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Research Article

Feature Extraction from Waste Generation Map by Applying Squared Error Algorithm Method

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Abstract: Solid waste management is a serious problem for cities throughout the world. Municipal Solid waste management is one among the fundamental and essential services provided by municipal authorities in the country to keep urban centers clean. The collection, transport, treatment and disposal of solid wastes, particularly wastes generated in medium and large urban centres, have become a relatively difficult problem to solve. Image Processing plays an important role in solving different problems related to Municipal Solid Waste Management. Image Segmentation is an important tool for feature extraction procedure. There are several algorithms for Image Segmentation approach. In this paper we have depicted Squared Error algorithm as a feature extraction method. We have applied this algorithm on a geo-referenced spatial database supported by a Geographic Information System (GIS).
Keywords: Image Processing, Feature Extraction, Geographical Information System

INTRODUCTION

Solid waste management is a serious problem for cities throughout the world. *Municipal* Solid waste management is one among the fundamental and essential services provided by municipal authorities in the country to keep urban centers clean. The collection, transport, treatment and disposal of solid wastes, particularly wastes generated in medium and large urban centres, have become a relatively difficult problem to solve. The characteristics and quantity of MSW arising from domestic, commercial and industrial activities in a region is not only the result of growing population, rising standards of living and technology development, but also due to the abundance and type of the region's natural resources. More than 90% of the MSW generated in India is directly disposed on land in an unsatisfactory manner. Salt lake (Bidhan Nagar) is one of India's plan cities and like other large cities faces similar problems of poor solid waste management [1- 6]. A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. The longitude and latitude information of each waste bin of the Salt Lake Municipal area was considered in our study. This information was plotted on demographic map of this municipal area. The derived image was kept for future use. Image Segmentation method can be applied for better perceptive approach towards implementation of a feasible solution in MSWM because Image Segmentation is an important tool for feature extraction procedure. There are several algorithms for Image Segmentation approach. . In this paper we have depicted Squared Error algorithm as a feature extraction method. We have applied this algorithm on a geo-referenced spatial database supported by a Geographic Information System (GIS).

Table 1: Sources and Quantity of Solid Waste.

Sources Of Waste	Weight(Kg)
House	110085
Market	34450
Play Ground	75
Park	1452
Institution	7342
Office	7824
Shopping Mall	2707
Hospital	2155
Bhavan/Complex	32879
Factory	1600
Total	200578

Sources: Bidhan Nagar Municipality Corporation (2011)

Solid waste management is a statutory function and (Bidhan Nagar) Municipal Corporation is responsible for the management of MSW generated in the city. The city is divided into 88 block and all operations of solid waste management (SWM) in this area are performed under four heads – sweeping , collection, transportation and disposal.

Major sources of MSW in the Bidhan Nagar Municipal Corporation area are residential areas, commercial/market areas, offices and institutions. Salt lake city generates approximately 200.578 ton/ d of MSW daily. Bidhan Nagar Municipal Corporation has estimated the amount of MSW generated from various sources in the city as shown in table 1.

CURRENT SWM SITUATION OF THE STUDY AREA

In Salt Lake area, waste collection is inadequate, in which a large percentage about 10% remains either in the places where it originates or staying longer in the collection points leading to a number of environmental and health hazards e.g. dust, smell, smokes from burning etc. Furthermore, the mounds of waste stored become breeding grounds for disease carrying flies, cockroaches, mosquitoes and rats and thus creating health risks. Due to climatic factors like high temperature and humidity along with high organic matter content, MSW decomposes rapidly resulting in unhygienic conditions. Hence in most areas, collection has to be done on a daily basis. Currently, different collection methods are being used in Bidhan Nagar Municipal Corporation and include: house-to-house collection (primary collection), and collection from roadside storage areas (3-sided enclosures). The remaining waste is disposed on vacant land and in canals.

Salt Lake City is divided into 88 blocks. For better SWM 6-8 sweepers are provided in each block. A broom, a scraper and a small bin and a tri cycle bar is provided to each sweeper. 4 members for sweeping 2 members for market sweeping and 2 member for house to house collection are working for waste collection. After the collection the waste they just disposed into the community bins. Wastes produced in the house are called household wastes. It is classified as dry waste, wet waste and hazardous wastes. Plastic, packing materials, and pieces of glass are not bio-degradable, that is, they do not decay or decompose. They are called dry waste. The left over vegetables, unconsumed food, fruits, flowers, meat, and bones are bio- degradable and are known as wet wastes. Used battery cells, paint boxes, chemicals, pesticides, used syringes, unused and outdated medicines and so on are called hazardous wastes. But Bidhan Nagar Municipal Corporation is not taking any steps for segregation or classified as dry waste, wet waste and hazardous wastes. Also they are not organising awareness programmes for segregation of wastes and shall promote recycling or reuse of segregated materials. Bidhan Nagar Municipal Corporation has provided 45 storage places in the form of large masonry storage enclosures, and dumpers for temporary storage of MSW, which is collected from the city during secondary collection. Large masonry storage enclosures are open spaces enclosed on three sides with a masonry wall of about 1.2–1.8 m height, with capacities ranging from 30 to 60 m^3 and located in congested areas with narrow winding streets. Waste is brought to these depots in handcarts during primary collection while trucks can drive into these areas and pick-up waste from here for disposal to the landfill site. These large storage enclosures can also be thought of as transfer stations even though they are not formally designed for compaction, nor do they have equipment for separation or processing. A part from absence or improper locations for transfer stations for solid waste collection, the routing system for trucks in Salt Lake has a lot to be desired. Some areas of the city are extremely difficult to access by refuse collection trucks, waste is transported to a collection point. In those situations, the trucks make one trip or two instead of three times a week as per requirements. Thus, much waste remains uncollected. Bidhan Nagar Municipal Corporation aims to provide daily collection, but overflowing bins are common features throughout the city, despite the excess storage capacity. A major factor responsible for this problem is the frequency of collection. In practice, the collection frequency is less than the design requirement (daily); in many cases collection is on a weekly basis. Another major factor is the location of the bins. These locations are decided without considering vehicle accessibility, population density or rate of waste generation in the local service area. The waste dumped in Muller very area does not undergo any treatment; hence a threat to the environment and pose health risks to the inhabitants. For this reason, the biodegradable wastes shall be processed by composting, vermicomposting, anaerobic digestion or any other appropriate biological processing for stabilization of waste. In Salt Lake, the disposal site of Muller very is located in sector- V at an average distance of 5 km from the collection points. Bulldozers at the disposal area are used to spread and level the garbage. There is no restriction for non-biodegradable, inert waste and other waste that are not suitable either environment and pose health risks to the inhabitants. For this reason, the selection of sites where to dispose the waste has to be done scientifically with a number of feasibility studies.

METHODOLOGY

Primary and secondary data were collected to propose options for better solid waste management for Salt Lake city. Random questionnaire survey was conducted at the study area with collecting Geographic Position System (GPS) of existing waste bins, containers and illegal disposal sites using GPS device. Secondary information about solid waste management associating other relevant information, like demographic and socio-economic data from various governmental and non-governmental sources were collected to decide the viable option for waste management. Spatial data were generated using collected GPS data and high resolution satellite images of the study area. Thematic maps were prepared for every relevant feature in GIS platform with digitization of collected secondary data. The geo-referencing and geo-processing were conducted to define all the dataset in Salt Lake Municipality area projection and to set the specific dataset boundary. Concurrent GIS software (ArcGIS 9.2) with its network analyst extension was used to generate the waste generation map of Salt Lake area. This map is as follows:

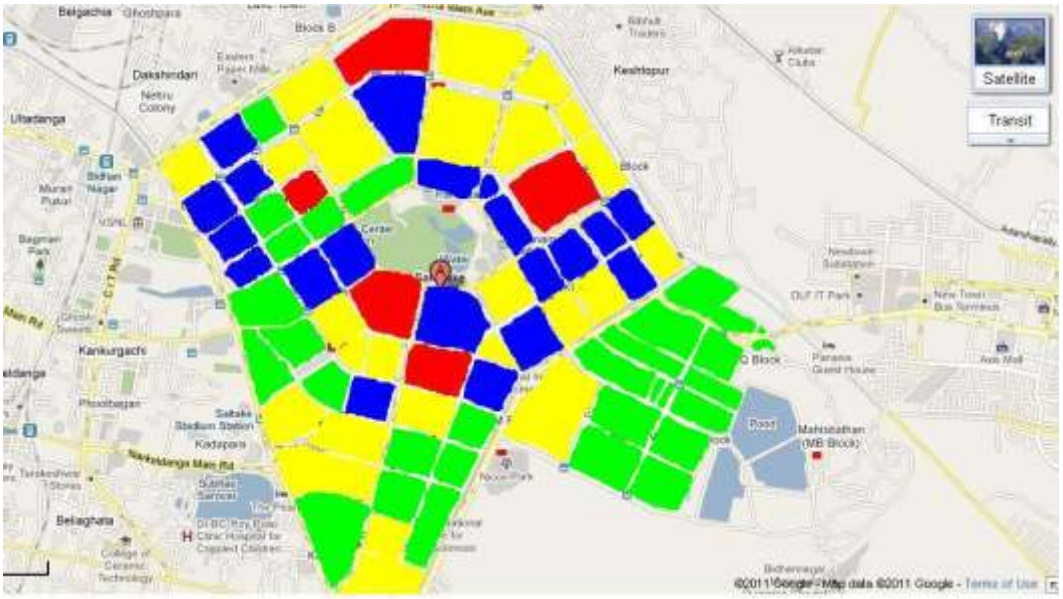

Fig 1: Waste Generation Map of Bidhan Nagar (Salt Lake) Municipal Area

Where,

Serial Number	Color Code	Significance
1	Green	0-1500 Kg Waste Produced Daily in this Block
2	Yellow	1501- 3000 Kg Waste Produced Daily in this Block
3	Blue	3001- 4500 Kg Waste Produced Daily in this Block
4	Red	>4500 Kg Waste Produced Daily in this Block

APPLICATION OF IP BASED TECHNIQUE

From the above waste generation map, following questions may be raised:

- Can we retrieve waste generation information from this map automatically?
- Can we classify the region into subparts on the basis of waste generation?

To give the answers of above questions, IP based application may be effective. In this case, Image segmentation can be considered because it can identify the regions of interest in a scene or annotate the data. Image Segmentation process refers to the process of partitioning an image into group of pixels which shows the similarities i.e. homogeneous between them. These groups are heterogeneous in nature. Thus Segmentation process is able to split up the image into connected areas and it divides the image into meaningful regions with respect to some criterion.

Clustering is one of the important segmentation method by which a given image can be segmented into some regions where each group of regions show close relationship between them. The clustering technique can be classified into hierarchical clustering and partitional clustering. The characteristic feature of hierarchical clustering is to construct the dendrogram whereas the partitional clustering algorithm obtains a single partition of the data. The partitional clustering method is suitable in large data sets. Both clustering methods have some demerits. For example, in hierarchical clustering method, the overall computation time will be increased during the construction of dendrogram and incase of partitional clustering method predefined desired output clusters must be selected. In this case the predefined convergence criterion is considered which will be compared with initial data points and squared error algorithm is used as a convergence criterion.

We have applied this algorithm on binary image data and the derived segmentation information is superimposed on previous image and the resulted image is shown below:

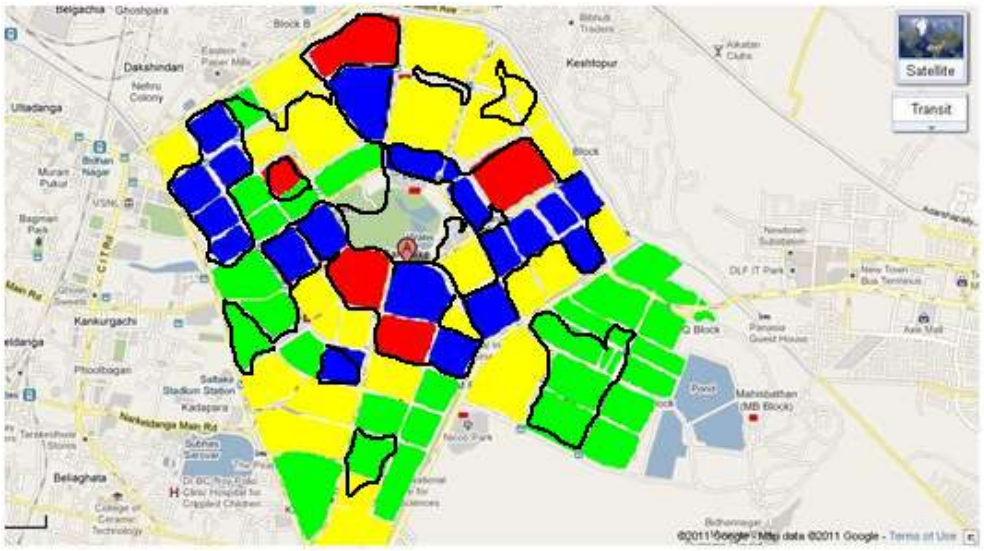

Fig 2: Segmentation output by squared error algorithm

From this segmented image we can see that the region where garbage production is huge is more or less clearly segmented. But some false regions are generated.

CONCLUSION

In the conclusion it has been discussed about the reformation in the concepts of the data management and the analysis carried with the help of GIS. Once the waste management department is aware of the total function of the GIS system, it will get acquainted with its effectiveness. Then there will be an entire record of all the things related to the waste management and suitable logistic management and spatial planning can be achieved. This can be done with the help of both GIS and Image analysis on the different layers for practical implementations. By applying the functions like overlaying, applying buffer for proximity analysis or by applying queries through a structured query language (SQL) the required information can be extracted.

- Demographic map can be used to know the more waste generating areas.
- The category of waste like domestic, industrial, commercial etc can be found out easily with the help of the land use map.
- Existing location of the waste bins and the street maps will provide the proximity of the bins to the waste collection service routes. In case of any inconveniency for the waste collecting crew the bins can be re located.
- A map showing the current waste generated and the waste generated in different wards, sectors and along the roads, streets and junctions. The segmentation approach helps to isolate those areas where waste generation is maximum.
- These above enlisted points are said to be an important exercise to begin with. The points overall covers many waste management issues, but they are very generalize and require a lot of data and proper analysis using the GIS software. There will be a requirement to develop several models to apply all those points on the real time data.

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