

Smart Solid Waste Management System Using IOT

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Abstract

Many times we see that the garbage bins (Dustbins) are placed at public places are overflowing due to increase in waste every day. This creates unhygienic condition for the people and also creates bad smell (foul smell) around the surroundings which leads in spreading some deadly diseases & human illness. To avoid this kind of situation we are working on the project to design “Smart Waste Management System using IoT”. In this proposed System there are multiple dustbins located in the city or the Campus. These dustbins are provided with low cost embedded device which helps in tracking the level of the garbage bins and a unique ID will be provided for every dustbin in the city so that it is easy to identify which garbage bin is full. When the level reaches the threshold limit, the device will transmit the signal to the cloud server with details like dustbin level along with the unique ID provided. These details can be checked by the concern authorities from their place with the help of Internet and an immediate action can be made to clean the dustbins. As soon as dustbin has reached its maximum level, waste management department gets alert via SMS via Mobile network (GSM) placed at dustbin so department can send waste collector truck to dustbin location to collect garbage. The objective of the project is to enhance practical use of IoT based solid waste collection and management system for metro Politician cities. Internet of Things (IoT) is very popular nowadays in the smart cities because of its application in waste management, water management, etc. This paper performs a review of existing IoT-enabled solutions in smart cities waste management. The objective of this paper is to get knowledge about the strengths and weaknesses of the system in order to bring improvements and innovations to manage waste effectively and efficiently and maintain a healthy environment in our cities. We have performed reviews on 15 research paper articles in the literature and the results obtained shows that existing solutions were similar in the technologies used. This thus, calls for further improvement and innovation.

Keywords: Waste Management, IoT, Smart Cities, Sensors, Garbage.

I. INTRODUCTION

Things that are associated with Internet and once in a while these gadgets can be controlled from the web is called as Internet of Things. The Internet of Things (IoT) is an idea where the close by objects are associated through wired and remote systems without client intercession. In IoT, the gadgets impart and trade data to offer clever types of assistance to the clients. The ongoing advances in cell phones outfitted with different sensors and correspondence modules. This cutting edge innovation is utilized in the Internet of things. Because of the benefits of IoT administrations, squander the executives has additionally become a noteworthy issue in

instruction, industry, and government as major IoT application fields. The brilliant dustbins are set on the numerous areas in the city. This waste is additionally gotten by the city company's trucks to at long last dump it in dumping territories which are outside the city. Because of absence of assets and incapable foundation, some waste isn't gathered which contains genuine wellbeing risk squanders like clinical squanders, synthetic squanders, and so on which hurts the general condition [1]. Time to time cleaning the dustbin territories is an answer for this issue. Monitoring the status of the receptacle physically is a troublesome activity. There are numerous dustbins are situated in a city. In this framework, the Smart residue receptacles are associated with the cloud server through versatile system innovation (GSM Technology) to get the continuous data of the keen dustbins which are set in different areas in the city. These dustbins have a raspberry pi based framework with ultrasonic sensors [2]. The ultrasonic sensor identifies the degree of the residue in dustbin and imparts the signs to raspberry a similar sign field code and send to the application and it is gotten. The information is gotten in the cloud server which is broke down and prepared. The information is looked by an office which check the information on a screen which shows the status of the Garbage. The division get alert on the screen about dustbin is full and educates individual whoever is answerable for gathering trash from the specific zones. The dump trucks gather the trash from the totally full dustbin and arrange it [3].

1.1 Background and Motivation

Internet of Things (IoT) is another correspondence innovation which is anticipated as a worldwide system of physical items and gadgets having the ability to collaborate with one another. It has a system of physical gadgets, machines, and so on outfitted with hardware, sensors and programmings and system network that makes them ready to gather and trade information with each other.

1.2 Objectives

1. The objective is to understand the strengths and weaknesses in order to bring improvements and innovations to manage waste effectively and efficiently as well as maintain a healthy environment in our cities.
2. To enhance practicality of IoT based solid waste collection and management system for smart city.
3. To Deployment of dustbin based on the actual needs.
4. To Reduce Cost and resource optimization.
5. To Improves Environment quality

1.3 Scope of the study

The Scope of this System there are numerous dustbins situated all through the city. These dustbins are given minimal effort ultrasonic sensors which helps in following the degree of the trash canisters and a remarkable ID will be accommodated each dustbin in the city with the goal that it is anything but difficult to recognize which trash receptacle is full. At the point when the level arrives at as far as possible, the gadget will transmit the level alongside the special ID gave to the cloud server through portable innovation. These subtleties can be gotten to by the worry division from their place with the assistance of Internet and a prompt activity can be made to clean the dustbins [4].

1.4 Problem statement

Commonly we see that the trash receptacles which are set at open places in the urban areas are flooding because of increment in the waste each day. It makes unhygienic condition for the individuals and makes terrible stench in the encompassing. This leads in spreading some savage infections and human disease. To dodge such a circumstance we are wanting to configuration "Keen Waste Management System utilizing IoT" [5].

II PROPOSED SYSTEM ARCHITECTURE

The IoT innovation has been viewed as a reality as a few gadgets are being associated with the Internet just as impacting our everyday exercises in various manners. IoT has brought an interconnectivity between objects, individuals, sensors and administrations. The innovation has accomplished a far reaching application wherein urban areas' waste administration isn't a special case. In this paper, we have talked about a few deals with brilliant waste gathering frameworks as IoT-empowered answers for shrewd urban areas' waste administration. The significance of this examination is to distinguish various takes a shot at IoT applications identified with brilliant waste assortment, their restrictions, potential arrangements, advancements utilized, their proficiency and execution. The rundown of the discoveries is appeared in Table I and Fig. 1 shows the conventional design of savvy squander the executives [6].

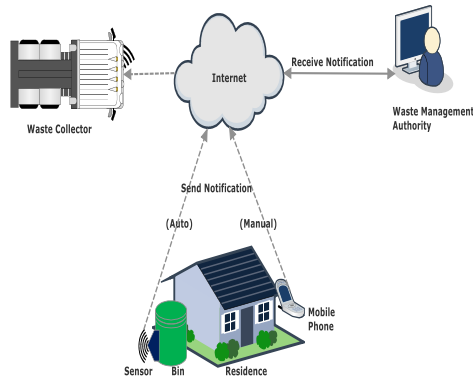


Fig.01 General smart-waste collection architecture

The examination performed shows that there are a few unique answers for squander the board utilizing IoT innovations with each having its methodology, qualities and shortcomings. All the examinations considered in this paper built up a waste assortment framework utilizing IoT gadgets which works by detecting the edge level of the waste container and send warning or cautions to the suitable specialists when the canister is full. The correspondence of this data was accomplished utilizing SMS instant messages, portable applications, etc [7]. Additionally shows appeared in Table I are the general difficulties looked by the IoT innovations utilized in the frameworks. The downsides experienced with these gadgets are detecting precision influenced in different climate conditions, clients inclined to unapproved get to particularly for RFID card and having short range capacities that influences the exhibitions. Specifically, the apparatuses used to send receptacle status to the recipient side are short extended and requires establishment instruments that make them not to be down to earth in a city application, and a portion of the frameworks don't have area device that alarms the collector of the area of the full canister [8]. We have recognized the pertinence of picking fitting innovation when structuring IoT-empowered waste assortment. That is innovation which has less constraints and can work fantastically in numerous or various situations and climate conditions. Subsequently, the specialized devices utilized in the receptacle to the collector side is to be cautiously and appropriately introduced for what it's worth of significance when executing such arrangement. The savvy framework which is introduced ought to have a huge inclusion and long battery life. The area device used to send the canister status ought to have the option to express the area and remarkable ID of the receptacle just as give and an enhanced course for squander assortment [9].

3.1 Hardware Model Design

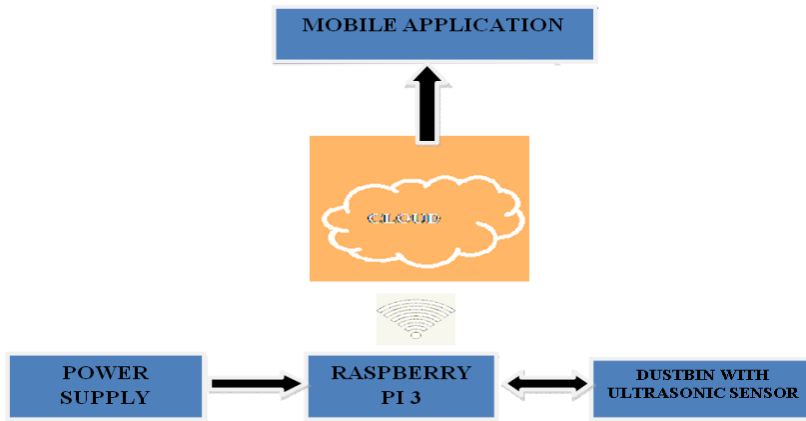


Fig.02 Proposed System Architecture

Table 1: Summary of IoT-enabled Solutions in Waste Collection

| Ref. | IoT Technology | Communication Technology | Pilot Size | Range Achieved | Location information tool | Micro-controller used | Limitation |
|------|-------------------|--------------------------------|-----------------------------|--|---------------------------|-----------------------------|---|
| [1] | Ultrasonic sensor | Ethernet/WiFi OR 3G connection | 11 smart bins 2 gateways | 240 meters 110 meters (different areas) | GPS | - | Ultrasonic sensors: sensing accuracy can be affected by changes in temperature |
| [2] | Ultrasonic sensor | GSM | - | - | GPS | Node MCU controller | GSM is prone to bandwidth lag |
| [3] | Infrared sensor | WiFi | - | - | - | ARM LPC2148 controller | WiFi is a short range connection technology |
| [4] | Ultrasonic sensor | GSM/GPRS | 2 Smartbins | - | GPS | “not specified” | A new user gets register himself, this means anyone can have access to the system |
| [5] | Ultrasonic sensor | GSM | - | - | - | Arduino Uno microcontroller | It uses a text message to notify the municipality |
| [6] | Load | GSM | - | - | Robot | LPC2131/32/34/36/38 | GSM is prone |

| | sensor | | | | mechanism | | to bandwidth lag |
|------|--------------------------------|------------|---|---|------------|-----------------------------|--|
| [7] | Ultrasonic sensor | WiFi | - | - | - | Arduino Uno microcontroller | WiFi is a short range communication technology |
| [8] | Cloud computing | - | - | - | - | - | A user has to send the status of the bin |
| [9] | Ultrasonic sensor | ZigBee GSM | - | - | - | Arduino Uno microcontroller | ZigBee is prone to attack from unauthorized people |
| [10] | Ultrasonic sensor | GSM/GPRS | - | - | GPS | - | NIR contains less information on the spectra |
| [11] | Ultrasonic sensor | ZigBee GSM | - | - | - | UARP microcontroller | ZigBee is prone to attack from unauthorized people |
| [12] | Ultrasonic sensor | RFID | - | - | - | ARM 7 controller | RFID is prone to unauthorized access |
| [13] | Ultrasonic sensor | RFID | - | - | GIS server | - | Requires the person to always have the RFID card upon using the bin for identification |
| [14] | Ultrasonic sensor IR sensor | Ethernet | - | - | - | Arduino Uno microcontroller | Bins' notifications, do not have location details and ID |
| [15] | Ultrasonic sensor | - | - | - | - | - | Requires that each type of waste material has a bin thus can't be implemented on door to door. |

3.2 CIRCUIT DIAGRAM

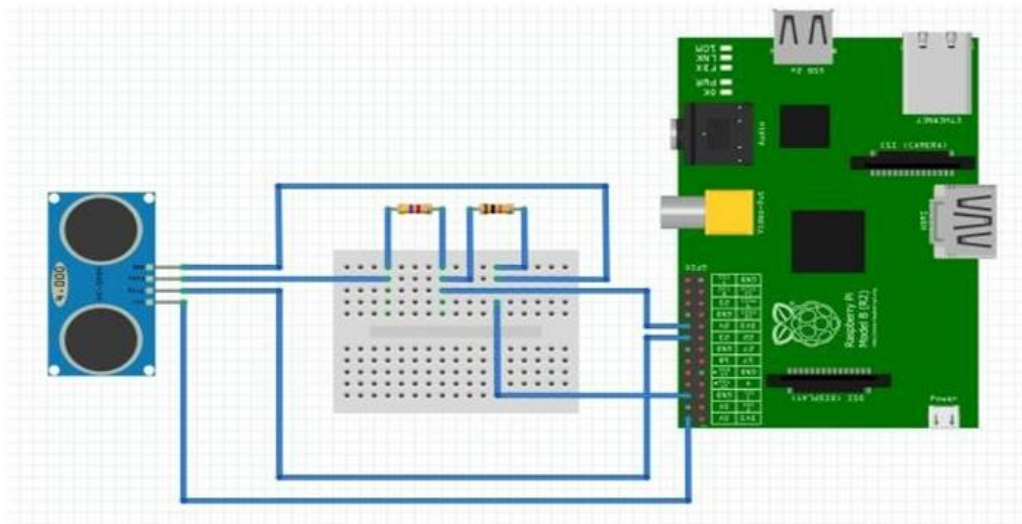


Fig.03 Circuit Diagram

3.3 WORKING (METHODOLOGY)

This undertaking Smart Waste Management utilizing IOT is an imaginative framework which will assist with keeping the urban areas clean. This framework screens the trash containers and alarms about the degree of trash gathered in the trash receptacles through a portable application. For this the framework utilizes ultrasonic sensors set in the canisters to identify the trash level and ready when the trash is at the full level. The framework makes uses of Raspberry Pi for gathering data from ultrasonic sensors and sending information to the cloud server. The framework is fueled by a 12V force flexibly. A Software is worked to demonstrate the status to the client checking it. The product gives a perspective on the trash containers and features the trash gathered in shading so as to show the degree of trash gathered. Therefore this framework assists with keeping the city clean by educating about the trash levels of the canisters by giving trash level of the containers by means of IOT application improvement stage [10]. The approved individual gets the sign of trash dustbin is full through the product and afterward illuminate the concerned individual who is answerable for the assortment of trash where the trash receptacle is full specifically zones. The information get put away in the cloud server made and afterward the information is recovered in IoT applied to outside and open situations, correspondence is significant for administration provisioning. Since this kind of IoT has a wide help territory which is the entire city, solid correspondence is essential for gadgets to speak with one another. Thusly, the SGBs used in the proposed framework speak with one another dependent on a remote work arrange, making sure about correspondence unwavering quality. With a battery-based force flexibly, the portability of the proposed framework is made sure about. In IoT with a wide help territory, information trades and administrations ought to be led consistently whenever and any area. Client comfort has been improved with the appearance of IoT[11].



**EMPTY
SMARTBIN**



**FULL FILLED
SMARTBIN**

Fig 04. Actual working of Smart Dustbin

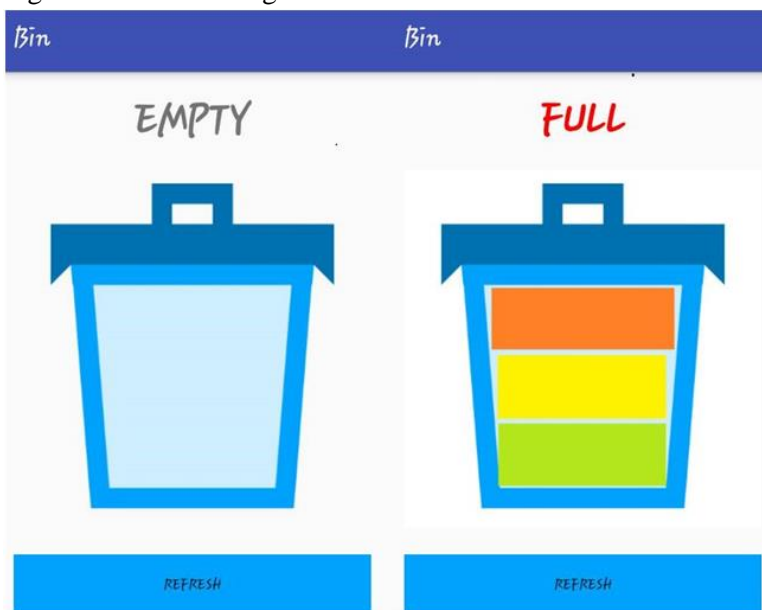


Fig 05. Smart Dustbin Status

IV. WHY IOT

The Internet of Things (IoTs) can be portrayed as interfacing regular items like advanced cells, Internet TVs, sensors, and so forth to the Internet where the gadgets are wisely connected together empowering new types of correspondence among things and individuals, and between things themselves. Building IoT has progressed essentially over the most recent a long time since it has added another measurement to the universe of data and correspondence innovations. It is normal that the quantity of gadgets associated with the Internet will amass from 100.4 million of every 2011 to 2.1 billion constantly 2021, developing at a pace of 36% every year. In the year 2011, 80% machine to machine (M2M) associations

were made over portable systems, for example, 2G and 3G and it is anticipated that by 2021, this proportion will increment to 93% since the cost related with M2M over versatile systems are commonly less expensive than fixed systems [12]. Presently anybody, from whenever and anyplace can have availability for anything and it is normal that these associations will broaden and make a completely propelled dynamic system of IoT. Checking and controlling the activities of urban and provincial foundations like extensions, railroad tracks, on-and seaward wind-factories, Thermal force plants, and hydroelectric force plants is the principle application IoT. The IoT framework can be utilized for observing any occasions or changes in auxiliary conditions and changes in the indigenous habitat that can bargain wellbeing and increment danger of normal and synthetic catastrophes. It can likewise be utilized for planning fix and support exercises in a productive way, by organizing assignments between various groups and the men who are working of these offices. IoT gadgets can likewise be utilized to control basic foundation like scaffolds to give access to ships. Utilization of IoT gadgets for observing and working foundation is probably going to improve occurrence the executives and crisis reaction coordination, and nature of administration, which lessens expenses of activity in all framework related activity [13]. The improvement of the Internet of Things will reform various segments, from computerization, transportation, vitality, social insurance, budgetary administrations to nanotechnology. IoTs innovation is likewise been applied to make another idea and wide advancement space for brilliant homes to give knowledge, comfort and to improve the personal satisfaction. The IoT advances mindfulness about our reality, and a stage from which to screen the responses to the changing conditions that said mindfulness uncovered us to[14]. The IoT empowers bunch applications extending from the smaller scale to the large scale, and from the minor to the basic. Since we're concentrating here on why the IoT is significant, we should direct our concentration toward the "large scale" and the "basic" first, and take a gander at certain thoughts that are as of now being developed over the globe. Natural checking utilizations of the IoT ordinarily use sensors to help ecological assurance by observing air or water quality barometrical or soil conditions and can even incorporate zones like checking the developments of untamed life and their territories. The Technology can likewise be utilized to distinguish normal catastrophes like seismic tremor or wave as an early-notice frameworks and it can likewise be utilized by crisis administrations to give increasingly successful guide, food prescriptions to the common disasters influenced regions. IoT gadgets in this application spread a huge geographic territory. It has been contended that the normalization IoT brings to remote detecting will change this zone. More research on the Iot and its applications can get upsets different fields too [15].

V. LIMITATIONS OF THE EXISTING SYSTEM

1. Time consuming and less effective: trucks go and empty containers whether they are full or not.
2. High costs.
3. Unhygienic Environment and look of the city.
4. Bad smell spreads and may cause illness to human beings. More traffic and Noise

VI. ADVANTAGES OF THE PROPOSED SYSTEM

1. Real time information on the fill level of the dustbin.
2. Deployment of dustbin based on the actual needs.
3. Reduction in Cost and efficient optimization of resources.
4. Improves Environment quality and Air quality
5. Fewer smells

6. Cleaner cities
7. Intelligent management of the server.
8. Effective usage of dustbins.

CONCLUSION

We have executed ongoing waste administration framework by utilizing shrewd dustbins to check the fill level of keen dustbins whether the dustbin are full or not. In this framework the data of every savvy dustbin can be gotten to from anyplace and whenever by the worry individual and they can take a choice in like manner by utilizing the IoT. By actualizing this proposed framework, the cost decrease, asset advancement, viable use of savvy dustbins should be possible. In view of the utilization of this framework there is in a roundabout way decrease of the traffic in the city. In metropolitan urban areas the trash assortment vehicle visit the region's regular twice or threefold which relies upon the number of inhabitants in the specific zone and in some cases these dustbins might be full or may not be full. This framework will educate the status regarding every single dustbin on ongoing premise and he information can be gotten to by the concerned division which investigates this. The office investigates the information and sends the trash assortment vehicle to the region where the dustbin which is full is found. The extension for the future work is this framework can be actualized with time stamp in which constant clock appeared to the worry individual at what time dust canister is full and at what time the waste is gathered from the brilliant dustbins. IoT correspondence standards have given the ability to gadgets to impart and share data in long range separations while using less force. In this paper, we have led and introduced examination of brilliant waste assortment frameworks utilizing IoT advancements. The goal was to distinguish the innovations utilized, their difficulties, potential arrangements and other specialized elements. An outline of the discoveries is appeared in Table I. The examination shows that the present frameworks are comparable regarding the IoT innovation utilized and the general activity of the framework. Be that as it may, the use of LoRa on the frameworks was not found and this contrarily impacts their exhibitions. That is, instruments used to send container status to the beneficiary side are short extended which required establishment devices while a portion of the frameworks don't give area data that alarms the recipient of the particular situation of full receptacle. Consequently, it is significant that improvement and advancement are speedup the administration of waste in our urban communities to guarantee sound condition and limit the maladies and diseases. Subsequently, as a future work we prescribe the utilization of LoRa innovation to support the life span of IoT-empowered arrangements and their presentation couple with different advancements. This stems from LoRa's capacity to give broadened inclusion utilizing less force utilization and its unwavering quality.

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