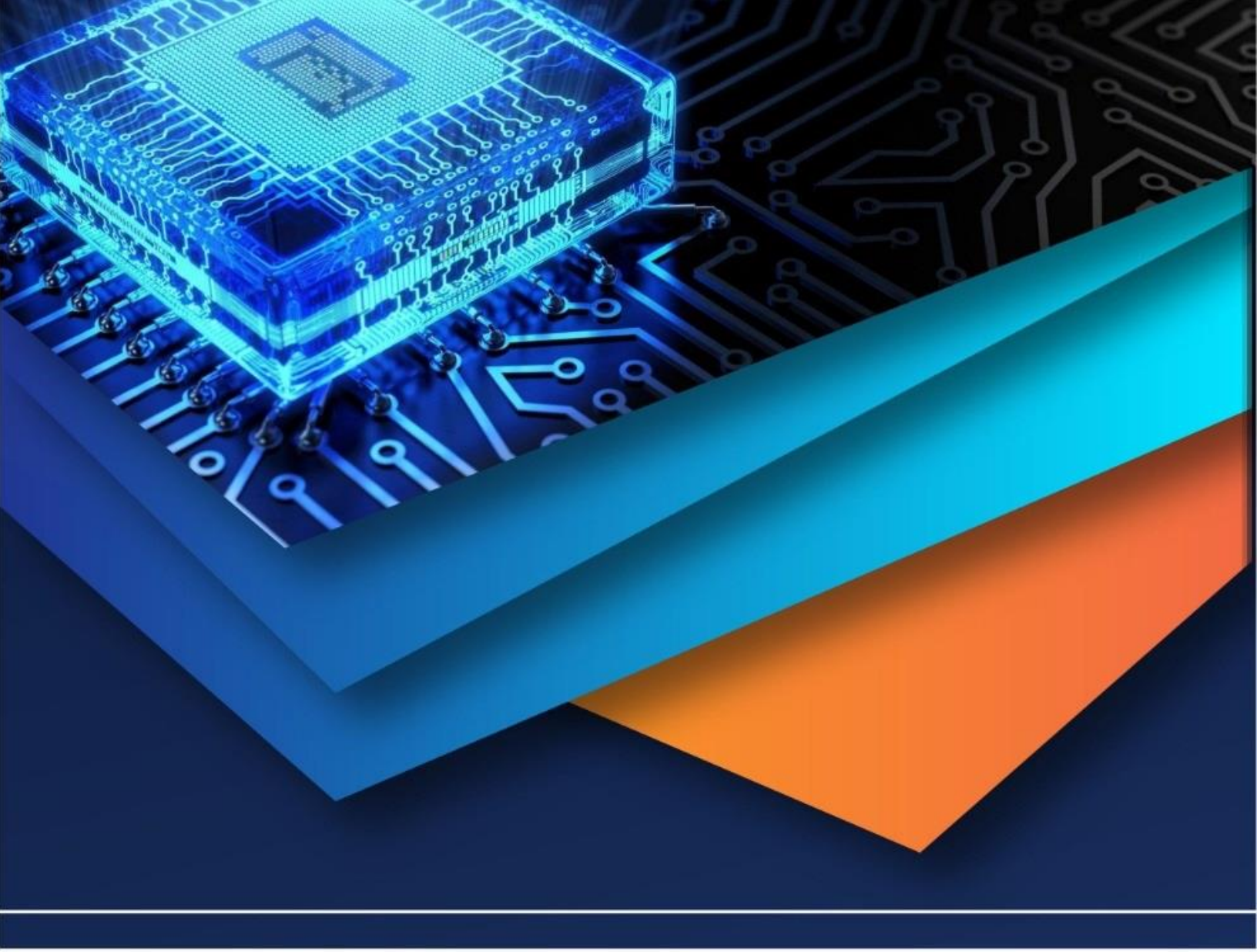
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