

**IOT BASED WASTE MANAGEMENT SYSTEM**J. Rajasekhar<sup>1</sup>, N. Srinivasulu<sup>1</sup>, K Surendra<sup>1</sup>, P. kowshik<sup>1</sup>, G. Kedarnath<sup>1</sup>

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**Abstract** -Waste Management is one of the biggest challenges across the globe that affects humans' lives in terms of change in environmental conditions and other factors. To acknowledge this issue Internet of things (IoT) is the best platform as the scope of the Internet of things is widely spread in every sector. The production of waste material is increasing day by day due to the exponential growth in urbanization, thereby resulting in the utilization of resources by humanity. The wastes are different forms according to their sources like municipal, industrial and hazardous waste. Managing a different kind of waste is a very tedious task. To resolve this issue, we will use IoT-based solutions in these different fields. This paper is all about a summary of various methods and techniques used in waste management based on IoT in different sectors. Based on this overview, one can easily carry out their further work.

**Keywords:** IoT, waste management, cloud server, controller

**1. INTRODUCTION**

Waste management is a cyclic process that needs to be monitored and disposed of regularly. Dumping waste materials is the main problem that comes across our day-to-day life. Wastes are of different forms according to their source. They are municipal waste, industrial waste, and hazardous waste, segregation of these different kinds is a difficult process. Transportation, recycling this waste, and finally, disposal is a hectic task because we have different waste materials, and the recycling mechanism may vary according to the type of waste material source. If appropriate methods are maintained in classification and dumping, it does not lead to landfilling.

We have different wastes in this first one is Municipal solid waste produced by the daily household activities, including mainly food waste, used newspapers, old clothes, damaged furniture, cardboard boxes, batteries, etc. [1]. Most of these waste items can be recycled, and we can get the new products out of it if we properly classify this waste according to their source and then dump it. Municipal solid waste can be less harmful and bio-degradable when compared to other wastes [2].

Industrial and hazardous waste is harmful when compared to municipal solid waste. In these two categories, the proper method of segregation and dumping is there, but workers are failing to follow the classification and dumping process, which leads to dumping in open lands, thereby causing health issues and pollution. The main cause of industrial waste is the production of various goods in different industrial sectors like mills, plants, industries, and mines. Industrial waste is again divided into different forms based on the source they are chemical waste, industrial solid waste, and toxic waste. These types of waste need to be regulated considerably. [3]

Mainly in Hazardous waste management, certain rules and regulations should be implemented as it affects human lives and change in environmental conditions. The main

source of this waste is generated from the automobile industry, hospitals, garages, photo processing centers, etc.

Though trash cans are available everywhere in public and private places due to excessive production of waste materials people are used to through the trash in open areas, especially in the industrial sector. Waste is collected and disposed of by rag pickers in every sector. As a result, the burden on rag pickers is increasing, affecting their health, especially in our current pandemic.

Relying on traditional methods in parallel, we should also opt for technical methods on waste management. This issue needs to be addressed effectively using advanced technologies like IoT. By using this technology, we can also reduce waste management and time issues. IoT is very useful in this field by using smart methods to monitor the garbage bins, track the waste materials, and even recycle. Using this advanced technology, the human effort will be reduced, and we will get satisfactory results.

According to the statistics, municipal waste generation is estimated in India from 2001 to 2041. Up to 2011, plastic waste produced across the country is 56 million metric tons per year, and in the future, by 2041, it will reach 200 million metrics per year approximately. [1] The graphical representation of msg By 2021-2025, the market size to expand 190.88 million MTPA in hazardous waste management according to Technavio and industrial waste management market by 8.1% in 2020-2027[4][5]

The waste generation is increasing day by day according to the above results indicates alarm sign for future generations to solve these issues various technical methods are introduced in this field by using IOT according to the source of waste is detailed

## 2. LITERATURE SURVEY

Literature survey in carried on different methods and proposed techniques involved in Municipal solid waste management, industrial waste management, hazardous waste management through IoT technology.

Municipal solid waste management using IOT: Various methods using IOT Technology in municipal waste management. In paper [6] author proposed smart garbage and waste collection bin and Food waste disposal machine (FWDM) for collection of waste and recycling of food waste. In the smart garbage and waste collection bin, Microcontroller MSP430, IR Sensor (TSOP 1738), weight sensor, and WIFI are used for communication purposes. The main motive behind this is to create awareness among the people about the food waste and also sends the information to the authorities if the dust bin is full so that the rag pickers will collect the waste

IoT-based garbage monitoring and clearing system are used to monitor the level of the garbage and send the notification to the authority. Led lights indicate that the dust bin is full and useful for the people to know that garbage is full and information is passed through municipal authority. GSM module Wi-Fi modules are used as communication technology. The proposed system consists of solar panel to save energy [7]

"Smart Garbage Monitoring Using IoT" This author illustrates biodegradable and non-biodegradable wastes and their Separation process. The biodegradable and non-biodegradable wastes are recognized by computer vision API, and according to the type of material, the disposal will be there. The LCD is used to point out that the trash bin is full. WIFI and

Computer vision is the used Technologies for this purpose. Maintenance is very difficult and costly because so many sensors used like RC-A-524 Metal Detector Sensor Module, IR Motion Sensor, OV7670 image sensor, Arduino Uno[8]

Efficient Waste Collection System, Here author come up with a unique concept of The centralization of smart bins enables communication among them to transmit information about every bin. If these bins are filled, it informs the authorities about the status of the bin along with the shortest path to reach the destination without any delay. Here author designed the bin in such a way that along with indicating the level of the bin, he added another sensor to know if there are any harmful gases present or not, which is added advantage. In some cases, the life-threatening situation occurs due to the harmful gases, so that it will be more helpful to the trash pickers. So, the sensors used for this are HC-SR04 level sensor, MQ-4 Gas quality sensor, Arduino UNO Board [9]

Waste Management Improvement in Cities using IoT generally waste separation takes a lot of time that the separation of Dry waste and wet waste is very difficult, so the author identifies this issue and comes up with a solution to separate dry waste and wet waste. Here the author discusses the process of separation of these both wastes. To make the separation easier, the author proposed a hardware circuitry made up of Arduino board, Ultrasonic Sensor, Moisture Sensor, which identifies and divides the type of waste material through sensors. The communication mode used for this process is WIFI, GSM [10]

Discuss the maintainer of solid as it is difficult to monitor manually, so here author proposed online monitoring of trash cans through the web page. So this will be very easy to monitor without physical presence near the bins. The designed circuitry for this is a Pic microcontroller, ultrasonic sensor to know the level of the bins[11]

The hardware used by the author to maintain the trash cans is Arduino. The ultrasonic sensor is used to monitor the level of the bins. If any overflowing occurs, information is passed to the authorities about the level of dust bins through the android application. In this proposed system, continuously real-time monitoring of bins will be there [12]

here author discusses the method of segregation of waste depending on the type of waste material. The sensors detect the waste separate the waste accordingly, whether it is plastic, metal, or biodegradable wastes. Hardware needed for this separation is STM controller, capacitive and inductive sensor, level detector, gas sensor. This author proposed a method for biodegradable waste that separates them from others and controls the odour produced by the waste through chemical treatment. WIFI is used as means of communication between the station and the authorities. It is a very complex process to manage and handle the circuitry [13]

In paper [14], the author designed an application to monitor that landfilling sites and update the site's status to avoid excessive landfilling to the authorities. The landfilling sites can be easily maintained and monitored continuously through this application. This author uses node MCU for controlling purposes, an ultrasonic sensor for data, and PHP for web application programming.

Smart Bin- An Internet of Things Approach to Clean and safe Public Space, Neetha, Sanjana Sharma here authors proposed smart dustbin which timely monitors the bins and if it is full notification send to the concerned authority the technology used for a mode of

communication is WIFI by using this smart bins waste will be collected properly so that there will be no lag is collecting the waste if excess waste is thrown it won't overflow on roads, here sensors plays a major role so they must be intact and hardware used for this purpose are Smart sensors, Arduino [15].

In this paper [16],the author discusses hazardous industrial management,earlier approaches, and limitations.The proposed paper consists of Industrial hazardous waste (IHW)compatibility software and its mathematical model. He illustrated the web-based waste proportioning software system (WPSS) and detailed the linear programming model. Through this system, we can achieve effective waste management.

### 3. PROPOSED WORK

Smart waste management is a use of the Internet of Things (IoT). The advancement of IoT technology enhances existing waste management through improved technology and societal forecasts. A smart trash management system based on IoT gives advantages over traditional garbage management. A smart waste management system analyses bin levels using a variety of sensors to signal an emergency when the bin is full. Then the authorities must act. IoT can assist in collecting and analyzing reports on a cloud server that are quickly available to regulating authorities, allowing them to take appropriate action in the event of carelessness.

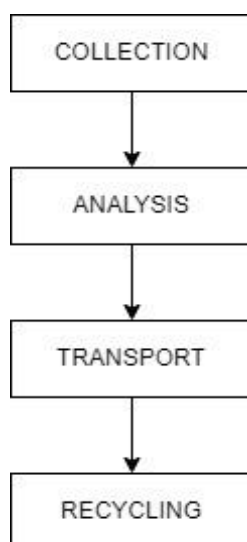


Fig 1. The flow of the Smart waste management

Figure 1. shows the flow of smart waste management in this process. First, we collect the waste from the different areas analyze the data and the different kinds of wastes. And This process will be continued

In this paper, we utilize a set of sensors capable of sensing the level, temperature, dangerous gas, position of the garbage bin, and so on.a collection of sensors linked to the controller is the core of the entire network; the controller will send the collected data to the supervisor, who will then start taking the appropriate measures.The communication will take place via the Wi-Fi device. The supervisor may review information via a webpage or a mobile app.We can see all of the statistics on the webpage dashboard.

We provide the most recent garbage bin changes.Each waste bin can have two slots, one for wet waste and one for dry waste.The amount of garbage in each slot is detected using level sensors.Utilizing WIFI, the state of the bin is transmitted to the cloud and the nearby admin office.There will be numerous bins in regions that fall under the jurisdiction of a single major

regional office. Whenever a container gets filled, all data from the garbage bin is recorded inside a document and delivered to a Regional Office. There are numerous bins in regions that fall under the jurisdiction of a single major regional office. The data obtained by the server will eventually be used to assist Recycling Relationships in recycling the garbage.

Smart bins will play an important part in this management system by allowing processing to begin orderly. Figure 2 shows the smart waste bin. Smart waste bin

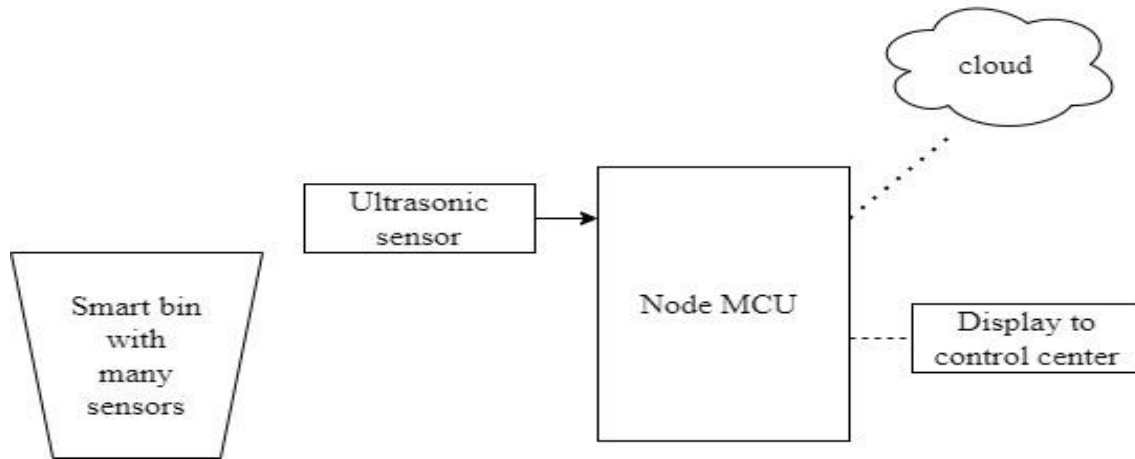


Fig.2 Smart waste bin

#### 4. Conclusion

Finally, we can conclude from the above illustration that various methods in waste management involve the collection of garbage, segregation, and disposal according to the type of waste material. It also indicates further scope in this area to cope with the present situations. But still, we need to focus on proper segregation and disposal methods on industrial and hazardous waste as we face a big challenge in this sector.

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