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# IoT Based Smart Dustbin with Advanced Waste Management Techniques

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**ABSTRACT:**Waste is produced wherever there is life and humans are living. It will be a part of everyday lifecycle as long as the life exists. With the increasing population, increasing urbanization, and change in the lifestyle, waste management has become a challenge not only for the developing countries, but also for the developed ones. By 2050, more than 84% population in the developed countries and more than 64% in the developing ones will be in urban areas. Better technology and better ways of handling waste enables a systematic approach in this regard. Waste management is one of the major problems faced by different cities all over the world. We see dustbins and garbage disposals in urban areas piling up and overflowing everyday with waste from household refusals, institutions and public establishments. To prevent this IoT smart dustbin can be used as it will solve the above problems very efficiently. Dynamic scheduling and collecting waste are the manual process, but done efficiently through online using IoT.

**KEYWORDS:** Smart dustbin, Waste management, IoT.

## I. INTRODUCTION

The Waste management is a task that takes place in a remarkable variety of locations and circumstances. Any environment under human control contains a moderate amount of waste. Waste management is a crucial requirement for naturally sustainable improvement in many countries. The use of garbage containers for waste accumulation is a common approach for strong waste transmission. Without being aware of the state of the receptacle, the waste management team must identify themselves in person at each garbage collection location. There are two possible outcomes in this situation: either there is no disaster for the social occasion, or the container has overflowed. Strong waste management, which while bothering the earth's balance, has been one of the main concerns with our situation. In addition, effect The public's health is impacted by sly. Given the need for modern technology, the intelligent trash canister can be expensive, but given the number of trash cans required in India, an expensive trash canister would not be a practical first attempt. For this reason, we have chosen to use based sensors to lower its cost and increase its productivity in applications. When the trash level reaches its peak, this framework ensures prompt garbage can cleaning. A record is submitted to the higher authority, who can take necessary action against the contractor or collector in question, if the trash can is not cleaned by a certain time. This system also detects fake reports, which might lessen corruption in the overall administrative system. This lessens. the total number of trash collection vehicle trips, which reduces the overall consumption associated with rubbish collection. It finally maintains cleanliness in public. As a result, the intelligent garbage management system increases the effectiveness of garbage collection. Such structures are defenceless against the different ways that pieces of the structure can be destroyed and should be attacked. The ability to collect data is made possible by the new perspective on the global IoT infrastructures, which also more effectively addresses common management problems. These days, all trash cans must be collected by the waste vehicle, even if they are empty. We then demonstrate how to employ genetic algorithms (GA) as a tool for garbage-collection optimisations in light of this reality. The GA should assist with to utilise the garbage truck more efficiently, i.e., more frequently in areas that are overburdened. In our IoT environment, we offer experimental scenarios for various GA use-cases. With the rapid advancement of technology and the emergence of new ideas, effective solutions have been created to help address the issues that humans encounter in the natural environment. Clustered communities are expanding quickly as a result of the growing global population, yet this growth has its own requirements, chief among them the need for cities to develop sustainably. Utilising technology to address this need led to advancements in the internet of things (IOT), which served as the foundation for the creation of smart cities. Moreover, technology has evolved to bring into existence several devices that enhance processes and services rendered in our society. The integration of these technological devices into already existing processes for waste management will establish an efficient system to ensure

that waste within the cities is effectively managed.

## II.LITERATURESURVEY

**Kannapiran Selvaraj et.al [2]** A novel approach to Garbage management using Internet of things (IoT) and GSM Communication with GUI representation using MATLAB is also suggested. Moreover, an IoT based intelligent bin for smart cities using IR sensor, GSM, and Internet is developed. Other methodologies used for Waste bin monitoring system are based on Zixbee and GSM communication, PIC controller and GSM, WiFi module and IoT assisted RF module and web browser.

**Mahesh Chandra Bhatt et.al [3]** The main focus in this proposed model was to improve the waste management process and to enhance the quality of the city's environment. Many times, it is observed that the dustbins are not covered and causes the spillage of the waste by birds. It also solves this issue in the current method. It is truly achievable in the city with this proposed model by providing an automatic opening for the dustbins lid and by providing the dustbin full status to the concerned worker.

**Sonali Joshi et.al [4]** They used an ultrasonic sensor connected to the NodeMCU which gives the level of the waste in the bin. Their model uses a PIR sensor which detects any motion near it. A buzzer is connected to the model which buzzes as soon as the ultrasonic sensor gives a reading for the level of the waste or if any movement is detected. A moisture sensor is connected to the bin which gives the output of moisture in the waste. All these values are sent to Thingspeak cloud and Virtuino app. The drawback with this model is that there is no cloud security. The model we propose attempts to use a different cloud and a self-developed app which ensures total security in the model.

**Adam Wong Yoon Khang et.al [5]** proposed A Smart Dustbin based on IoT in which the smart bin was built on a platform which was based on Arduino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. This sensor was placed on the top of the bin. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. At the end, a conclusion was made that various issues like affordability, maintenance and durability were addressed when these smart bins were designed. It also contributed towards a hygienic and clean environment in the process of building a smart city.

**Theodoros Anagnostopoulos et.al [6]** The paper presents a large-scale, dynamic routing model with time windows taking into consideration multiple disposal trips and drivers' lunch breaks. A fitness search space analysis for a variety of waste collection scenarios is described by utilizing statistical and information theoretic parameters. The authors conclude that using such parameters, the mutation landscapes are more easily distinguishable than crossover landscapes. Comparing with our taxonomy, the physical infrastructure involves outdoor, organic waste bins. Moreover, the IoT Technology involves capacity sensors and the software analytics include an overview of the dynamic routing. The model is evaluated with synthetic data. The strengths of the paper are the incorporation of drivers' lunch breaks as a routing parameter along with the multiple disposal trips. However, the paper does not define a concrete architecture.

**S. Vishnu et.al [7]** To validate the proposed system architecture, the following significant experiments were conducted: (a) Eight trash bins were equipped with PBLMUs and connected to a LoRaWAN network and another eight trash bins were equipped with HBLMUs and connected to a Wi-Fi network. The trash bins were filled with wastes at different levels and the corresponding unfilled levels of every trash bin were monitored through the intelligent GUI.(b) An experimental setup was arranged to measure the sleep current and active current contributions of a PBLMU to estimate its average current consumption. (c) The life expectancy of a PBLMU was estimated as approximately 70 days under hypothetical conditions.

**Jayashree Ghorpade et.al [8]** This paper depicts the utilization of our model of "Smart Dustbin" in dealing with the waste accumulation management. The dustbin itself works as a robot, when it is full on command from authorized person it goes to prelearned path (for first time user has to guide towards garbage dumping area) and empties itself. An authorized person gives command from Webpage where dustbin status is updated regularly.

**Diego Gabriel Rossit et.al [9]** This work focuses on the problem of locating waste bins in an urban area, which is considered to have a strong influence in the overall efficiency of the reverse logistic chain. This article contributes with an exact multiobjective approach to solve the waste bin location in which the optimization criteria that are considered are: the accessibility to the system (as quality-of-service measure), the investment cost, and the required frequency of waste removal from the bins (as a proxy of the posterior routing costs). In this approach, different methods to obtain the objectives ideal and nadir values over the Pareto front are proposed and compared. Then, a family of heuristic methods based on the PageRank algorithm is proposed which aims to optimize the accessibility to the system, the amount of collected waste and the installation cost. The experimental evaluation was performed on real- world scenarios of the cities of Montevideo, Uruguay, and Bahía Blanca, Argentina. The obtained results show

the competitiveness of the proposed approaches for constructing a set of candidate solutions that considers the different trade-offs between the optimization criteria.

**Sreejith s et.al [10]** This paper entitled “Smart Bin for Waste Management System” plays a vital role in the waste management system. A healthy domain is essential to a solid and cheerful environment. Clean and hygienic environments are a key need in human habitable environments. Smart bin is to develop a gainful and dynamic waste administration framework. In public places, dustbins are being flooded just as the waste spills out bringing about contamination. This likewise expands number of infections as huge number of bugs to breed on it. The outcome demonstrated that the detecting framework is effective and savvy and can be utilized to robotize any solid waste bin management process.

### III. PROBLEM STATEMENT

Present project work mainly focused on domestic waste whose value is unrecognized since people don't spend time on segregating waste into their basic streams. The environmental risks associated with poor waste management are well known and understood. We see dustbins and garbage disposals in urban areas piling up and overflowing everyday with waste from household refusals, institutions and public establishments. In order to prevent this smart dustbin is used as it will solve the above problems very efficiently.

### IV. METHODOLOGY

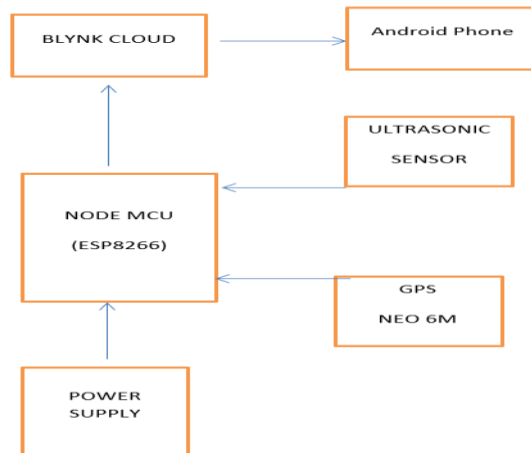


Fig 1. Block diagram of IoT based Smart Dustbin

The system mainly consists of the IOT controller ESP 8266 which communicates the sensor data into the blynk cloud. The HC-SR04 ultrasonic sensor acquires the data of Bin waste height and sends the signal to controller and the linear actuator compresses the waste. The controller intern pushes the data into the android app via cloud, the GPS connects into the satellites and collects the longitude and latitude values and show the present location of the animal in the map widget. The whole system works with the 5v voltage powered by the li ion battery OR the power supply from the adapter.

### V. MATERIALS USED

#### A. NEO-6MV2 GPS Module:

The NEO-6MV2 is a GPS(Global Positioning System) module and is used for navigation. The module simply checks its location on earth and provides output data which is longitude and latitude of its position. The compact architecture, power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and

space constraints.

**B. NodeMcu:**

The ESP8266 is the name of a microcontroller designed by Espressif Systems. It is a self-contained WiFi networking solution offering as a bridge from the existing microcontroller to WiFi and is also capable of running self-contained applications. It can monitor and control things from anywhere in the world –perfect for just about any IoT project.

**C. Relay:**

The relay is the device that opens or closes the contacts to cause the operation of the other electric control. It detects the intolerable or undesirable condition with an assigned area and gives the commands to the circuit breaker to disconnect the affected area. Thus protects the system from damage. It works on the principle of electromagnetic attraction.

**D. Ultrasonic sensor:**

The ultrasonic sensor (or transducer) works on the same principles as a radar system. An ultrasonic sensor can convert electrical energy into acoustic waves and vice versa. The acoustic wave signal is an ultrasonic wave traveling at a frequency above 18kHz. The famous HC SR04 ultrasonic sensor generates ultrasonic waves at 40kHz frequency. Typically, a microcontroller is used for communication with an ultrasonic sensor.

**E. Linear Actuator:**

An actuator is a part of a device or machine that helps it to achieve physical movements by converting energy, often electrical, air, or hydraulic, into mechanical force. An actuator is a device that converts energy, which may be electric, hydraulic, pneumatic, etc., to mechanical in such a way that it can be controlled.

**F. SMPS 12V/20amp:**

An SMPS with an output of 12V and 20A can deliver a maximum power of 240 watts. It converts AC input voltage to a DC output voltage using high-frequency switching, making it more efficient than traditional linear power supplies. An SMPS module typically consists of a rectifier circuit, a high-frequency oscillator, a power transformer, and a control circuit. The oscillator generates a high-frequency signal that drives the power transformer, which in turn produces the required voltage and current levels.

**G. Blynk App:**

Blynk is a mobile app that allows you to control your hardware projects connected to the internet. It is a platform that simplifies the process of creating internet-connected projects and allows you to remotely control and monitor them from your smartphone or tablet. The Blynk app allows you to create custom user interfaces for your projects with various widgets, such as buttons, sliders, graphs, and LEDs. Blynk works by providing a cloud-based service that allows your hardware project to communicate with your mobile device. Some of the widgets available in the Blynk app include buttons, sliders, gauges, and graphs.

### VI. DESIGN OF MODEL

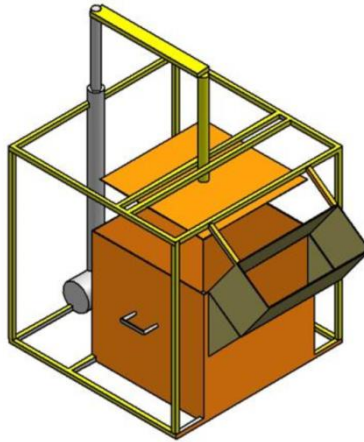


Fig 2. 3D Model

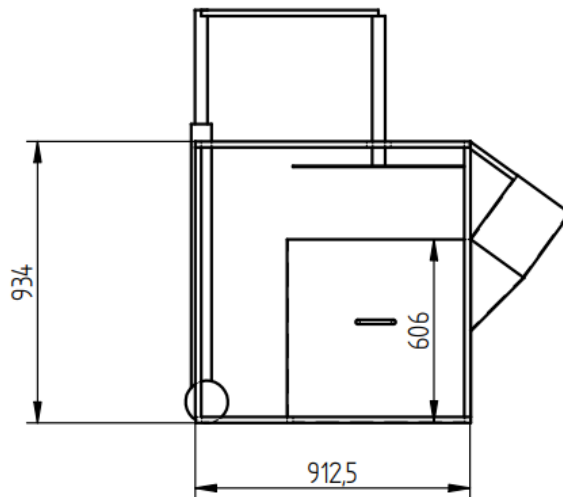


Fig 3. Front view

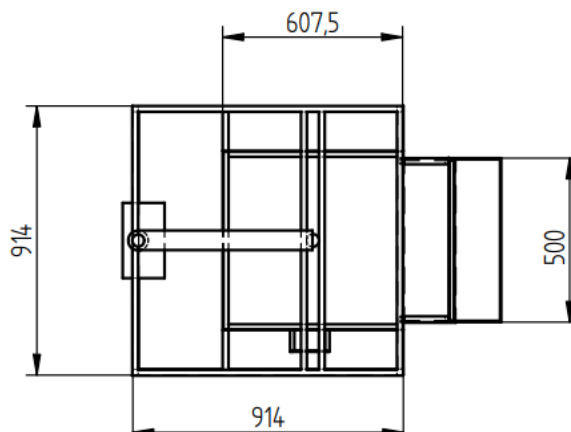


Fig 4. Top view

## VII. FUTURE SCOPE

Smart dustbins: Dustbins equipped with sensors and connected to the Internet of Things (IoT) can monitor their fill levels and optimize waste collection. They can also be equipped with GPS technology to optimize collection routes, reduce collection times and costs. Modern dustbins can sort waste into different categories, such as plastic, glass, paper, and organic waste, with the help of integrated sensors and automated sorting technologies. These dustbins will help increase the percentage of waste that gets recycled, which can be further processed into new products, ultimately promoting a circular economy. Autonomous cleaning systems integrated into dustbins can reduce labour requirements and decrease the spread of germs and bacteria.

## VIII. CONCLUSION

Advanced waste management is done without much manual interventions. We have studied different characteristics of smart dustbins from literature. We have designed and fabricated and met the requirement for the smart dustbin. We have implemented a real time waste management system by using sensors to check the fill level of smart dustbins. This system helps in assessment of dustbins from any place at any time and helps in taking decisions accordingly. This system also helps in cost reduction, traffic control and also helps in systematic way of waste management.

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