**Overview**

Solid waste management is a serious challenge for all metropolitans and growing cities worldwide. Today the situation of cleanliness in Indian cities is worst than ever. Some of are major cities are labeled as one of the dirtiest cities in the world. The government and/or the municipal corporation are overwhelmed with the amount of garbage, which our cities are generating. This situation is going to get worse in the future if we don’t handle this now!

We investigated this issue to try to figure out why we are in this situation and what our government is doing to work this problem. Surprisingly we found out that there are policies formed by the government which can help curb this problem. But these policies are so blur that the system can easily be fooled.

To empower the government and the local municipalities we have come up with and deployed a very cost effective mobile/web based solution, which is already revolutionalising how Mira Bhayander Municipal Corporation is managing its solid waste management process. Our cost effective and productive solution based on open source and indigenous technology to solve this challenge in an efficient manner. Our GIS Solid Waste Management Solution offers an integrated approach to manage all the people, vehicles, Waste Processing Station, and other aspects of cleaning a city in a single unified Geographic Information Systems (GIS) platform built using open source technologies such as PostGIS, Openlayers, OpenCV and GeoServer.

**Key Problems**

In solid waste management the biggest issue is accountability and digital documentation of various cleaning related activities.

**Accountability**
What we found out that the sanitation officers (SOs) who are doing their work are not recognized and treated equally with the SOs who doesn't work at all. This is because there is no system in place, which can assess the performance of every individual.

**BioMetrics that don’t work**
Also the existing fingerprint biometrics devices are not automated so that they cannot present the data in the real time without any manual intervention. That means the data can be tampered with.
Solid Waste Management Solution – by Spatial Ideas

GPS – where are thou?
Municipal corporations cannot even tell how many trucks are currently on the field to pick up the waste or how many tons of waste has been dumped at the processing stations. So the contractor’s work cannot be monitored and thus they cannot be penalized for shoddy work. The money has been spent on GPS devices, RFID Sensors that are either damaged or stolen.

No Proper Reporting
The data if presented to decision makers is presented in such un-actionable manner that the only thing is achieves is waste of a lot of paper. There is no way one can quickly identify the problem areas with a simple glance or surfing through the unstructured reports.

The Solution

We developed MoEGIS (Mobile Enterprise Geographical Information System) which is a low cost mobile + web GIS framework. MoEGIS uses low cost android smartphone, which are equipped with GPS sensor and a decent camera. These two act as sensors for making everything Location Aware and also a great Biometrics device. With low cost smartphones on the rise and wide spread connectivity over data networks such as 2G and 3G, this approach has proven simply put, highly effective!

The Solution enables the supervisors to better execute and manage their work force, the Sanitation officers to do a better job at tracking issues and handling them and also do a better planning for the waste removal process and this also allows participation from the citizens. The Platform ensures:

1. Credibility
2. Accountability
3. Seamless Cleaning operation
4. Civic Awareness
5. Ease of use (idiot proofing)
6. Multi Lingual

The overall design shows how all the stakeholders are connected in this platform.

www.spatialideas.com
All the vehicles (compactors) are tracked by software installed on affordable and cost effective mobile devices, which are used to track location and transmit via 3G connections. Similarly the supervisors and Sanitation officers on the field are tracked. Biometric software (based on Facial Recognition) equipped devices are provided at attendance points to ensure right number of people are reporting as daily-wage workers. We are also able to identify when a Collection Bin is picked and even analyze the patterns to come up with an optimized route and time for the trucks. The software also tracks amount of Solid waste being sent to the processing station to ensure a complete and holistic solution.

Centralized web software accessible over the Internet is provided to the management for monitoring the progress and creating reports of various kinds. Automatic reports and summaries are emailed to concerned staff to keep everyone informed in a timely manner.

We recognized that where the conventional system fails is they just collect the data, they never analyze it and present it in an extremely simple manner which is simple to understand and easy to act on. So we provide user a dashboard in which on a single web page the user can see entire process that is being carried out on that particular day.

The screenshot below is the dashboard of the web application.
Solid Waste Management Solution – by Spatial Ideas

On the left hand one can get the overall summary of the daily activities, which gives you the entire picture related to the Solid Waste Management:

- How many different kinds of vehicles are operational today.
- How many daily wage-workers were present
- How many bins were picked up today.
- How much waste was sent to the Processing Station
- How many complaints were raised today by the sanitation officers
- How many grievances the citizens raised.

On the map one can see
- Real-time position of the vehicles.
- Exact location of the citizen complaint.
- Location of the sanitation officers when they were on the field.
- Bins status - Red (Unpicked) or Green (Picked)
Reports
Any intelligent tool is nothing if it cannot analyze the data and present it as useful information. MoEGIS not only analyze the data but also finds and informs user about possible anomaly. This is very useful specially when you are handling a large corporation with a large workforce. The data is represented in an easily readable manner and thus saves time and provides real intelligent information to the user

<table>
<thead>
<tr>
<th>Truck Type</th>
<th>Running</th>
<th>Total</th>
<th>Visits to Processing Station</th>
<th>Waste Disposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 Tons</td>
<td>40</td>
<td>42</td>
<td>41</td>
<td>218,475</td>
</tr>
<tr>
<td>3 Tons</td>
<td>25</td>
<td>24</td>
<td>33</td>
<td>100,695</td>
</tr>
<tr>
<td>1.5 Tons</td>
<td>13</td>
<td>13</td>
<td>14</td>
<td>29,405</td>
</tr>
<tr>
<td>Sweeper Truck</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Our Solid Waste Management Solution allows users to:

1. Real-Time Face Recognition based Attendance of Daily Waste Workers
2. Tracking of Vehicles involved in Solid Waste Management
3. Getting updates on amount of waste Processed.
4. Geo-Fencing to ensure honesty in operations
5. Reporting and SMS/email alerts
6. Check Anomalies such as repeat attendance, an errant truck movement, bins being ignored, error patterns which give us intelligence to further improve the system.
7. Citizen Participation via Smartphone application
Solid Waste Management Solution – by Spatial Ideas

MoEGIS is a well-proven proprietary solution, which includes:

- High accuracy location tracking
- Very accurate face recognition
- Highly customizable web interface
- Set of Very intuitive mobile applications
- Smart Alert mechanism

The Solid Waste Management Solution is a great example of leveraging MoEGIS Platform to provide an end-to-end monitoring/managing Solid Waste in any city. It smartly uses a collection of mobile applications coupled with a rich tablet friendly interface to provide a strong control on Solid Waste Management for the concerned citizens.

The solution has been successfully deployed in a Municipality in India and is proving to be very effective.

info@spatialideas.com