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Geoinformatics Engineering

REQUIREMENT ANALYSIS AND SPECIFICATION DOCUMENT

for

Solid Waste Management

(SWM)

Authors:

- Israa Ahmed Mohammed Abdalla
- Ahmed Mohamed Eltahir Yassin
- Mohamed Ridaeldin Mukhtar Mohamed

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https://five.epicollect.net/project/solid-waste-management-amc/data#

Revision history

Version	Date	Change
version 1.0	20th of April, 2022	first submitted version
Version 2.0	07th of June, 2022	final submitted version

Introduction:

1.1 Overview of the project

Around the world, waste generation rates are rising. In 2016, the worlds' cities generated 2.01 billion tons of solid waste, amounting to a footprint of 0.74 kilograms per person per day. With rapid population growth and urbanization, annual waste generation is expected to increase by 70% from 2016 levels to 3.40 billion tons in 2050.

Compared to those in developed nations, residents in developing countries, especially the urban poor, are more severely impacted by unsustainably managed waste. In low-income countries, over 90% of waste is often disposed of in unregulated dumps or openly burned. These practices create serious health, safety, and environmental consequences. Poorly managed waste serves as a breeding ground for disease vectors, contributes to global climate change through methane generation, and can even promote urban violence.

Managing waste properly is essential for building sustainable and livable cities, but it remains a challenge for many developing countries and cities. Effective waste management is expensive, often comprising 20%–50% of municipal budgets. Operating this essential municipal service requires integrated systems that are efficient, sustainable, and socially supported.

1.2 The problem

In most of the cities in India , the scientific and systematic storage of waste at source is not in practice. The waste is normally thrown in nearby vacant areas ,government vacant land ,drains, streets etc. Because of waste thrown on the street, the environment becomes ugly and unhygienic , so even in case of regular cleaning by Municipal Workers also, the city can not be kept clean for more than 2-3 hours.

At sources people generally don't arrange to provide proper dustbins , in residential , institutional and commercial areas .In case of open drains and large drains passing across the city , people throw waste and these drains are clogged , and the width of large drains are reduced because of continuous dumping.

1.3 Purpose of the system

The main aim of our application is to help the users who are looking for the nearest dumping area from his/her location .

1.4 Definitions, Acronyms, and Abbreviations

1.4.1 Definitions

Name	Definition
Epicollect5	Epicollect5 is a mobile and web application for free and easy data collection. It provides both web and mobile applications for the generation of forms and freely hosted project websites for data collection. © 2021 Center for Genomic Pathogen Surveillance, more info available on Epicollect5.
SWM	Solid waste management is a term that is used to refer to the process of collecting and treating solid wastes.
WSGI	Web Server Gateway Interface. A calling convention for web servers to forward requests to web applications or frameworks written in the Python programming language.
DBMS	Database Management Service. Software that interacts with end-users, applications, and the database itself to capture, create, maintain, and control access to the database and analyze stored data. MySQL, PostgreSQL, Microsoft SQL Server, Oracle Database, and Microsoft

	Access are examples of widely available DBMSs. For the development of this project, PostgreSQL has been chosen.
HTTP	HyperText Transfer Protocol. A protocol for distributed, collaborative, hypermedia information systems as the foundation of data communication for the World Wide Web, where hypertext documents include hyperlinks to other resources that the user can easily access.
Web application	Also referred simply as a web app, is a client–server computer program that the client (including the user interface and client-side logic) runs in a web browser.
API	Application Programming Interface. A computing interface to a software component or a system, that defines how other components or other systems can use it or interact with each other, regardless of the programming language implemented, allowing for interoperability. An API defines the kind of requests that can be made to the software and how to make them to obtain a certain response.
REST API	REST: Representational State Transfer. A software architectural style that defines the set of constraints to be used for creating Web Services, to provide interoperability between computer systems on the Internet. A REST API is a web service API that uses URIs, HTTP protocol, and JSON for data format.

SQL	Structured Query Language. A domain-specific language used in programming and designed for managing data held in a relational database management system (RDBMS), or for stream processing in a relational data stream management system (RDSMS).
CRUD operations	Operations to be performed in an SQL database. These transactions describe the overall interaction with the database and contain: Create, Read, Update and Delete.
Active user	In the context of this project, active users are identified as residents who actively contribute to the dataset via Epicollect5 and who may use the proposed web application to aid their decision making.
Passive user	Passive users are identified as users that did not yet contribute to the Epicollect5 dataset but may use the proposed web application to inform themselves. Passive users may include environmental organizations , municipalities , etc.

1.4.3 Abbreviations

Abbreviation	**Description**
SWM	Solid Waste Management

1.5 Reference documents

- https://five.epicollect.net/project/solid-waste-management-amc/data
- https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/solid-waste-management

OVERALL DESCRIPTION

2.1 Scenarios

➢ Scenario n.1

Sami is asked by his wife to take the trash with him, and he is already late from his work so he needs to find the closest garbage to his house by using SWM website and save time.

➢ Senario n.2

The government plans to clean the district as the percentage of diseases is increasing, so it was essential to know the open dumping areas with the assistance of SWM .

- Scenario n.3

  Ola is a radiologist who started her Msc. degree thesis for knowing the relation between radioactive and hazardous waste components which affect the environment by affecting population and moreover cause disasters, so SWM website was a good reference for her to get data and analyze it .

- Scenario no.4

  Ali is a CEO of a start-up business who thinks of making a company that cares about making home accessories by recycling solid waste. He made a deal with SWM to support him by the locations of needed materials, as he found it very costly following the procedures of the government with less efficiency.

2.2 User characteristic

The below-mentioned actors are the main users of the system:

2.2.1 Customer

Every person who wants to reach the garbage.

2.2.2 Member

A member is a customer with access to the system and registered to the database.

Phenomenon:

Phenomenon	Shared, machine, world	Controlled by
User registration	shared	world
User login information stored in server database	machine	machine
User login	shared	world
User adds comment(extension)	shared	world
User edits or deletes comments (extension)	shared	world
User rates the SWM dumps(extension)	shared	world
User logout	shared	world

2.4 Use cases

2.4.1Use case no.1

- Use case name: Allocate Garbage location
  - ➢ Participating Actors: Citizens
  - ➢ Garbage Allocator
  - ➢ Resources
- Entry Condition
  - ➢ There is a trash
- Flow of Events
  - ➢ The user determines his location
  - ➢ SWM replies with a list of all the garbage areas
  - ➢ The Dispatcher selects the closer garbage from the list which is closer and goes

toward

2.4.2Use case no.2

- Use case name: Categorize the solid waste

- Participating Actors: Radiologist
  - ➢ Resource Allocator
  - ➢ Resources
- Entry Condition
  - ➢ Study about solid waste that might emit harmful radiations
- Flow of Events.

- ➢ The Dispatcher selects detailed descriptions about Resources that might make radiation.
- ➢ SWM replies with a list of Resources that fulfill the Dispatcher's request.
- ➢ The Dispatcher selects the Resources from the list and allocates them for the study.
- ➢ The Dispatcher makes his graphs and analysis.

Requirements:

3.1 Technical Requirements

- The dataset is collected using technicians and provided by Epicollect5 to be presented to the user in a map.
- The software should be coded in python language.
- The system should be available as a web application that can be used throughout the web browser.
- The system shall display web pages by the means of HTML code and CSS.
- The system shall use Google Maps, or Bing Maps as the base map for the multi-layered interactive mapping tool.
- The system shall retrieve data from Epicollect5 using its REST API.
- The system shall access data from the Epicollect5 database, either in real-time at every user request or with intermediate storage of the data in another database to uphold service, even when the Epicollect5 database is down or cannot be reached.

3.2 Non-Functional Requirements:

Performance requirements:

3.2.1 Reliability

The website will be synchronized with the Epicollect5 database (whether in real-time upon each user request or with an intermediate step of data storage in another database. Thus, any changes that are being performed via the Epicollect5 platform shall be represented in the web application. .

3.2.2 Security

Users' credentials should be covertly taken care of. The system must obtain a certain level of security since anyone can register. The user's login information like passwords should be stored hashed. It must always display the same information as what is uploaded to Epicollect5, without the risk of possible alteration by an external source, jeopardizing data integrity. The comment section represents a special vulnerability of the system in terms of security and shall be restricted to a certain size and type that can be posted, filtering and validating input to avoid attackers storing unreasonable amounts of data in our system via the comment section, or Cross-Site Scripting to inject code, induce a slowing or shutting down of the application with malicious or persistent code, decreasing or denying the service of the web application.

3.3 Functional Requirements:

- The system shall allow users to query and visualize data according to their needs (location, metal bin, open dumping, etc.) i.e., provide data analysis by the means of filter.(extension)
- The system should allow users to register by entering their (username, address and password).
- The system should allow members to login using their (username and password), and log out.
- The system shall ask for, and then capture the user's location (create a cookie for the user session) to provide customized data visualization (extension).

- The system shall provide the distance from his location to the nearest dumping areas. (extension).
- The system shall display the location of the user in map view (extension).
- Information about points can be retrieved by the user/member by clicking on a point.

4.1functional specifications of the system:

The web page of the proposed system should offer the following functions:

- **A mapping tool**: comprising a base map layer Bing Maps, Google maps displaying the city. The map will be a dynamic element with which the user can interact.
- The map will display all garbage in the city with the feature of displaying specifications for each landfill separately.

EFFORTS spent:	
Author	**Effort**
Israa Ahmed	**34%**

Ahmed Yassin	**33%**
Mohamed Ridaeldin	**33%**