

# Cloud-Based Segregation Of Waste In Smart Cities

Amit Mittal, Shivangi Mittal

**Abstract:** Waste management is fast growing issue involved at every place in the country. The research is done keeping in mind Swacch Bharat mission governed by prime minister of our country. In this work the first survey is carry forward with the idea of having the segregation of waste at city level instead of performing it door to door. All the essential requirement and algorithm is explained in detail. The idea behind the work is to setting up of all the resources will be of high cost. The cloud computing facilitate remote sight computation which will help differentiating between dry waste and wet-waste. The work is an approach to recycle more waste in order to prevent the country from health issues as well as helping the government servants in increase of economy with the waste recycling.

**Index Terms:** Big-Data; Hadoop; garbage dump ;Recycle;Segregation; Soil moisture sensor; Waste management .

## 1 INTRODUCTION

Sustainable development in every possible dimension whether it is health, finance, refuge and spirit, is demand of everyone. Of all the required possessions the one which we are concern about in our work is health. If any individual will be ask to answer what is the root cause of unhygienic environment in our country India, then most of us will end up with the answer of having improper waste management system. Waste management system can be defined as process which undertake the activities of collecting, transporting, disposing and recycling of waste. The process is managed and capitalized by government entities, for this certain policies are designed as well. The policies contains the specifications which mention the management of waste should be performed in hygienic way. The commonly found scenario everyone is complaining against the waste mismanagement, but also they are the generator of it as well. In respect to land filling, almost all individuals mostly show the reluctant behavior. The end result is more incinerators and polluted environment. Among all the major findings, the main pollutant is material which is made of plastic whether it is form of tin, bags or any such. The negative point having the plastic is that it is non- renewable resource used widely all around the globe. The requirement insisted keeping all the points in focus is presence of proper suitable solid waste management. The impact of environmental issue should be as less as possible. Integrated solid waste management is desired in order to efficiently run all the services. In our work, the waste management focused in of country India. The major challenges are increase of barren lands in large amounts, immense generation of non-renewable waste and presence of improper management facilities. The root cause of the challenges mentioned are urbanization, industrialization and innovation of synthetic material at low cost [1].

In presence of variety of religions along with people with different perception and beliefs, the formation of single waste management maintenance is quite difficult. India is diversified country hence the political issues for having the permissions of performing the best in field are also questionable. The major finding is that the unit with financial backbone utilized packaged materials whereas group with financial crises uses loosely packaged materials. The higher class thus generates more waste in comparison to the other groups. These waste belongs paper, plastics and many such items. With increase in urbanization it is also observed that the kind of waste exposed also changes, current world is having e-waste, paints and pesticides as a waste. Also the waste exposed by farmers, household, industrialist, doctors are completely different. Study also reveal the fact depicts with every increase in year the amount of waste generated will also increase [2]. The figure below show the expected waste estimation of waste generation from 2001 to 2041 at certain intervals.

## 2. LITERATURE REVIEW

Tapan Naryana [3] conducted the survey in three field viz composting, incineration and landfilling. The observed work find that the incineration should not be performed in mixed waste as it can have harmful gaseous substances in it. The further suggestion is composting as best option among all if performed with the segregated waste. Ministry of Environment and Forest (MoEF) [4] introduce the solid waste management (SWM) rules are mentioned in order to define the entities involved, along with their duties. It also mention the waste processing and collection differences with changes in mountain regions. Sunil Kumar et al. [5] performed the study in field of waste management in depth, the opportunities with which waste can be recycled efficiently is discussed in the work. It also considers the challenges associated in order to accomplish the proper waste management. International solid waste association (ISWA) suggests the waste can have nutrients in it which if managed properly can result in more recycled material. The community works actively in field of waste management [6]. The waste generation at world level is mentioned by them. It also conveys that the valuable material can be extracted from the waste which is of no cost to the one who disposed but can be valuable for the collector.

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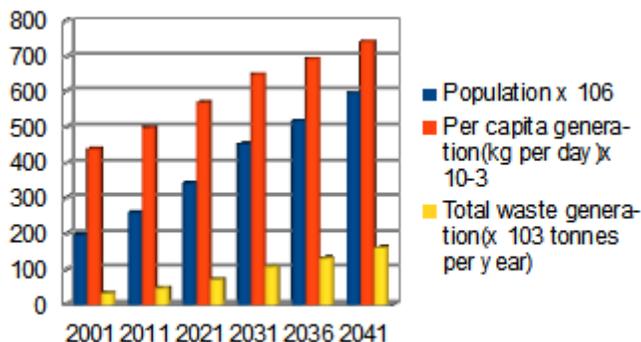


Fig. 1. Population growth and waste generation estimation

V Sridevi, Musalaiah Modi, M.V.V.Chandana Lakshmi, L kesavarao [7] review the study which conveys the integrated solid waste management approach and consequences of ineffective waste management system to health and hygiene of an individual. It also explain the categorization of all possible wastes. Vandana Mathur [8] performs the analysis which calculate the number of polythene bags required to collect the waste in respect of family members. It also evaluate the pattern of hiring of garbage collection services, along with mode of disposal analysis. The complete analysis is performed for the metro city Delhi and NCR. Rajendra Kumar Kaushal, George K. Varghese, Mayuri Chabukdhara [9] in Table I observe the current trend of municipal solid waste (MSW) to find the issues involved in it. The prime focus of work is to study the changing trends of waste in order to suggest the better management facilities. All the future issues are discussed in the work, keeping an assumption if current waste management scenario will be continued.

TABLE I. AVERAGE COMPOSITION OF WASTE IN INDIAN METROS [9]

% by weight of waste							
compos table	iner t	pap er	plasti c	glass	metals	textile	leather
41	40	6	4	2	2	4	1

Mufeed Sharholi, Kafeel Ahmad, Gauhar Mahmood, R.C. Trivedi [10] calculate the collection efficiency in regard to waste collection of individual cities and perform the evaluation with respect to generation and disposal. Variety of possibilities are suggested in order to have better management of waste. Metallic collection bins generation, health hazards involved, littering are some mentioned in this work. David C. Wilson, Costas Velis, Chris Cheeseman [11] performs study in field of waste recycling. The work suggests the importance of recycling in MSW. It also collect the social, economical and health impact of it the recycling if done accordingly. The recycling is termed as informal recycling in waste management act hence the work also encourage the integration of it with formal MSWM. Zaheer Khan, Ashiq Anjum, Kamran Soomro and Muhammad Atif Tahir [12] researches in field of cloud computing analysis and data mining. The work suggest that if data will be available for open access then many stalk-holders will be capable of extracting the eye-opening patterns. They further add the possibilities of not having three Vs of Big data with the open data portals as velocity, volume and variety. As the focus is smart cities in the work hence the presence of Big

data is considered and the cloud well-known framework Hadoop is configured for implementation. Sadia Sharmin, Sikder Tahsin Al-Amin [13] proposed the solution for waste management with the help of Ant colony optimization. The cloud based services are used in order to have centralized management. The work focused on performing the efficient transportation and services. The system also provide the facility of dynamic changes adaptability. Sauro Longhi et al. [14] proposed the waste management architecture with the help of Data Transfer Node (DTN) and the monitoring system. The benefit associated with remote monitoring system is that user can have interaction using web browser. In order to have the optimized resource management the Decision Support System (DSS) is suggested. Charith Perera, Arkady Zaslavsky, Peter Christen, Dimitrios Georgakopoulos [15] proposed the model which offers sensing as a service model. The classification is performed in the form of owners, publisher, service provider and consumer. Among all the relevant management for smart cities interaction with the cloud based system is explained. The work also consider the waste management as well. The IoT and smart cities interaction is proposed with built-in cloud facilities. Theodoros Anagnostopoulos, Arkady Zaslavsky, Alexey Medvedev, Sergei Khoruzhnicov [16] implements top k query dynamic scheduling algorithm. The research suggest the bins with highest capacities are ranked in order to have even better transportation. The comparison of all static and dynamic transportation is evaluated in order to prove the suggested approach is better. Overhead computation is calculated along-with.



Fig. 2. System overview of research work [16]

### 3 PROBLEM DOMAIN

In previous work, the solution is given through which waste can be segregated as individual entity level which refers to each habitation in our case. When the same problem is realized at city level with the assumption that the waste is not segregated at individual level then certain drawbacks in our previous approach [17] is realized which are mentioned as below: As the storage of threshold value will required certain analytics, the same when done at dumping ground will required the resources which will be capable of storing such large number of values. Increase in sensor readings due to large amount of waste, the processing speed of obtaining the essential calculations should be very high hence the resources should be capable of performing such fast computations.

## 4 PROPOSED SOLUTION

The initial idea of threshold calculation suggested in our previous work observe that the same can be done at city level as well. Although it is also realized that as the model enhances the requirements with it will also change as well. The detailed explanation of this new work is given with complete detail in this section.

### 4.1 Cloud based design

The model is based on cloud computing due to the fact that it is quite difficult to process such large values at trenching ground. Setting up of all the resources will be of high cost [18]. The cloud computing facilitate remote sight computation. Among all the cloud service ecosystem, Hadoop is best suited for our work therefore it is suggested, as it allows cluster based computation. In order to process the idea on large datasets, Map reduce is used.

#### 4.1.1 Map reduce

In Map reduce framework two functions are used namely Map and reduce. The Map function is responsible for breaking the vast ranges of values in the form of key and pair whereas reduce function filter the undesired values to generate the output. Each cluster consist of one Master Job-tracker and one slave node Job-tracker. The execution is performed by Task-tracker whereas resource management and scheduling is done by Job-tracker.

### 4.2 Big Data analytics

Researches suggest that Big data and cloud are conjoined hence the distributed data storage will be performed based on cloud computing [19]. The analysis whenever we opt in real time will have large number of values. In order to get the desired value of threshold, the number of observations will be more. Therefore the work implemented will have knowledge extracted with at well.

### 4.3 Required resources

#### 4.3.1 Soil moisture sensor

As the work is carried out at large scale the portable sensor will sense the moisture of all the waste along with the pH, the sensor has the diameter of size 16 \* 5 cm/dia. It calculates moisture up to accuracy of  $\pm 0.1$  (10%-80%) and pH accuracy of  $\pm 0.3$ . The sensor can bear any operating temperature ranging from 5-50°C.



Fig. 3. Soil moisture sensor with Arduino board

#### 4.3.2 Raspberry pi 3

The latest model of Raspberry pi 3 is with the configuration having quad core processor of 64 bit ARM clocked at 1.2 GHz,

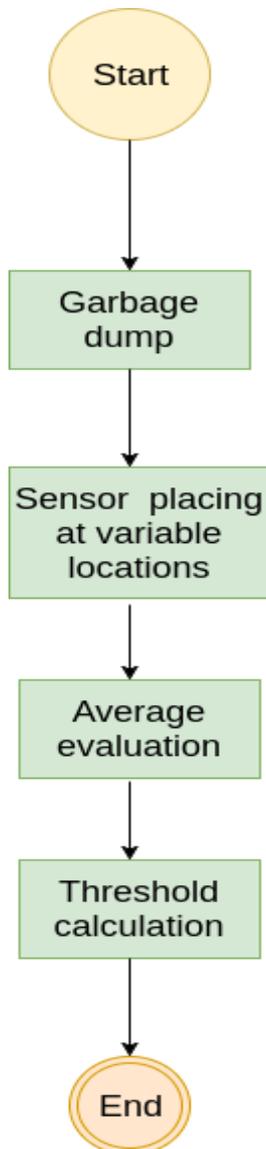
graphical processing unit embed in it is of 400 MHz. Memory is of 1 GB, 4 USB ports. It overcomes the drawbacks of Arduino Duemilanove having the inbuilt Ethernet allowing the data access up to 10/100 Mbps thus easily implementing 802.11 standards. Raspberry is combination of microprocessor and micro-controller which is having the processing of 1.25 GHz CPU with ARM v8 cortex A53. The clock speed is of 1.2 GHz is present and memory of 1 GB with 4 USB ports. The display can be achieved using HDMI port of 3.5 mm jack. The figure 5 mention the Raspberry Pi 3.



Fig. 4. Raspberry Pi 3

#### 4.3.3 ESP8266

ESP8266 is platform with 2.4 GHz, the LED pins of it can be power on and off as per the need. It is system-on-a-chip with general-purpose input output. In this work the same phenomenon is solved by taking into consideration city based segregation instead of considering the small domain. The problem is sought out using the cloud based framework named as Hadoop. Map reduce is the processing scenario which we is opted in the framework in order to process large amount of data processing with fast computation capabilities is desired. The work of Map function is to break data in the form of key value pairs whereas reducer takes out the essential outputs from the map function and then implements it. The given solution when computes large set of inputs will need fast processing capabilities along with less computation time hence HDFS remarkably called as Hadoop Distributed File System is chosen for as an idea. The approach for large scale evaluation is given as mentioned below: Entire garbage dump is collected and parts of it are formed and taken for analysis. The placement of the sensor can be done manually or by some other means. From that part of dump sufficiently enough amount of soil moisture sensors are placed with the wooden stick embedded in it at variable location in order to calculate the moisture. Say if waste of one complete street is analyzed, then 100 sensors must be required. Hundred in reference to sensor analysis is large amount hence Big data analytics approach is also used. The value from all the sensors are calculate and captured for further analysis. The average value of all the 100 sensors will be considered as one output. Say 50 such garbage dumps are present in the ground. The threshold is calculated by averaging the values of outputs of all the garbage dump through Monte Carlo method of analysis. The flowchart of proposed algorithm is shown in below figure:



Flowchart of proposed model

The architecture of the proposed model can be given as shown in figure below:



Fig. 5. Proposed architecture of our scheme

The above find garbage value will be considered as threshold for other dump yards and digital analysis is done with the logic that if threshold exceeds the amount decided from the above steps, then will be taken under the category of liquid whereas if less than threshold then it will be advised as solid.

Using all the above mentioned requirement, the real-time calculation of threshold at dumping ground can be performed. The worked suggest that if the threshold comes out to be 50, then the value somehow less than it will help in getting the segregation of solid waste at least. Once the desired threshold will be obtained then further the digital programmed device can be fed which will help in checking out which part to be segregated and which part to not. The work propose the segregation of waste of solid section only as segregating from the liquid is quite tough. The purpose of suggesting this methodology is that if more amount of waste will be segregated then it will help in recycling more waste. The proposed methodology if utilized properly will result in generating more economy to the country as the waste generated per capita is increasing everyday.

## CONCLUSION

Waste management is the one of the major issue known since long. The amount of capital investment doesn't lead to the outcomes it should have. The waste is dumped instead of managed which lead to serious land and air pollution. Its not always necessary that one which is waste to individual is of no use to other. Certain facts suggest that waste management should follow the cycle of three Rs which is recycle, reuse and reduce. It is duty of each person to generate less waste keeping in mid the saving of ecosystem. The harmful waste is threats to health of society which revert back to everyone in form of new diseases. In the given model, the waste segregation scheme at broad level is suggested. The scheme require high tech resource in order to perform in-depth analysis. The work if once come up with the desired threshold will help in making the further segregation process easy and convenient.

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