Solid Waste Management using GIS

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Abstract— Uncontrolled growth of the urban population in developing countries in recent years has made solid waste management a crucial issue. Very often, a considerable amount of total expenditures is spent on the gathering of solid waste by city authorities. Optimization of the routing system for the gathering and transport of solid waste thus constitutes a crucial component of an efficient solid waste management system. This paper describes an attempt to design and develop an appropriate storage, collection and disposal plan for Kalyani, West Bengal State (India).
A GIS optimal routing model is proposed to determine the location of dustbins in the Kalyani City, where citizens can look up for dustbins with capacity and type and can dump the garbage in it. The model uses dustbin type, dustbin location in the form of latitude and longitude and dustbin managing organization. The proposed model can be used by citizens to find the dustbins and it will promote cleanliness in the society.

Keywords—waste, Geographic Information System, maps, waste management

I. INTRODUCTION

Kalyani is a developing city with rapid population growth in a limited land area. Waste Generation is also increasing proportionately with the growth of the population. Waste Management Using GIS will promote citizen of Kalyani to dump the waste in dustbins only. Using the proposed solution citizens can find dustbin on the map with different capacities and types and can easily dump the waste in it. It will be helpful in promoting cleanliness in the society. The issue of solid waste is not only because of the increasing quantities but also largely because of an inadequate management system and insufficient information about disposal location in the locality. Waste management authorities have plans for managing the generated waste efficiently in a city but the waste that is not disposed of in its correct place by the citizens is left unmanaged, which can load to different problems like pollution in the local environment. Since people will be using the proposed solution to find the dustbins in the locality, which in result will influence the government to install dustbins (both biodegradable and non-biodegradable) with different capacities at a fixed interval at different locations. This solution can also help the government in taking necessary actions for the management of the unmanaged waste in the locality.

II. RELATED WORK

In this section, we will discuss and acknowledge the published papers relating to this "Solid Waste Management using GIS", where the individuals or groups proposed the use of Geoinformatics System for the use of managing the waste in a particular area. Many work has been done earlier in this field related to waste collection and management and other ways of visualizing the data of waste produced by the population.

B.Shoba, Dr.K.Rasappan in their paper naming **"Application of GIS in Solid Waste Management for Coimbatore City" [1]**, they developed thematic maps for city Coimbatore City, where they showed different aspects of waste generation and management so the municipality can develop plans to manage the waste in an efficient manner to save the city and keep it green. They developed maps showing the wards in four administrative zones that are North, East, West and South, where Map1 showed the wards that comes under different administrative zones. In Map2 they showed the population density in every ward. Map3 showed the waste generated in every wards and Map4 displayed the number of workers allotted to a particular ward for managing the waste.

S. H. Rahman and S. Rahman published a paper naming **"Urban Solid Waste Management Using GIS Technique: A Case Study on Mohammadpur Thana at Dhaka of Bangladesh" [2].** They did a case study on the waste management done by the Dhaka City Corporation in their area naming Mohammadpur, Dhaka. They used Geographical information system (GIS) to propose an efficient scenario with relocating the existing waste bins and containers and another scenario was proposed with number of bins (25), containers (30) and existing illegal dumping sites (14) to attain an 80% waste collection efficiency including optimization and selection of waste collecting routes for Mohammadpur Thana. A participatory Community Management Information System (COMMIS) and further suggestions for an integrated SWM were also recommended.

G. Vaishampayan in her paper naming **"A study Report on Implementation of GIS in Solid Waste Management" [3]**. In this study they showed that GIS innovation was utilized for the advancement of a strategy for the optimization of blended MSW gathering. The system employments different geographical information (way organize, area of waste canisters, arrive utilizes and so on) in co-operation with progressed spatial dissection GIS instruments. This will help the planners to develop.

S. Moiz Ahmed in his paper naming **"Using GIS in Solid Waste Management Planning A case study for Aurangabad, India" [4]**. This paper deals with how Geographical Information System can be used as a decision support tool for planning waste management. A model is designed for the case study area in an Indian city for the purpose of planning waste management. The suggestions for amendments in the system through GIS based model would reduce the waste management workload to some extent and exhibit remedies for some of the SWM problems in the case study area. The waste management issues are considered to solve some of the present situation problems like proper allocation and relocation of waste bins, check for unsuitability and proximity convenience due to waste bin to the users, proposal of recyclable waste bins for the required areas and future suggestions. The model will be implemented on the Aurangabad city's case study area data for the analysis and the results will suggest some modification in the existing system which is expected to reduce the waste management workload to a certain extent.

M.K.Ghose, A.K.Dikshit, S.K.Sharma in their paper naming **"A GIS based transportation model for solid waste disposal – A case study on Asansol municipality" [5]**. This paper describes an attempt to design and develop an appropriate storage, collection and disposal plan for the Asansol Municipality Corporation (AMC) of West Bengal State (India). A GIS optimal routing model is proposed to determine the minimum cost/distance efficient collection paths for transporting the solid wastes to the landfill. The model uses information on population density, waste generation capacity, road network and the types of road, storage bins and collection vehicles, etc. The proposed model can be used as a decision support tool by municipal authorities for efficient management of the daily operations for transporting solid wastes, load balancing within vehicles, managing fuel consumption and generating work schedules for the workers and vehicles.

A. Al-Hanbali, B. Alsaaideh, A. Kondoh in their paper naming "**Using GIS-Based Weighted Linear Combination Analysis and Remote Sensing Techniques to Select Optimum Solid Waste Disposal Sites within Mafraq City, Jordan" [6]**. They described how Landfill siting was determined within Mafraq City, Jordan, through the integration of geographic information system (GIS), weighted linear combination (WLC) analysis, and remote sensing techniques. Several parameters were collected from various sources in vector and raster GIS formats, and then, used within the GIS-based WLC analysis to select

optimum solid waste disposal sites. Namely, urban areas, agricultural lands, access roads, surface aquifers, groundwater table, fault system, water wells, streams, and land slope were considered in this research. Also, the trend of urban expansion within the study area was monitored using the Landsat data of 1989, 1999, and 2009 to support the selection process of disposal sites. It is found that about 84% of the study area was within "most suitable" to "moderately suitable" classes for landfill sites, while the rest of the study area was within "poorly suitable" and "unsuitable" classes.

C. Chalkias, K. Lasaridi published a paper naming **"Optimizing municipal solid waste collection using GIS" [7].** Local authorities constitute worldwide the main providers of waste management services. Waste collection and transport is responsible for a large fraction of the total waste management costs, currently in Greece in the range of 70-100%. EU policy requires that waste is treated to recover materials and energy prior to disposal and this increased level of service needs to be provided at the minimum possible cost, as the public will not be able to bear large increases in its waste charges. Municipalities are therefore under increased pressure to optimise their services, both in terms of quality and costs. Geographic Information System (GIS) technology provides an advanced modelling framework for decision makers in order to analyse and simulate various spatial problems, including various waste management aspects. In this study a methodology for the optimization of the waste collection and transport system, based on GIS technology, is developed. GIS technology is used to improve the efficiency of waste collection and transport in the Municipality of Nikea (MoN), Athens, Greece via the reallocation of waste collection bins, the introduction of new vehicle routing and new vehicle time. Results demonstrate that the proposed scenario considerably improves efficiency in terms of collection time, travel distance, CO_2 emissions and fuel consumption.

III. METHODOLOGY

For the Primary data about the dustbins in the Kalyani area will be collected through **Epicollect5** Software (A platform to gather information regarding the geo-locations). The exact location of the dustbins, containers, will be collected by using the GPS device including the different parameters such as type of dustbin, the capacity of dustbins. The data will be collected in the form of CSV File (Comma Separated Value) which will be fed into the database. Further which be shown on the map in the proposed solution. And after the data collection phase we will include a feature in our platform so the administrator can add dustbin to the maps direct through the platform, this will reduce the human effort in collecting data at different intervals.

3.1. Collection of Data
For the collection of data of different dustbins and disposal locations we be using a free platform named as Epicollect5. **Epicollect5** is a mobile & web application for

free and easy data collection platform. It provides both the online and mobile application for the generation of forms (questionnaires) and freely hosted project websites for data collection. Projects are created by using the web application at five.epicollect.net then downloaded to the device to perform the data collection. Data are collected (including GPS and media) using multiple devices and every one data are often viewed on a central server (via map, tables and charts). Data can be exported in csv and json format.

Figure 1: Official Logo of Epicollect5

3.2. Importing of Data

As in the above we got to know that we can export data in different format from the data collection platform **Epicollect5.** We will be exporting data in the form of CSV (Comma Separated Values) from Epicollect5. Then we will be importing the csv file to our MySQL database. After importing the data to our database we can work with the data and show data in the maps integrated in the user interface.

3.3. Using the Data

After importing the data from the CSV file to our database we can use this data in the controller of our web application to show the location of the dustbin or disposal location with details like their type & capacity in the User Interface. We will also use the data to map the city with places with disposal of waste at higher level.

IV. RESULTS AND DISCUSSION

The result would benefit citizens, government and mostly nature if the proposed solution will be accepted. Citizens will be able to dump their household or any kind of waste only in the dustbins, that not only makes the environment or surrounding clean, but also makes it free from bacteria or viruses which may have severe effects on our body. Our proposed solution will make sure there wouldn't be any dumping yard on the road side, citizens would dump their household or any kind of garbage only in the dustbins provided by the government.

The government will be able to keep a record of the dustbins installed at different locations in the city. Also they can respond to the complaints of the citizens regarding dustbins or collection of garbage from their locality.

Since we are heading towards pollution free and clean environment our proposed solution will help us in making one.
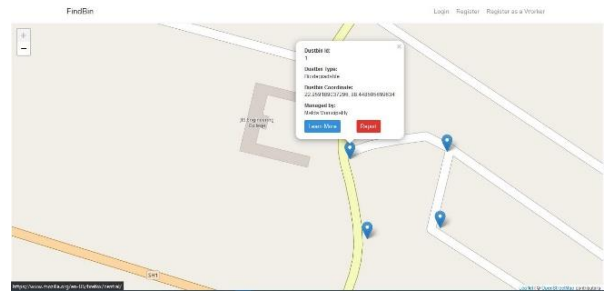
Few Screenshot of our platform:

Figure 2: Landing Page with details of a dustbin

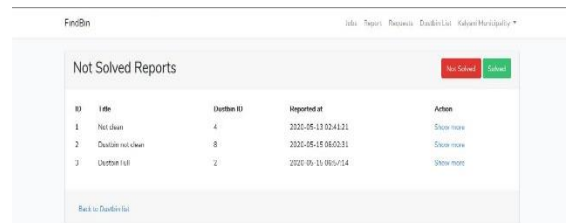Figure 3: Dustbins list under an Administrator

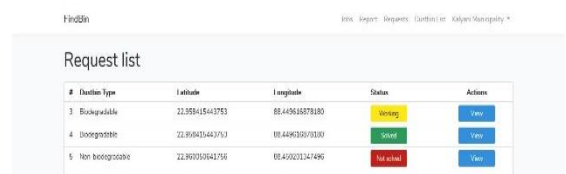Figure 4: Reports logged by user for a dustbin

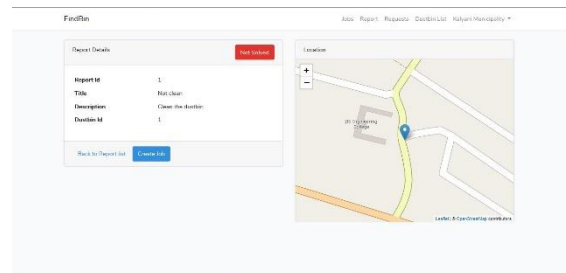Figure 5: Request logged by user for new dustbins with status

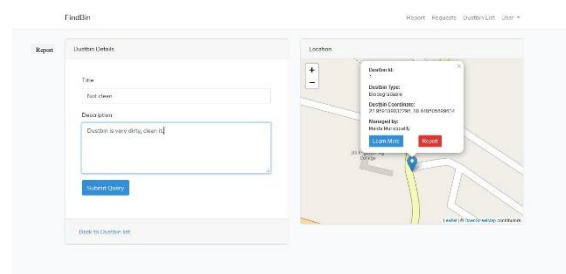Figure 6: Details of a Report along with map pointing to location of dustbin

Figure 7: Logging report form with the dustbin location in map with details.

V. CONCLUSION AND FUTURE SCOPE

GIS technique could be an efficient tool for constructing MIS, such technologies will be helpful for not only minimizing wastes spreading in localities. Though this platform helps the users along with the municipality or waste managing organization are benefited as the users will get to know about the bins near them and they can also complain about any difficulty in finding or if management was poor for the dustbins in their surrounding the municipality will get direct feedback. Along with these benefits they can also plan according to dustbins placed in the city. They can also plan routes according to the allocation of dustbins.

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