# *SMART WASTE MANAGEMENT USING IOT*

## *BE THE SOLUTION TO RUNOFF POLLUTION*

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***Abstract*—Proper waste management is a fundamental key to environmental stability. In this, an innovative solution of managing urban problem and environmentally conscious way to manage trash collection is presented. We present a trash collection management solution based on providing intelligence to trash bin using IOT prototype and sensors which helps in real time monitoring of level of trash in the bins . Data is processed by intelligence and optimized algorithms can be used to dynamically manage trash collecting mechanism used to provide optimized route for garbage collecting vehicles so that the management sends the vehicle to collect wastes only when necessary, which will reduce cost associated with fuel significantly, also segregation is done automatically by the bin to reduce human efforts and providing data which causes ease for recycling process,it compresses waste dumped into it thus increasing the input capacity of bin which helps to investigate benefits of such system over traditional system.**

***Keywords—trash bin , IOT sensors, segregation.***

## I. INTRODUCTION

Waste disposal is a common problem and has been persistent battle over the years, with successive Governments applying different approaches in a bid to eradicate the problem.Waste management is a global issue and that it is a growing source of concern in developed and developing countries due to increase in urbanization,changes in consumer pattern and industrialization leading to increase in waste generation.Worldwide interest in Smart Cities has aggrandized fostered by the need to find effective remedies to the major challenges of waste management for the next years.As one of the application of Smart City, Waste Management in a city is a formidable challenge faced by management corporations.Waste is defined as any material of no use and represents no economic value to its owner.Depending on the physical state of the waste it can be segregated as dry waste and wet waste. Waste management includes planning ,collection,transport, treatment, recycling and disposal of waste with monitoring and regulation.The existing Waste Management system, where the waste is collected from streets, houses and other establishments is not able to effectively manage the waste generated.

In this paper, an illustrative representation has been proposed that consists of three main aspects, the Smart Bin**[1]**, Garbage Collecting Vehicle**[2]** and the Data Analysis**[3]**. The Smart bin is an ordinary garbage container with some extraordinary capabilities that makes it Smart. The Smart bin is equipped with an array of sensors(working of the same is illustrated in the methodology section of the paper) which contribute to the Data analysis, It has the capability to segregate wastes and lastly it can compress the waste, all these reduce the human efforts making it the efficient waste management system. the second aspect is the Garbage collecting vehicle which is also equipped with sensors(working of the same is illustrated in the methodology section of the paper) which contribute to the third aspect i.e. the Data analysis which helps in finding the optimum Bin for certain location. A notification is sent to the management once the waste disposal reaches the threshold and preventing the lid if the Smart bin from opening.(it locks the lid).Management then dispatch the Garbage Collecting vehicle to collect the filled Smart bin. This reduces the fuel consumption significantly. The vehicle records information related to a Bin collection trip from certain location .Using data mining**[4]**, qualitative analysis will be carried out to generate reports.

The main objective of this system to be implemented is to replace the traditional existing system which will aid city to become a Smart City.

## II. LITERATURE SURVEY

With rapid urbanization, the country is facing massive waste management challenge. Over 377 million urban people live in 7,935 towns and cities generate 62 million tonnes of waste per annum. Only 43 million tonnes of waste is collected. Only 11.9 million tonnes is treated and 31 million tonnes is just dumped in landfills sites. Solid waste management is one among the basic essential services provided by management authorities to keep urban centers clean. The management authorities dump the waste in a haphazardly manner. Experts believe India has been following a flawed system of waste disposal and management. As per Central Pollution Control Board**[5]** Indians throw out 15,342 tonnes of plastic waste everyday of which only 60% is recycled and rest 40% is just dumped in landfill sites i.e 6,100 tonnes of plastic which end up polluting water resources. The biggest hurdle in plastic recycling and waste management is non-segregation of waste at source. Irregular management of management trash containers causes heap of garbage in a container to overflow, windblown litter and visible waste , pungent smell and inbreeding of mosquitoes, pests ,insects cause various diseases which deteriorates health of living beings.

Around 100 cities have been chosen to be developed as smart cities. The management authorities have to draw a long term vision for solid waste management and reinvent their strategies as per changing lifestyle.

The key to efficient waste management is to ensure proper segregation of waste at source and to ensure that the waste goes through different streams of recycling and resource recovery.

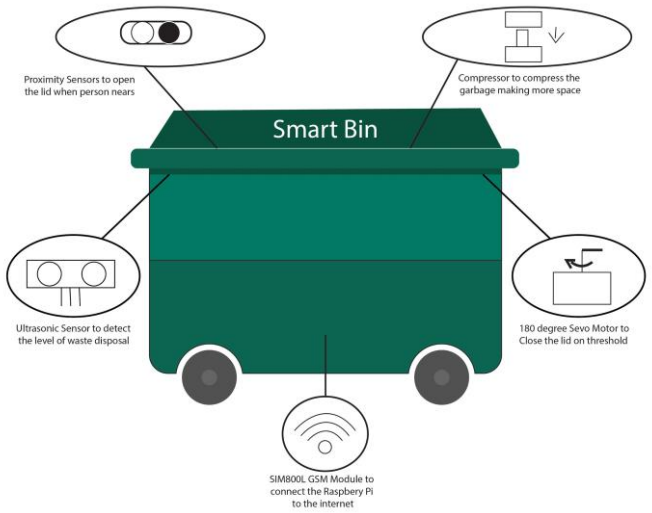
Community participation has a direct bearing on efficient waste management.

## III. Methodology

The paper is classified as follows, Section IV presents detailed working of the Smart Bin, Section V presents detailed description of segregation of waste, Section VI presents recycling process. Section VII describes the garbage collecting vehicle management.

## IV. Smart Trash Bin

The smart trash bin is an ordinary trash bin with some extraordinary capabilities. It consists of an array of sensors, which have their very own functionalities and are solar powered and are driven by Arduino**[6]**. Proximity Sensors**[7]** are embedded to the front of the bin, when a person nears to the bin the lid opens. The bin consists of three layers(compartments), the top layer just collects the waste disposed by the people, with the help of applied machine learning the waste is segregated into dry and wet waste and dumped into their respective layers. The Ultrasonic Sensors**[8]** monitor the level of waste disposal inside the bin, once the disposal reaches a certain threshold the lid is not allowed to be opened. The IoT module Raspberry Pi**[9]** is then responsible to notify the management the bin is full. GPS Sensor**[10]** coupled with Raspberry Pi sends the location where the bin is present, for the management to further dispatch garbage collecting vehicle.




## V. Segregation of Waste

Waste from the bin can be segregated at the source level by applying basic techniques. This can reduce the human efforts of segregation, but cannot eliminate entirely due to certain common aspects discussed in section IX. Common Techniques by which we can segregate the wastes are:

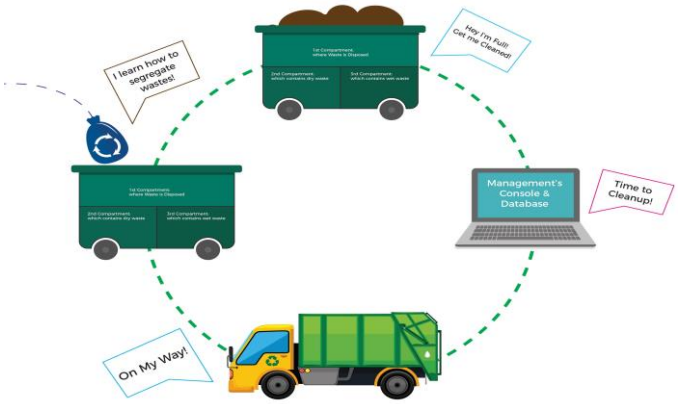
1. With the help of mesh, all the smaller particles and the bigger ones can be separated.
2. With the help of water detecting sensor**[11]** the wastes can be separated into wet and dry wastes.
3. With the help of weight detection sensor**[12],** whether a polyethene is empty or not can be determined.
4. Further with a blow of air, all the empty polyethene can be brought to an area where these polythenes are introduced to a heat source, as a result the polyethylenes shrink to form a compact material contributing to the recycling of the wastes which is discussed next.

## VI. Recycling of Waste

Segregation is the key for efficient Waste management system which makes ease for recycling.Recycling is a process of converting a waste material into a useful material and hence by increasing its economic value.In India, 62 million tonnes waste is produced per annum which consists of wet waste and dry waste.The wet waste generally refers to organic waste usually generated by eating establishments and are heavy in wet due to dampness, the recycling of wet waste is easy compared to dry waste as wet waste is biodegradable and can be decomposed by burying the waste underground it turns rich compost after a certain amount of time and can be used as manure, whereas dry waste consists of plastic which is a major problem to recycle.In India everyday 15,532 tonnes of plastic waste is produced.Although 60% of plastic materials are recycled such as PET(Polyethylene Terephthalate)bottles are recycled into park benches,school desks etc.It is also recycled to manufacture Indian Cricket Team uniform and blankets on Emirates Airlines,but the other 40% consists of plastic carry bags,plastic cups,plastic packing for chips,biscuits and chocolates etc. these are not recycled and are dumped in landfill,these can be recycled by construction of **PLASTIC ROADS** which offers better wear resistance and they do not absorb water, have better flexibility and less need for repair, cost effective: as recycled post consumer plastic is used is cheaper than using asphalt as asphalt is responsible for 2% of global carbon emissions.


## VII. Garbage Collecting Vehicle

Waste Collecting Vehicles are dispatched by the Management to the location sent by the Garbage container to collect it. The vehicles too are equipped with certain sensors such as weight detection sensor which detects the total weight of the containers per trip from certain location. Based on these analysis, An Optimum Sized Garbage Container can be provided to a particular area, to ensure that the Vehicle's Fuel is saved without compromising the cleanliness of a city.




## VIII. RESULTS

By implementing the smart trash bin over traditional bin, has shown various benefits that are it works great in limited spaces, effortless operation, lifetime support as they are durable for a long time ,segregation is easier as it is done at source, no inbreeding of insects and maggots, capacity is increased by 5X times the traditional bin. It is a low cost venture which looks neat and clean and economical.Additional revenue can be generated by wrapping customized designs and advertisements on the bins for marketing and promoting new initiatives and through recycling process minimizing the waste dumped in landfill sites, less fuel consumption.

## IX. ONGOING RESEARCH (DIFFICULTIES AND CHALLENGES)

As the disposal of wastes is in haphazard manner it becomes challenging to segregate the wastes beyond dry and wet wastes. Polyethene bags segregation is the key difficulty as they are light in weight and can fly around anywhere.

## X. CONCLUSION

Eliminates the common challenges of Waste Management system in dense urban areas, increase in recycling of waste materials as it is segregated at the source, as the smart bin lid is closed no transmission of diseases, less fuel consumption less carbon dioxide emission, overall contributing to **Swachh Bharat Abhiyan** initiative and also a **Smart City** solution for smart waste management and creating a cleaner and safer society for mankind and other living beings.

## XI. CITATION

**[1] Smart Bin** is the Garbage Container model which is proposed in this paper, and hence has been used throughout the paper.

**[2] Garbage Collecting Vehicle** is the same vehicle used by the waste management authorities with some additional functionalities proposed in this paper.

**[3] Data Analysis** is a process of inspecting, cleansing, transforming, and modeling data with the goal of discovering useful information, suggesting conclusions, and supporting decision-making.

**[4] Data mining** is the practice of examining large pre-existing databases in order to generate new information.

**[5]Central Pollution Control Board** is a statutory organisation under ministry of environment,forest and climate change.

**[6] Arduino** is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world

**[7]** A **proximity sensor** is a sensor able to detect the presence of nearby objects without any physical contact. A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal.

**[8]** An **Ultrasonic sensor** is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

**[9]** The **Raspberry Pi** is a low cost, credit-card sized computer. It's capable of doing everything what a desktop sized pc can do.

**[10] GPS** (Global Positioning System) is a satellite based system that provides location data to the another GPS receiver anywhere on the Earth.

**[11] A water sensor** is an sensor that detects the presence of water. Circuit is completed on detection of water else if water is not detected the circuit is not completed.

**[12] Load Cell (Generally known as Weight Sensor)** is a sensor that is used to "create an electrical signal whose magnitude is directly proportional to the force being measured."

**[13]Swachh Bharat Abhiyan** is a massive movement initiated by Government of India to clean India.

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