

Smart City Waste Management System

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ABSTRACT

Waste is defined as any material that cannot be reused and is an unavoidable byproduct of human activities which does not represent any economic value to its owner. Solid waste management is the most important challenge and Waste collection is a complex process which requires large amount of money and has become a critical issue in developing countries where a rapid increase in population has been observed. Solid Wastes are categorized into municipal wastes, hazardous wastes, medical wastes and radioactive wastes. A solid waste management (SWM) system includes the generation of waste, storage, collection, transportation, processing and final disposal. Solid waste management is one among the major environmental problems of both developed and less developed nations. In India, due to Rapid industrialization and population explosion people migrate from villages to the cities, which led to generation of thousands of tons of MSW (Municipal Solid Waste). The municipal corporations are completely responsible for proper waste management in their respective cities. In this paper an approach to smart waste collection is discussed which improves and optimize the handling of solid waste.

Keywords

Municipal waste, smart city, solid waste management, Sensor technologies

1. INTRODUCTION

Solid Waste is generated wherever the human life is present and it becomes a part of daily lifecycle. Today, waste management from its inception to its disposal is one of the important challenges for the municipal corporations in all over the world. Depending on the physical state of waste, waste are categorized into solid, liquid and gaseous and Solid Wastes are categorized into municipal wastes, hazardous wastes, medical wastes and radioactive wastes and Managing solid waste generally involves planning, financing, construction and operation of facilities for the collection, transportation, recycling and final disposition of

the waste [1]. Waste collected or generated from house should be stored at the generation source till it is collected by municipal workers. It is necessary to separate the wet (Kitchen waste) and dry waste (Recyclable waste), which is referred as primary segregation.

Paper, glass items, plastic and metal are the recyclables things among the waste generated. It is approximated as 4000 to 5000 metric tons of plastic waste is generated in India per day which accounts for 4 to 5 percent of total solid waste generated. Currently, collection of plastic waste is done by informal sector. In the same way about 95 percentage of waste paper collection is done by informal sector by door to door collectors and rag pickers. Construction and demolition waste constitutes up to 10-20 percent of total solid waste. As e-waste generation rates are increasing year by year and study says that only 5 percentage of e-waste was recycled per year, of which about 95 percentages is operated by informal sector. [2]

1.1 Current situation in India

The municipal corporations in their respective cities are completely responsible for the proper waste management. But many of municipal authority are not fulfilling their duties to provide efficient ways of controlling the generation of waste at source, collecting, transporting, disposal of that waste well mannered. Because of this inefficient waste collection, it is often mixed with excreta of humans and animals in the drains and leads to flooding of roads during rains, insect breeding and finally results into spreading of diseases.

1.2 Integrated solid waste management

The Integrated Solid Waste Management (ISWM) is mainly related to 3R (Reduce, Reuse and Recycle) approach which mainly focus on the minimization of the solid waste generated from different sources. The ISWM Hierarchy is shown in Figure. The hierarchy consists of Reduction of waste at source itself, Recycling, Composting, and Waste to Energy conversion and at last it prefers Sanitary Land filling.



Figure 1: Integrated solid waste management

As the waste disposed in community bins are not scientifically segregated so not suitable for optimal recycling. In India the segregation and recycling is achieved by rag pickers at a small scale who segregate the waste and sell them for their livelihood and the small vendors who buy newspapers, plastic items and other recyclable items from houses and process them for recycling.

To keep our environment clean and green our present prime minister gave the idea of building 100 smart cities throughout India. Now, as the number of smart cities is increasing the number of responsibilities is also required to be fulfilled. Swachh Bharat Abhiyan or the "Clean India Mission" is India's biggest cleanliness campaign that aims to fulfill the vision of "Clean India". Waste management is an integral part of this campaign. Solid waste management is one among the basic essential services provided by municipal authorities in the country to keep urban centre clean.

2. LITERATURE REVIEW

The collection, transportation and disposal of Municipal solid waste are unscientific. The Uncontrolled and haphazard manner of dumping of wastes in towns and cities has created overflowing landfills which leads to serious environmental implications in terms of ground water pollution and contribution to global warming. The country also needs policy and guidelines to enable the multiple corporations to run the waste services efficiently. [Gupta and Mohan et al. 1998] [3]

The researchers did a study that analyzed the process of municipal waste management in the city of Bangalore. The study involved the characteristics of municipal waste generated, the management practices involved and the role of municipal authorities in the overall process. The most important deficiencies found in the waste management system are the inadequate municipal service, uncontrolled dumping of waste, unscientific disposal system, lack of civic awareness in waste management etc. [Madhushree Sekher 2004] [4]

From last two decades, there is rapid growth in urbanization, industrialization and population in India, which leads to the problem in waste management. Cities are expanding like never before and the main topic of concern in these smart cities is cleanliness and hygiene. [Abdullah, Nibras 2018, Talari, Saber, et al 2017] [5][6]

The sensor detects the garbage bin level. Once if the garbage is filled information is sent to the municipal authorities. The basic idea is about knowing the real time data of each bin to decide the waste generation pattern, what bin should be emptied and what should not. [Kanchan Mahajan et.al 2014] [7]

Developed an electronic monitoring system with GSM, which sends SMS to the municipal authority informing that the dustbin if completely filled so that system can send the truck for the collection of trash and the ultrasonic sensor are used for sensing the level of garbage in the dustbin and GSM module was used for messaging purpose which gives information about the status of the dustbin whether it was filled or cleaned. [Anwar, Md Asim 2018] [8]

The ultrasonic sensor monitors the level of garbage in the bin and ensures immediate cleaning of the dustbin when filled. The implementation of this ultrasonic sensor in the waste bins prevents the overflow of waste and also an alert is sent to collecting authority. [Yusof, N. M., Jidin, A. Z., & Rahim, M. I. 2017, Kumar, N. Sathish, et al. 2016] [9] [10]

For smart city waste management it is not just collection and disposal of waste but also proper collection, segregation, reduce, reuse, and recycle of waste material. Household products must be managed appropriately because they are also releasing toxic gases into the air due to improper disposal of paints, car oil, old batteries, pesticides, etc. and the bio degradable items such as food waste also leads to production of poisonous gas like methane. However, management of household waste is still a challenging problem. [Ankidawa, Buba 2013] [11]

3. METHODOLOGY

Waste management is one among the primary problem that the world faces irrespective of the developed or developing countries. The waste management key issue is that the garbage bin at public places overflows well in advance before the commencement of the next cleaning process which leads to various hazards such as bad odor and ugliness to that place which may cause spread of various diseases. The spillover of waste due to increase in population leads to tremendous degradation of hygiene in waste management system. So we need smartness based waste management system for eliminating the garbage and to maintain the cleanness.

To eliminate the problem of collection and proper dispose of garbage or at least reduce it to the minimum level we need to develop an efficient system. The level of landfills and the amount that we can possibly recycle because recycling is highly useful and once the recycling and the sorting of metals, plastics, and glass materials are done then the metals can be reused, biodegradable waste can be extended beyond fertilizers and manure, plastics can be diverted from the landfills which will otherwise leads to choking of the earth and the glass materials after deep cleaning can be broken and melted back to form new articles.

Waste generated from households and streets are generally transferred into community bins which are made from metal or concrete. As the waste disposed in community bins is not segregated scientifically, therefore optimal recycling is not suitable. The various transportation modes for Waste management that is preferred in India are basically tractors, trucks, compactors and trailers. For transportation of waste in smaller town, trucks are generally used without proper cover system. The maintenance of vehicles is carried out by municipal authorities of that city and the overall collection and transportation comes to halt if there is any vehicles breakdown.

The strategies for waste minimization are: Minimizing the usage of packing materials, promoting the refill containers, introduce incentives for customers to return the package material, encouraging the environmental friendly design of products, promoting the development of eco industrial plants[2]. Awareness should be created among the local community and they should be encouraged and educated

towards the segregation of wastes at the generation point. Separately storing the inorganic and organic waste helps in optimizing the waste processing which leads to high proportion of wastes to be recycled and reused. In the stage of up gradation the world faces garbage stinking problem where we see the pictures of garbage bins in our daily life overfull and the garbage spills out which leads to the number of diseases as large number of insects and mosquitoes breed on it. Not only in India but in most of the countries in the world biggest challenge in the urban cities is solid waste management. Hence, such a system has to be build which can eradicate the problem or at least reduce it to the minimum level.

Number id is given to each garbage can and the id is stored in database with its location and a camera is placed at each garbage can which captures images of garbage can continuously. For different set levels, database is created which is used to compare the images that are taken previously by camera which is done through image processing. Simultaneously weighing sensor is used which senses the weight of garbage can.

Dust bins placed at open places across cities are flooding because of increase in the waste each day which creates unhygienic condition for the citizens, so to deal from such circumstance we can use wireless solid waste management system for smart cities that will allow municipal corporations to monitor the status of dustbins remotely over web server which helps in efficient cleaning of cities and thus optimizing cost and time required. When the dustbin starts overflowing the waste management department gets alert message via GSM module placed at dustbin so that the department can send the waste collector vehicle to collect garbage. The basic idea is about knowing the real time data of each vehicle and of each bin to decide the waste generation pattern, what bin should be emptied and what should not and optimizing different aspects like the total covered distance, the environmental impact and the number of vehicles required and reduction of engine

emissions, traffic congestion and noise and reduction of investment and operational costs.

Waste collection involves investment costs large expenditures and includes operational costs and environmental costs problems. There are Modern traceability devices to obtain data in real time, like Radio Frequency Identification systems, volumetric sensors, GPRS (General Packet Radio Service) and GPS (Global Positioning System) technology.

Ultrasonic Sensor - An ultrasonic sensor detects the waste level of the bin which is attached to each bin that measures the level of the waste in the bin by sending a sound wave and listen the reflected sound wave that is bounced back. It thus calculates the time taken by the wave for traveling and reflecting back, and measures the distance at which obstacle is present. The implementation of this ultrasonic sensor in the waste bins prevents the overflow of waste and also an alert is sent to collecting authority.

Moisture Sensor - By integrating moisture sensor the basic segregation of waste into dry waste and wet waste can be achieved. This sensor detects the moisture content of the waste which is disposed into the bin and depending on the moisture content of waste, segregates the waste and then the waste is stored separately. By this segregation of the waste using moisture sensor the further processing of waste can be done more efficiently.

Motion Detection Sensor - For automatic closing and opening of the lid of the bin a motion detection sensor can be placed exterior of the waste bin. This sensor detects person near to the bin for disposing any waste, and the lid is opened automatically for throwing the waste. This automatic opening and closing of lid is necessary because if waste is exposed to sunlight and external weather conditions then it gets decomposed and leads to bad smell.

Table 1: Population Growth and Impact on Overall Urban Waste Generation and Future Prediction until 2041.

Year	Population (million)	Per Capita Waste Generation Thousand Tons /year	Total Waste Generation Million Tons / year
2001	197.3	0.439	31.63
2011	260.1	0.498	47.30
2021	342.8	0.569	71.15
2031	451.8	0.649	107.15
2036	518.6	0.693	131.24
2041	595.4	0.741	160.96

4. CONCLUSION

Around the world, Urbanization is at its rapid growth as people desires to live in the city lights with more opportunities for success and growth. Due to which cities are expanding like never before to accommodate this growth and so the concept of smart cities came into action. The topic of concern in these smart cities is cleanliness and hygiene and necessary action should be taken for reducing the waste either by disposing it or recycling periodically. The objective of the paper is based on waste Management

System using Internet of Things for the real time access of information about the dustbin to check the fill level of dustbin to check if it is full or not. For successful operation of waste management facilities segregation is equally important. The other way is to conduct awareness programme among the citizens regarding the waste generation and its effect on human health and sustainability.

5. REFERENCES

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