

A
Project Stage-II Report
On
Plastic Waste Management System

By

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The Shirpur Education Society's
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2023-24

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In partial fulfillment of requirement for the degree of

Bachelor of Technology
in
Computer Engineering

Submitted By

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Under the Guidance of

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CERTIFICATE

This is to certify that the Project Stage-II (Semester-VII) entitled "**“Plastic Waste Management System”**" has been carried out by team:

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under the guidance of **Prof. P. A. Agrawal** in partial fulfillment of the requirement for the degree of Bachelor of Technology in Computer Engineering of R. C. Patel Institute of Technology, Shirpur affiliated to Dr. Babasaheb Ambedkar Technological University, Lonere during the academic year 2023-24.

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Acknowledgment

No volume of words is enough to express our gratitude towards our guide, **Prof. P. A. Agrawal**, Assistant Professor in Computer Engineering Department, who has been very concerned and has aided for all the material essential for the preparation of this work. She has helped us to explore this vast topic in an organized manner and provided us with all the ideas on how to work towards a research oriented venture. We wish to express my sincere gratitude towards Project Coordinator **Prof. Dr. S. S. Sonawane** for his timely suggestions and instructions.

We are also thankful to **Prof. Dr. Nitin N. Patil**, Head-Department of Computer Engineering, for the motivation and inspiration that triggered us for the project work.

we are thankful to **Prof. Dr. J. B. Patil**, Director—R. C. Patel Institute of Technology, Shirpur for the support and encouragement.

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ABSTRACT

Plastic Waste Management System

With increase in population, the scenario of cleanliness with respect to Plastic waste management is degrading tremendously. The overflow of plastic in public areas creates the unhygienic condition in the nearby surrounding. It may provoke several serious diseases amongst the nearby people. It also degrades the valuation of the area. To avoid this and to enhance the cleaning, ‘Plastic Waste Management System’ is proposed in this project. In the proposed system, admin create a plastic waste bin id and send to the volunteer to collect that plastic waste and also have facility to people lodged the complain against the plastic waste which is spread near him/her. It is a user friendly system which is used by any person easily.

‘Plastic Waste Management System’ can lead to error free, secure, reliable and fast management system. It assist the user to concentrate on their other activities rather concentrate on the record keeping. Thus it will help organization in better utilization of resources. The organization can maintain computerized records without redundant entries. That means that one need not be distracted by information that not relevant, while being able to reach the information.

The aim to automate its existing manual system by the help of computerized equipments and full-fledge computer software, fulfilling their requirements, so that their valuable data/information can be stored for a long period with easy accessing and manipulation of the same. Basically the project describes how to manage for good performance and better services for the clients.

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Chapter 1

INTRODUCTION

The world is in a stage of upgradation, there is one stinking problem we have to deal with. Garbage! In our daily life, we see the pictures of garbage bins being overfull and all the garbage spills out. This leads to the number of diseases and insects and mosquitoes breed on it. A big challenge in the urban cities is solid waste management not only in India but for most of the countries in the world. Hence, such a system has to be build which can eradicate this problem or at least reduce it to the minimum level[1].

The waste collection process is a critical aspect for the service providers. The traditional way of manually monitoring the wastes in waste bins is a complex, cumbersome process and utilizes more human effort, time and cost which is not compatible with the present day technologies. In order to overcome all these problems, we are proposing the idea of a waste management system which helps in the management of waste with the least human interaction in order to maintain a clean environment[1].

Smart cities integrate multiple mobile or web solutions to build a comfortable human habitation. One of these solutions is to provide an environmentally friendly, efficient and effective garbage management system. The current garbage collection system includes routine garbage trucks doing rounds daily or weekly, which not only doesn't cover every zone of the city but its completely inefficient use of government resources. The proposed system, where admin manage the garbage app for full online

based monitoring and analyze the system. Her admin handle bins, driver, complaints from user and work report from driver. This paper proposes a cost-effective mobile or web based system for the government to utilize available resources to efficiently manage the overwhelming amounts of garbage collected each day, while also providing a better solution for the inconvenience of garbage disposal for the citizens. This is done by a driver, app will provide predictive and guide routes generated through for garbage trucks. Then driver update the status of work done will be data collected. An web app is developed for the workforce and the citizens, which primarily provides the user create complaints available smart bin[10].

In this project, we use PHP and MySQL database. It has three modules:

1. Admin
2. Volunteer
3. User

User can also update his profile, change the password and recover the password.

1.1 Background Knowledge

Plastic waste has become a global environmental challenge, contributing significantly to pollution and adversely affecting ecosystems. The production and consumption of single-use plastics have escalated over the years, leading to a surge in plastic waste generation. The environmental impact of plastic waste, including marine pollution, soil contamination, and harm to wildlife, necessitates urgent attention and sustainable solutions.

Understanding the life cycle of plastic, from production to disposal, is crucial for devising effective waste management strategies. It involves analyzing the environmental and social implications of plastic use, identifying key stakeholders, and evaluating existing waste management practices.

1.2 Motivation

The motivation behind this project stems from the pressing need to address the environmental consequences of plastic waste. The detrimental effects on biodiversity, human health, and the overall well-being of the planet underscore the urgency to implement sustainable plastic waste management systems. Additionally, the potential for economic benefits through recycling and the reduction of greenhouse gas emissions further motivates the exploration of innovative solutions[12].

1.3 Problem Statement

The unabated growth in plastic production and inadequate waste management practices have led to the accumulation of plastic waste in landfills, oceans, and other ecosystems. Traditional methods of waste disposal, such as landfilling and incineration, contribute to environmental pollution and resource depletion. The lack of awareness, infrastructure, and efficient recycling systems exacerbates the problem, necessitating a comprehensive approach to plastic waste management.

1.4 Objective

- Garbage Management System which helps in the management of waste with the least human interaction in order to maintain a clean environment.
- Provide route planning for the collection based on the selected fill level and priorities of each bin.
- It is very much faster than manual system
- Easy and fastest record finding technique.
- It is very much flexible to work
- It is very user oriented.

- Data can be stored for a longer period.

1.5 Scope

The scope of this project encompasses the entire life cycle of plastic, from production and consumption to disposal. It includes the development of a robust recycling system, educational campaigns to raise awareness, and initiatives to reduce the use of single-use plastics. The geographical scope will initially focus on a specific region but aims to provide a scalable model for broader implementation[14].

In the subsequent sections of this project report, each aspect of the Plastic Waste Management System will be explored in detail, providing a comprehensive understanding of the proposed strategies and their potential impact on mitigating the plastic waste crisis.

Chapter 2

LITERATURE SURVEY

2.1 Review of Existing System

In this section, a comprehensive review of existing plastic waste management systems is conducted. This involves an analysis of global and regional initiatives, government policies, and industry practices aimed at addressing plastic waste. Key aspects considered include collection methods, recycling technologies, public awareness campaigns, and the effectiveness of current systems in reducing the environmental impact of plastic waste.

The review also assesses the challenges and shortcomings of existing systems, such as insufficient infrastructure, limited recycling capabilities, and gaps in regulatory frameworks. Understanding these shortcomings is crucial for proposing improvements and developing a more effective plastic waste management system[15].

2.2 Limitation of Existing System

Building on the review of existing systems, this section delves into the limitations and challenges faced by current plastic waste management practices. Common issues include:

Inadequate Collection Infrastructure: Many regions lack proper systems for collecting and sorting plastic waste, leading to improper disposal.

Limited Recycling Capacity: Existing recycling facilities may not be equipped to handle the volume and variety of plastic waste, limiting the effectiveness of recycling efforts.

Low Public Awareness: Insufficient awareness among the public about the environmental impact of plastic waste and the importance of proper disposal and recycling.

Regulatory Gaps: Inconsistent or weak regulations on plastic production, use, and disposal contribute to the challenges faced by waste management systems.

Identifying these limitations provides a foundation for proposing targeted solutions in the subsequent sections[15].

2.3 Literature Review Table

A literature review table is created to summarize relevant studies, research articles, and case studies related to plastic waste management. The table includes key findings, methodologies, and outcomes of each source, providing a consolidated overview of the current state of knowledge in the field. This aids in identifying best practices, successful strategies, and areas where further research is needed.

The table may categorize literature based on themes such as recycling technologies, community engagement, policy interventions, and the economic viability of plastic waste management.

Table 2.1: Literature Review Table

Sr. No	Review Year	Paper Title	Author(s)	Findings or Techniques or Algorithms
1	2024	A Holistic Framework for Circular Economy-Based Plastic Waste Management	Chen, M., Yang, Y., & Wong, M. H.	Proposes a multi-stakeholder framework integrating life cycle assessment, eco-design, and extended producer responsibility to optimize resource recovery and minimize environmental impact.
2	2023	Artificial Intelligence for Sorting and Recycling Mixed Plastic Waste: A Review	Kim, H. C., & Kim, W. S.	Reviews the application of AI techniques like computer vision and deep learning for automated plastic waste sorting, highlighting challenges and potential solutions.
3	2022	Biodegradation of Microplastics: Promising Strategies and Future Directions	Kollarczik, K., & Zhu, Y.	Examines the potential of various biological approaches, including enzymes and engineered microbes, for degrading microplastics and mitigating their environmental harm.
4	2021	Blockchain-Based Traceability and Transparency in Plastic Waste Management	Wright, L., & Venter, L.	Explores the use of blockchain technology to track plastic waste streams, promote accountability, and incentivize sustainable practices in the plastic industry.
5	2020	Chemical Recycling of Plastic Waste: Technological Advances and Environmental Implications	Schmidt, B. S., & Zimmermann, T.	Discusses advanced chemical recycling technologies like pyrolysis and gasification, evaluating their efficiency.

2.4 Proposed System

Building upon the insights gained from the existing systems' review and limitations, this section outlines the proposed Plastic Waste Management System. It includes detailed plans for recycling, reusing, and reducing plastic waste, covering:

Recycling Infrastructure: Describing the design and implementation of an efficient recycling system, including collection methods, sorting processes, and recycling technologies. Education and Awareness Programs: Outlining initiatives to inform and educate the public, businesses, and policymakers about the importance of responsible plastic use and disposal. Innovative Solutions: Introducing novel approaches and technologies that enhance the sustainability of plastic use, such as biodegradable alternatives, circular economy models, and green packaging[2].

Collaboration Strategies: Discussing partnerships with governmental bodies, industries, NGOs, and local communities to ensure a holistic and collaborative approach to plastic waste management. This section serves as the foundation for the subsequent chapters, providing a detailed roadmap for the implementation of the proposed Plastic Waste Management System.

Chapter 3

Requirement Analysis

3.1 Method used for Requirement Analysis

Requirement analysis is a crucial phase in the development of the Plastic Waste Management System. This section outlines the methodologies employed to gather, document, and analyze the project requirements. Commonly used methods include:

1. **Stakeholder Interviews:** Conducting interviews with key stakeholders such as government officials, waste management authorities, industry representatives, environmentalists, and community members to understand their perspectives, needs, and expectations.
2. **Surveys and Questionnaires:** Administering surveys and questionnaires to a broader audience to collect quantitative and qualitative data on current waste disposal habits, awareness levels, and opinions on plastic waste management.
3. **Site Visits and Observations:** Visiting waste disposal sites, recycling facilities, and communities to observe current practices and identify potential challenges in the existing system.
4. **Review of Existing Documentation:** Analyzing existing reports, policies, and studies related to plastic waste management to gather insights and identify gaps in the current understanding[9].

3.2 Data Requirement

This section outlines the data required for a comprehensive understanding of the plastic waste management landscape. The data requirements encompass:

1. **Waste Generation Data:** Quantitative data on the types and volumes of plastic waste generated in the target region, including information on sources, categories, and seasonal variations.
2. **Demographic Data:** Information about the population demographics of the target area to tailor awareness campaigns and initiatives to specific audience segments.
3. **Infrastructure Data:** Details on existing waste collection and recycling infrastructure, including locations, capacities, and technology used.
4. **Legislative and Policy Data:** A review of existing laws, regulations, and policies related to plastic production, use, and waste management to ensure alignment with proposed interventions.

3.3 Functional Requirements

Functional requirements describe the features and capabilities the Plastic Waste Management System must possess to meet its objectives. This includes:

1. **Collection and Sorting System:** Specification of methods and technologies for efficient collection and sorting of plastic waste at various stages, from households to designated collection points.
2. **Recycling Processes:** Detailed descriptions of the recycling processes, including the types of plastics targeted, recycling technologies employed, and the end products generated.
3. **Education and Awareness Modules:** Functionalities of educational programs, awareness campaigns, and communication channels to disseminate information about responsible plastic use and waste management.

4. **Monitoring and Evaluation:** Criteria and metrics for monitoring the effectiveness of the system, such as reduction in plastic waste, increased recycling rates, and changes in public behavior.

3.4 System Specification

System specification provides a detailed blueprint of the Plastic Waste Management System. This includes:

1. **Technical Specifications:** Hardware and software requirements for the system, including information on data storage, processing capabilities, and communication infrastructure.
2. **Security Measures:** Measures to ensure data security, privacy, and protection against potential threats or misuse.
3. **Scalability and Flexibility:** Design considerations that allow the system to scale with increasing demand and adapt to evolving technologies and requirements.
4. **Integration with Existing Systems:** Strategies for integrating the new plastic waste management system with existing waste management infrastructures, databases, and communication channels.

This section lays the foundation for the subsequent phases of the project, providing a clear roadmap for the development and implementation of the Plastic Waste Management System.

Chapter 4

Planning and Scheduling

4.1 Project Planning

Project planning involves outlining the overall strategy, goals, and tasks necessary for the successful implementation of the Plastic Waste Management System. This section includes:

1. **Objectives and Goals:** Clearly defining the project's objectives and goals, emphasizing the recycling, reusing, and reducing aspects of plastic waste management.
2. **Scope:** Reiterating the scope of the project and specifying any potential expansions or limitations during the planning phase.
3. **Resource Identification:** Identifying and allocating resources, including human resources, technology, funding, and partnerships.
4. **Timeline:** Establishing a realistic timeline for the project, considering both short-term and long-term milestones.
5. **Regulatory Compliance:** Ensuring that the project adheres to relevant regulations and legal frameworks associated with waste management and environmental protection[15].

4.2 Project Scheduling (Cost Effort)

1. Initial Project Setup & Planning (1 week):

- Requirements Gathering: Conduct comprehensive stakeholder meetings to gather specific requirements for the multilingual Systematic Farming Website.
- Budget Allocation: Establish the project budget, considering hardware, software, and development costs.
- Resource Allocation: Identify and allocate necessary resources, including project team members and external partners.
- Software and Hardware Needs: Identify and procure the required software and hardware components for the project.

2. Data Collection Analysis (2 weeks):

- Market Research: Conduct market research to understand the linguistic and cultural diversity of the target audience.
- Language Analysis: Analyze linguistic preferences and dialects prevalent among farmers in different regions.
- Data Collection: Gather crop disease data sets to train and enhance the machine learning models.

3. Design & Development (4 weeks):

- Develop language-specific web pages.
- Develop user interface for effective interaction.
- Integrate Disease prediction model with website.
- Test and debug the system.

4. Testing & Quality Assurance (2 weeks):

- Test application and accuracy of crop disease model.

- Analyse results and refine if it is necessary.
- Verify accuracy and consistency of the project

5. Deployment & Support (1 week):

- Deploy the project.
- Provide user training and support .
- Monitor performance and provide ongoing maintenance by using feedback.

4.3 Gantt Chart

		Name	Duration	Start	Finish	Predecessors
1		Literature Review	6 days	20/3/23 8:00 AM	27/3/23 5:00 PM	
2		Review of Existing System	4 days	20/3/23 8:00 AM	23/3/23 5:00 PM	
3		Limitation of Existing Sys...	2 days	24/3/23 8:00 AM	27/3/23 5:00 PM	2
4		Requirement Analysis	6 days?	28/3/23 8:00 AM	4/4/23 5:00 PM	
5		Method Analysis	2 days	28/3/23 8:00 AM	29/3/23 5:00 PM	3
6		Data Requirement	2 days	30/3/23 8:00 AM	31/3/23 5:00 PM	5
7		Functional Requirement	1 day	3/4/23 8:00 AM	3/4/23 5:00 PM	6
8		System Specification	1 day?	4/4/23 8:00 AM	4/4/23 5:00 PM	7
9		Planning And Scheduling	7 days	5/4/23 8:00 AM	13/4/23 5:00 PM	
10		Project Planning	2 days	5/4/23 8:00 AM	6/4/23 5:00 PM	8
11		Project Scheduling	3 days	7/4/23 8:00 AM	11/4/23 5:00 PM	10
12		Risk Assessment	2 days	12/4/23 8:00 AM	13/4/23 5:00 PM	11
13		Design Details	5 days	14/4/23 8:00 AM	20/4/23 5:00 PM	
14		Data Flow Diagram	5 days	14/4/23 8:00 AM	20/4/23 5:00 PM	12
15		System Modelling	4 days	21/4/23 8:00 AM	26/4/23 5:00 PM	
16		UML Diagram	4 days	21/4/23 8:00 AM	26/4/23 5:00 PM	14
17		Implementation Planni...	9 days	27/4/23 8:00 AM	9/5/23 5:00 PM	
18		Hardware Specification	3 days	27/4/23 8:00 AM	1/5/23 5:00 PM	16
19		Platform	2 days	2/5/23 8:00 AM	3/5/23 5:00 PM	18
20		Programming Language ...	4 days	4/5/23 8:00 AM	9/5/23 5:00 PM	19

Figure 4.1: Gantt Chart - Task

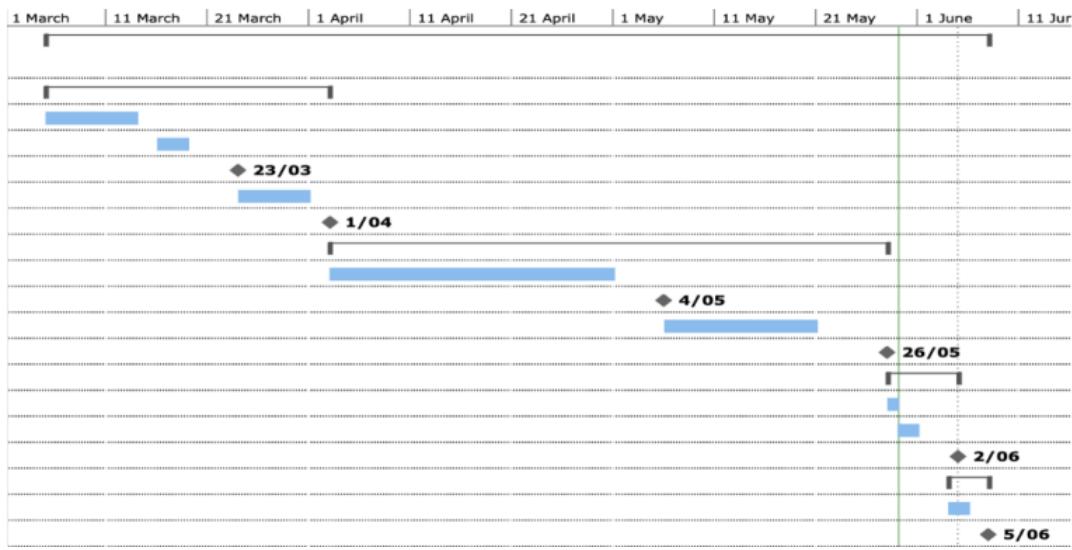


Figure 4.2: Gantt Chart - Graph

4.4 Risk Assessment

Risk assessment involves identifying potential risks that could impact the successful execution of the Plastic Waste Management System. This includes:

- Risk Identification: Identifying and categorizing potential risks, such as technological challenges, regulatory changes, budget constraints, and community resistance.
- Risk Analysis: Assessing the likelihood and impact of each identified risk, prioritizing those that pose the greatest threat to project success.
- Risk Mitigation Strategies: Developing strategies to mitigate or manage identified risks, including contingency plans, alternative approaches, and stakeholder engagement.
- Monitoring and Response Plan: Establishing a system for ongoing monitoring of risks and implementing timely responses to address emerging issues.

By systematically addressing potential challenges, the risk assessment ensures that the project team is well-prepared to navigate uncertainties and maintain project momentum.

Chapter 5

Design Details and Software Requirements Specification

5.1 Design Details

- System Architecture

Describe the overall architecture of the plastic waste management system, including the main components, their interactions, and how they contribute to the system's functionality.

- User Interface Design

Outline the design principles and features of the user interface that will be utilized by stakeholders interacting with the system.

- Database Design

Explain the structure of the database that will be used to store and manage relevant information, including user data, waste types, recycling statistics, and other pertinent data.

- System Security

Detail the security measures implemented to protect sensitive data and ensure the overall integrity and reliability of the plastic waste management system.

5.2 Data Flow Diagram

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It can be manual, automated, or a combination of both.

It shows how data enters and leaves the system, what changes the information, and where data is stored.

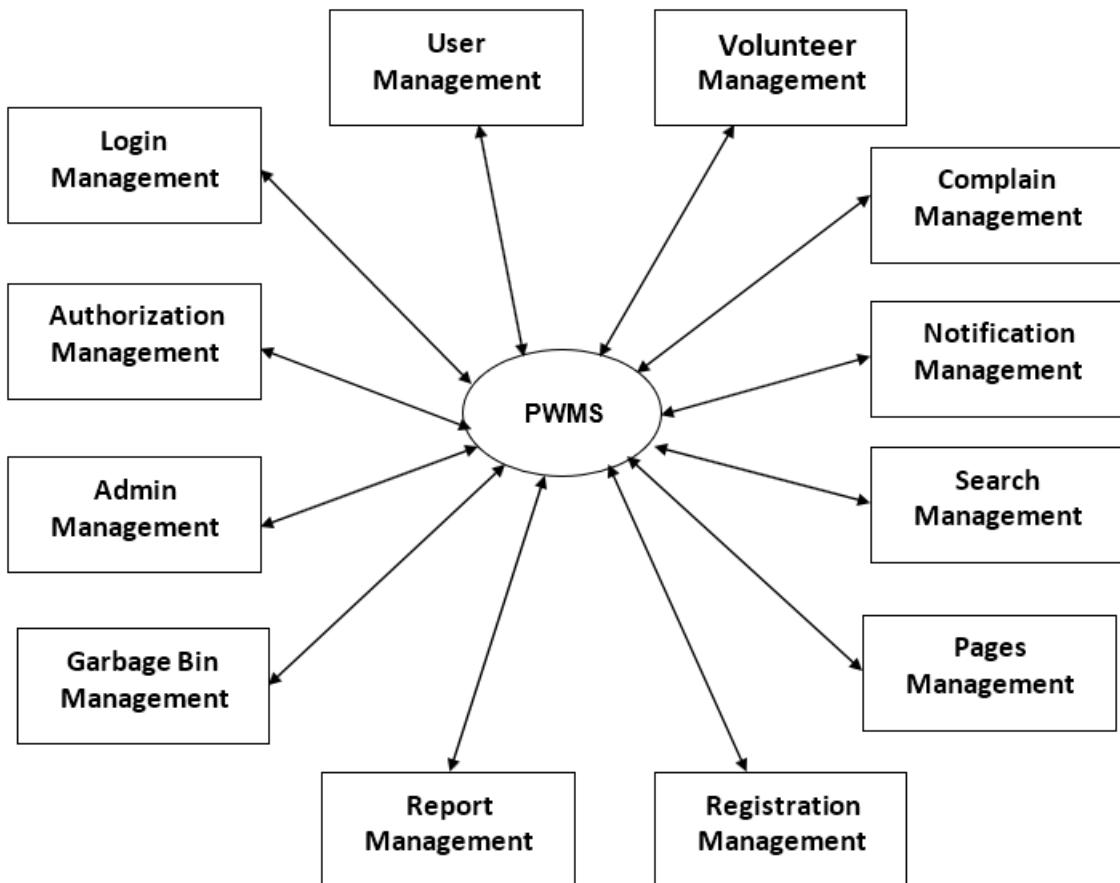


Figure 5.1: Level Zero DFD

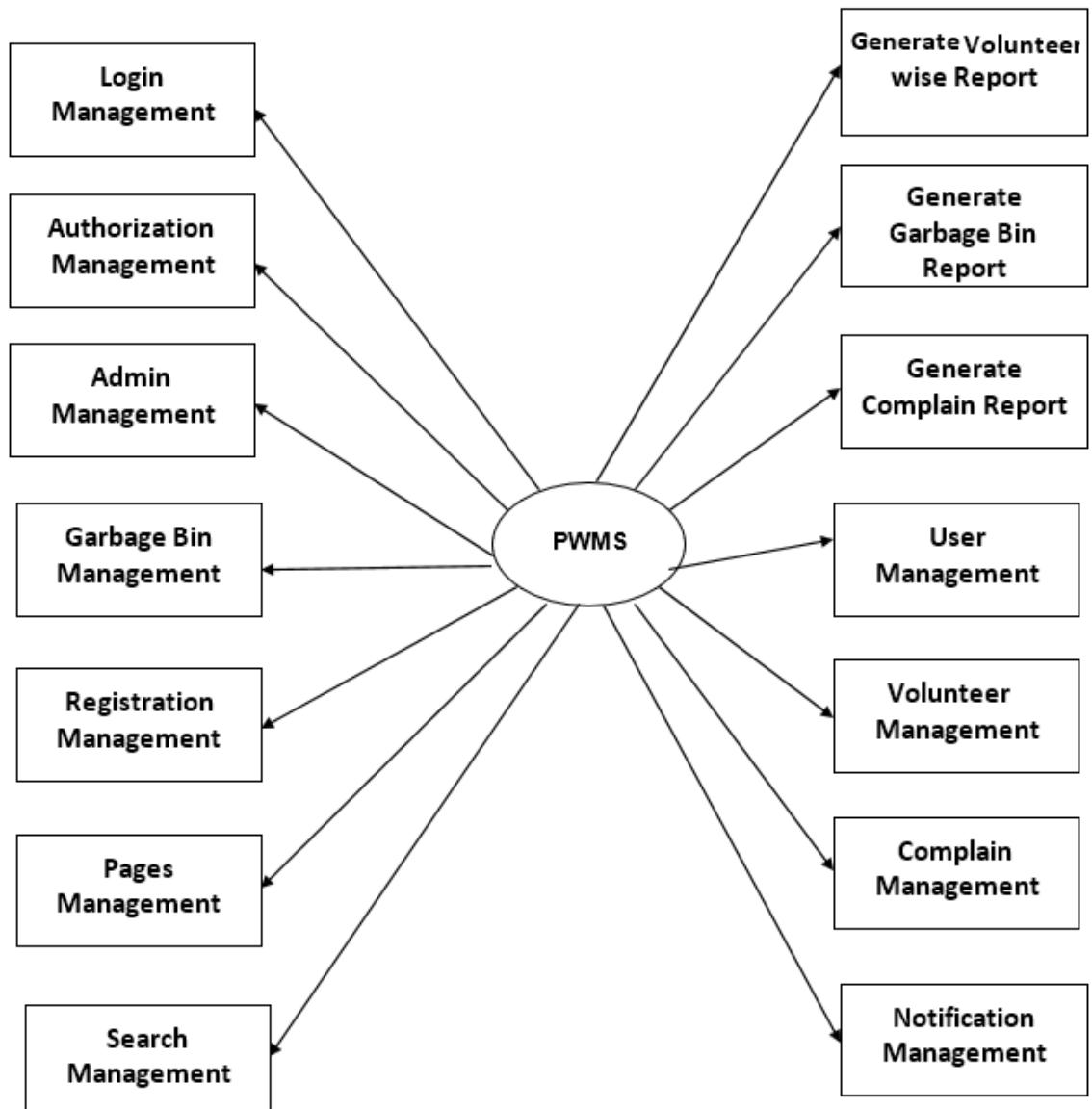


Figure 5.2: Level First DFD

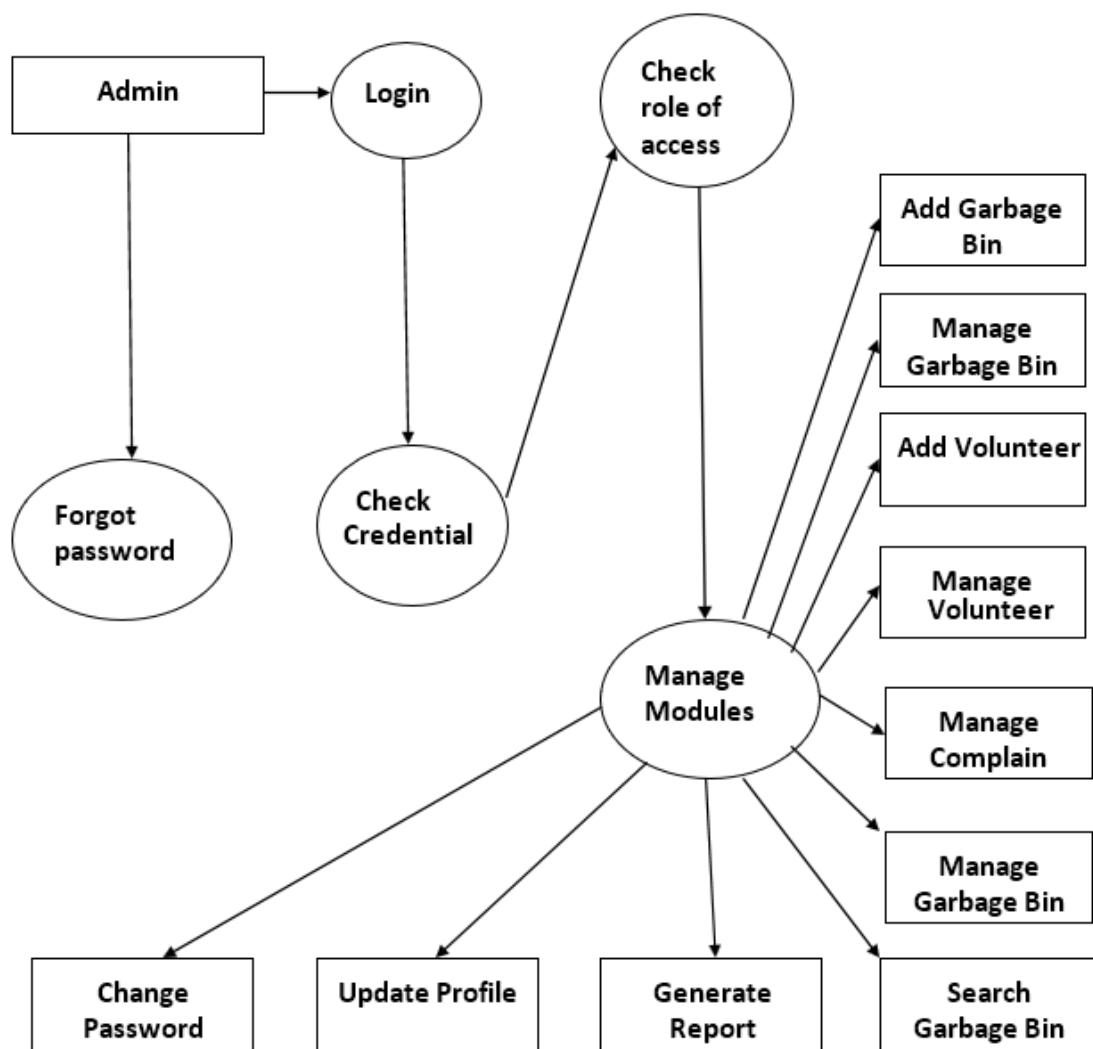


Figure 5.3: Level Second DFD

Chapter 6

System Modeling- Need of System modeling.

6.1 Use case

A use case diagram for a plastic waste management system illustrates the interactions between different actors (users or external systems) and the system itself. Actors include users with distinct roles (Administrator, Collector, Recycler) and external systems such as databases. The use cases represent various functionalities like submitting plastic waste, tracking its status, assigning collection routes, managing the recycling process, generating reports, and updating the plastic waste database. Relationships connect actors with their associated use cases, while the "extends" relationship accounts for optional and conditional use cases. The system boundary encapsulates the depicted functionalities, outlining the scope of the plastic waste management system.

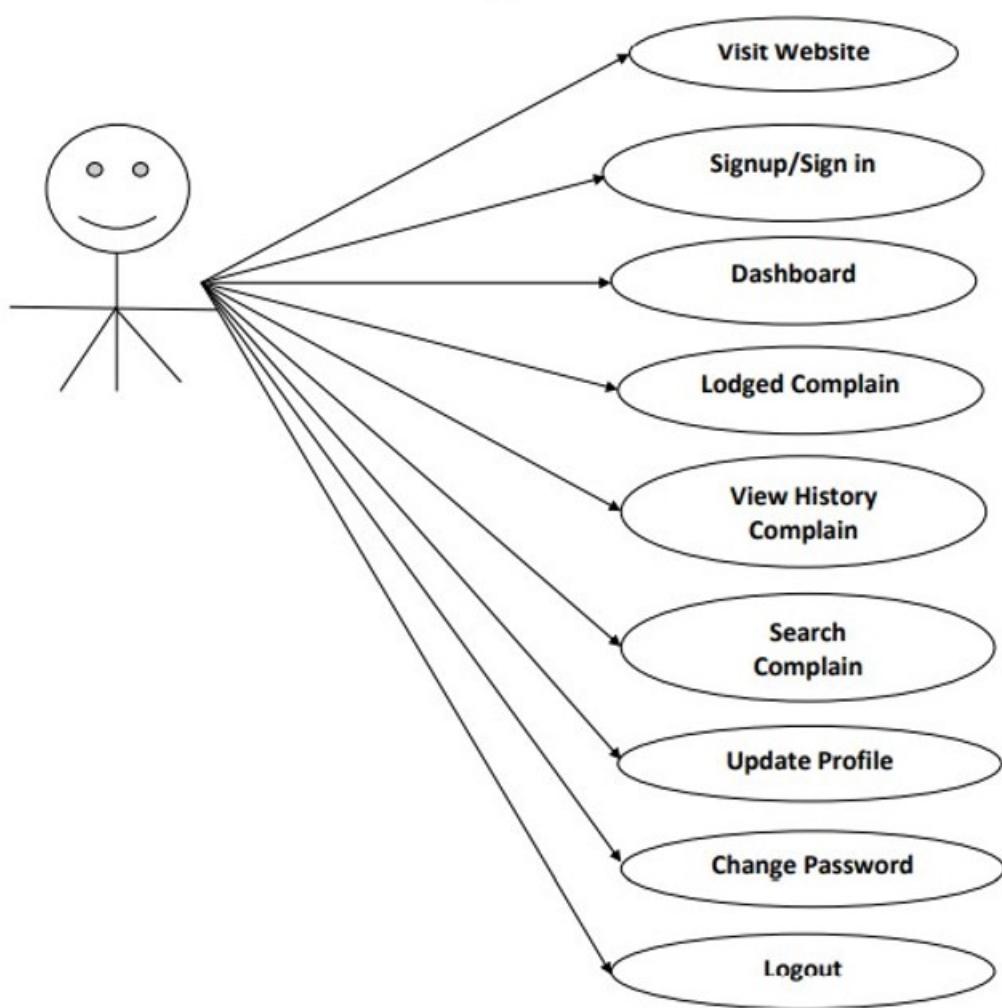


Figure 6.1: Use Case Diagram

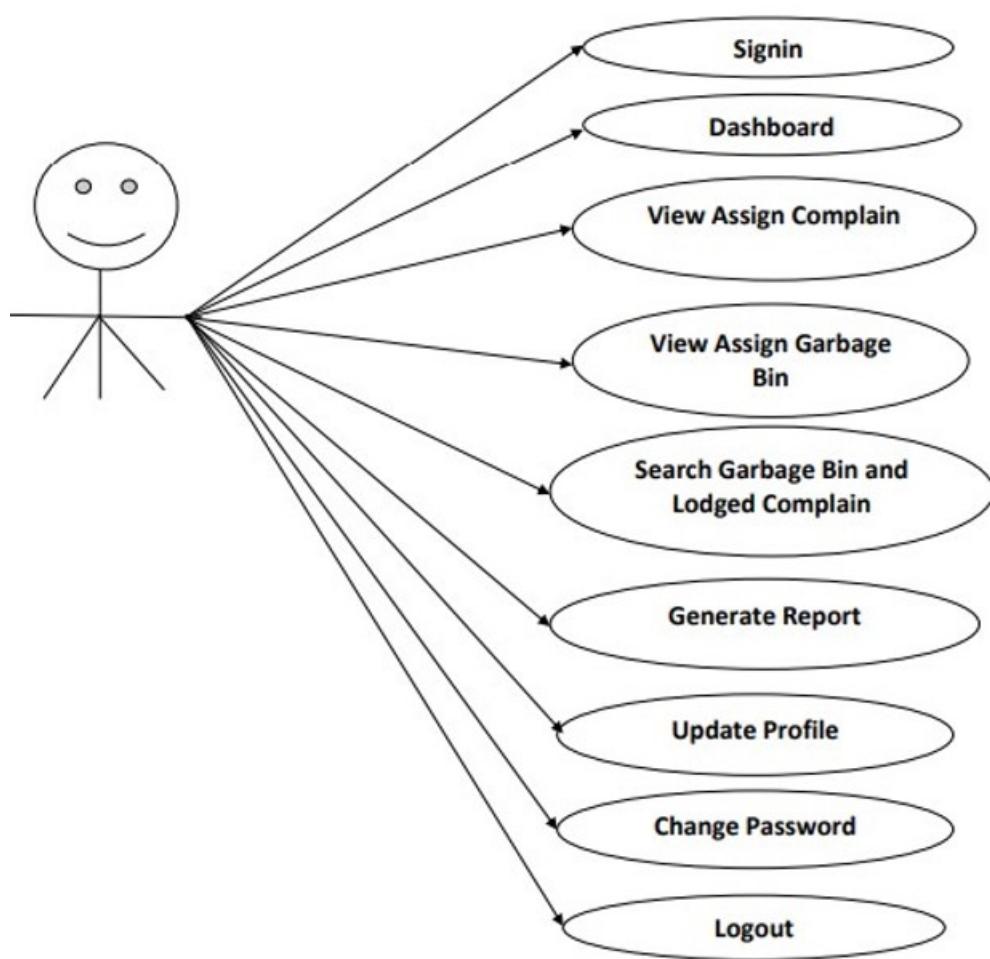


Figure 6.2: Use Case Diagram For Volunteer

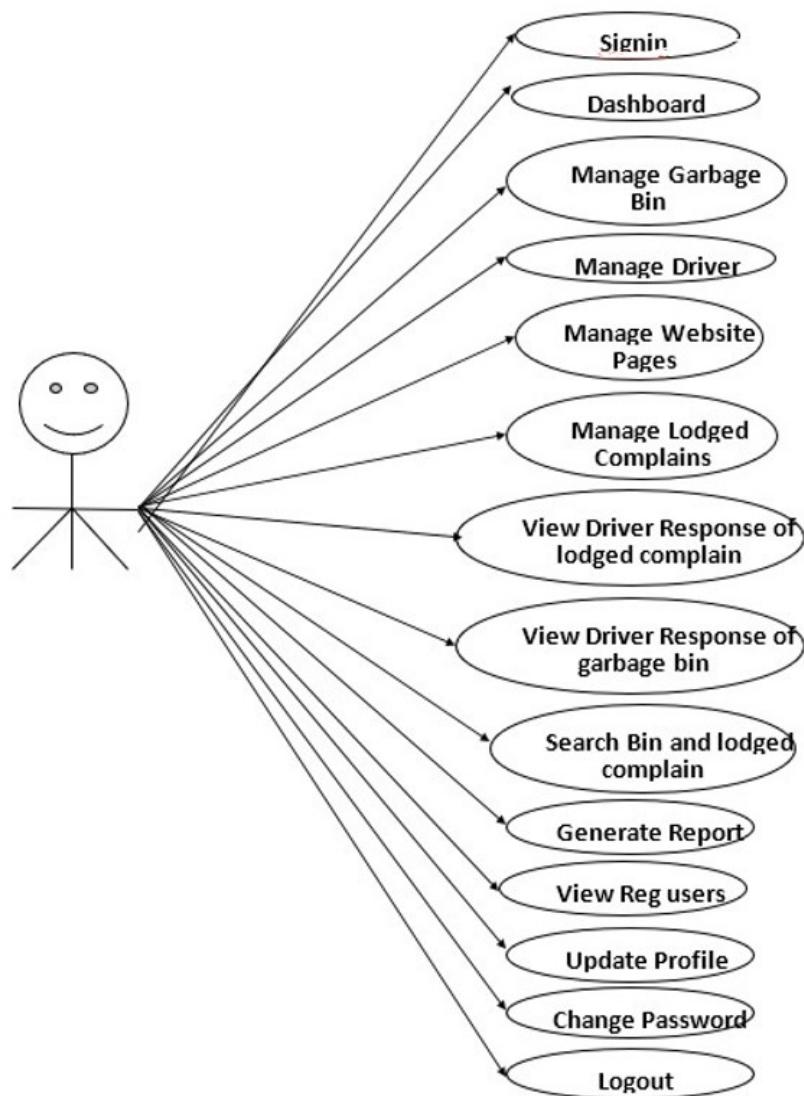


Figure 6.3: Use Case Diagram For Admin

Chapter 7

Implementation

7.1 Software Specification

- Processor: 1.5 GHz or more
- RAM:4GB or more
- HDD: at least 128GB
- Platform: Windows 7 Or More
- Programming languages used: XAMPP Server.

7.2 Runtime Snapshots

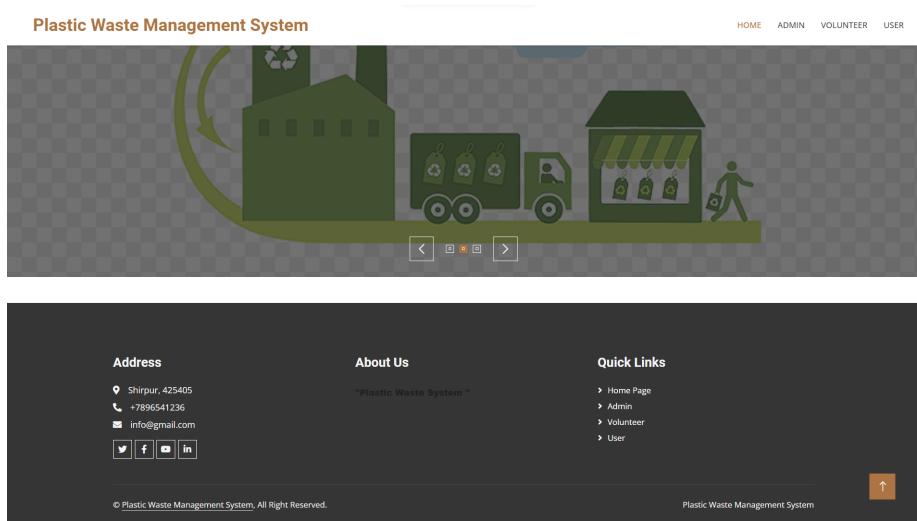


Figure 7.1: Home Page

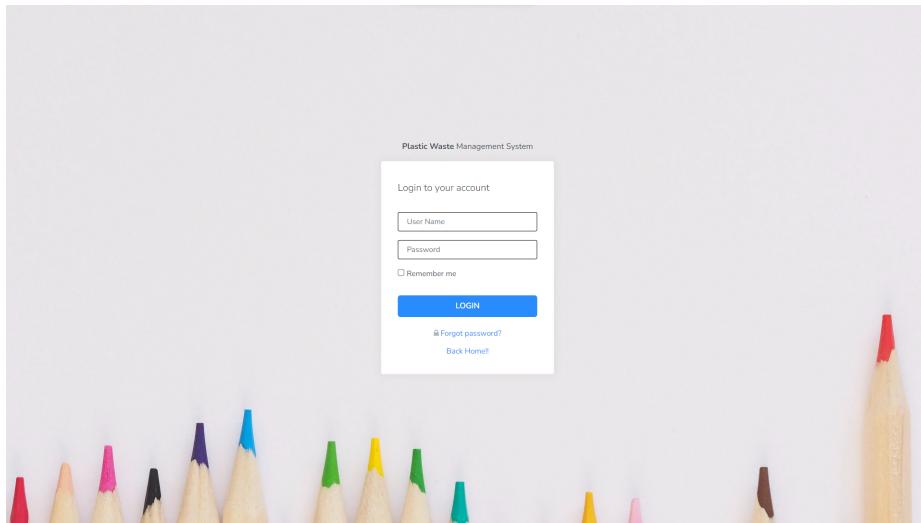


Figure 7.2: Login Page

The image shows the dashboard of the Plastic Waste Management System. At the top, there's a header bar with the system name and a user profile. The main area is titled "Dashboard". It contains four cards: 1) "Total Assign Complain" with value 4 and a "View Detail" link; 2) "Inprogress Complain" with value 1 and a "View Detail" link; 3) "Completed Complain" with value 3 and a "View Detail" link. Below these are two more cards: 4) "Total Assign Plastic Waste Bin" with value 2 and a "View Detail" link; 5) "Inprogress" with value 0 and a "View Detail" link; 6) "Plastic Waste Cleaned" with value 2 and a "View Detail" link. On the left side, there's a sidebar with navigation links: Dashboard (selected), Assign Complain, Assign Plastic Waste Bin, Search, Report, and Go to NGO site.

Figure 7.3: DashBoard

The screenshot shows the 'Admin Profile' page of the Plastic Waste Management System. The left sidebar shows the user is 'Admin' (adminuser@gmail.com) and has selected 'Dashboard'. The main content area is titled 'Admin Profile' and contains fields for Admin Name (Admin), User Name (admin), Email (adminuser@gmail.com), Contact Number (8979555557), and Registration Date (2022-08-02 17:53:36). A blue 'Update' button is at the bottom.

Figure 7.4: Admin Profile

The screenshot shows the 'Add Bin' page of the Plastic Waste Management System. The left sidebar shows the user is 'Admin' (adminuser@gmail.com) and has selected 'Create Bin'. The main content area is titled 'Add Bin' and contains fields for Bin ID, Area, Locality, Landmark, Load Type (a dropdown menu showing 'Choose the load type'), Period of Cycle (a dropdown menu showing 'Choose the Period of Cycle'), Bus Route Address, and Assign Volunteer (a dropdown menu showing 'Assign To'). A blue 'Submit' button is at the bottom.

Figure 7.5: Add Bin

S.No	Bin ID	Address	Assign To	Assign Date	Action
1	Bin-123	hjkjhdkhjkvut ylvtlyuncyruvityuy	vams123	2022-07-18 16:35:10	<button>Edit</button> <button>Delete</button>
2	B-123	jkhkj	vams123	2022-07-18 16:36:27	<button>Edit</button> <button>Delete</button>

Figure 7.6: Manage Bin

Figure 7.7: Add Volunteer

The screenshot shows the 'Plastic Waste Management System' dashboard. The left sidebar, under the 'Admin' account (adminuser@gmail.com), includes links for Dashboard, Create Bin, Volunteer, Complain, Volunteer Complain Response, Volunteer Bin Response, Search, Report, Reg Users, and Page. The main content area is titled 'Manage Volunteer' and displays a table of volunteer entries. The table has columns for S.No, Employee ID, Name, MobileNumber, Email, and Action. The data shows four entries:

S.No	Employee ID	Name	MobileNumber	Email	Action
1	vams123	TEST	4654654654	rahu123@gmail.com	<button>Edit</button> <button>Delete</button>
2	vams124	Test	9879879879	kai@gmail.com	<button>Edit</button> <button>Delete</button>
3	vams125	Mahesh Kumar	9879789799	mahesh@gmail.com	<button>Edit</button> <button>Delete</button>
4	test123	John Doe	1234567890	johndoe@gmail.com	<button>Edit</button> <button>Delete</button>

Below the table, it says 'Showing 1 to 4 of 4 entries' and has navigation buttons for Previous, Next, and a search bar.

Figure 7.8: Manage Volunteer

The screenshot shows the 'Garbage Management System' dashboard. The left sidebar, under the 'Joh Doe' account (johndoe@gmail.com), includes links for Dashboard, Lodged Complain, Complain History, and Search. The main content area is titled 'Lodged Complain' and contains several input fields for a complaint report. The fields are: Area (text input), Locality (text input), Landmark (text input), Address (text input), Photo (file upload input showing 'Choose File | No file chosen'), and Note(if any) (text input). A 'Submit' button is at the bottom.

Figure 7.9: Lodged Complain

S.No	Complain Number	Name	Mobile Number	Email	Status	Action
1	526529361	Moshin	7894566123	mos@gmail.com	Completed (Assign to vams123)	<button>View</button>
2	699612318	test	7946547897	test@gmail.com	On the way (Assign to vams123)	<button>View</button>
3	526529312	test	7946547897	test@gmail.com	Completed (Assign to vams123)	<button>View</button>
4	792381847	Joh Doe	1231231230	john doe@gmail.com	Completed (Assign to vams123)	<button>View</button>

Figure 7.10: All Lodged Complain

Complain Number	699612318		
Name	test	Email	test@gmail.com
Mobile Number	7946547897	Address of Plastic Waste	K-0890, fghy, uytu, New Delhi
Area	Kalyanpuri	Locality	jgjhgjhgjhg
Landmark	nera oppulent mall	Note	No Notes
Image			
Assign To	vams123	Complain Date	2022-07-22 18:06:54
Complain Final Status	Volunteer is on the way	Admin Remark	On the way
Tracking History			
#	Remark	Status	Time
1	your complain has been approved	Approved	2022-07-27 16:12:01
2	On the way for collecting the garbage	On the way	2022-08-14 11:48:28

Figure 7.11: View Lodged Complain

The screenshot shows the Garbage Management System's dashboard. On the left, there is a sidebar with a user profile for 'Joh Doe' (john doe@gmail.com) and navigation links for Dashboard, Lodged Complain, Complain History, and Search. The main content area is titled 'Lodged Complain History' and displays a table of complain history. The table has columns for S.No, Complain Number, Name, Mobile Number, Email, Status, and Action. One entry is shown: S.No 1, Complain Number 792381847, Name Joh Doe, Mobile Number 1231231230, Email john doe@gmail.com, Status Completed (Assign to vams123), and Action View. A search bar and pagination controls (Show 10 entries, previous, next) are also present.

Figure 7.12: Lodged Complain History

The screenshot shows the Plastic Waste Management System's dashboard. On the left, there is a sidebar with a user profile for 'Admin' (adminuser@gmail.com) and navigation links for Dashboard, Create Bin, Volunteer, Complain, Volunteer Complain Response, Volunteer Bin Response, Search, Report, Reg Users, and Page. The main content area is titled 'Volunteer is on the way for garbage' and displays a table of volunteer status updates. The table has columns for S.No, Complain Number, Name, Mobile Number, Email, Status, and Action. One entry is shown: S.No 2, Complain Number 699612318, Name test, Mobile Number 7946547897, Email test@gmail.com, Status On the way (Assign to vams123), and Action View. A search bar and pagination controls (Show 10 entries, previous, next) are also present.

Figure 7.13: Volunteer is on the Way

The screenshot shows the 'Resolved Complain' section of the system. On the left, there is a sidebar with a user icon and the text 'Admin adminuser@gmail.com'. Below this are several menu items: Dashboard, Create Bin, Volunteer, Complain, Volunteer Complain Response, Volunteer Bin Response, Search, Report, Reg Users, and Page. The main area has a title 'Resolved Complain' and a search bar. It displays a table with three entries:

S.No	Complain Number	Name	Mobile Number	Email	Status	Action
2	526529361	Moshin	7894566123	mos@gmail.com	Completed (Assign to vams123)	<button>View</button>
3	5265299312	test	7946547897	test@gmail.com	Completed (Assign to vams123)	<button>View</button>
4	792381847	Joh Doe	1231231230	johndoe@gmail.com	Completed (Assign to vams123)	<button>View</button>

Below the table, it says 'Showing 1 to 3 of 3 entries' and has navigation buttons for Previous, Next, and a page number '1'.

Figure 7.14: Resolved Complain

The screenshot shows the 'Search Assign Lodged Complain' section. On the left, there is a sidebar with a user icon and the text 'TEST rahul123@gmail.com'. Below this are several menu items: Dashboard, Assign Complain, Assign Plastic Waste Bin, Search, Report, and Go to NGO site. The main area has a title 'Search Assign Lodged Complain' and a search bar with the placeholder 'Enter Complain Number'. A 'Search' button is located below the search bar.

Figure 7.15: Search Assign Lodged Complain

The screenshot shows the 'Plastic Waste Management System' dashboard. On the left, there is a sidebar with a user icon and the text 'Admin adminuser@gmail.com'. Below this are several menu items: 'Dashboard' (selected), 'Create Bin', 'Volunteer', 'Complain', 'Volunteer Complain Response', 'Volunteer Bin Response', 'Search', 'Report', 'Reg Users', and 'Page'. The main content area is titled 'Registered Users' and contains a table with three rows of data:

S.No	Full Name	Mobile Number	Email	Date of Registration	Action
1	Moshin	7894566123	mos@gmail.com	2022-07-22 16:46:53	View Lodged Complain
2	test	7946547897	test@gmail.com	2022-07-22 18:04:42	View Lodged Complain
3	Joh Doe	1231231230	johndoe@gmail.com	2022-08-14 17:48:44	View Lodged Complain

Figure 7.16: Registered Users

The screenshot shows the 'Plastic Waste Management System' dashboard. On the left, there is a sidebar with a user icon and the text 'Admin adminuser@gmail.com'. Below this are several menu items: 'Dashboard' (selected), 'Create Bin', 'Volunteer', 'Complain', 'Volunteer Complain Response', 'Volunteer Bin Response', 'Search', 'Report', 'Reg Users', and 'Page'. The main content area is titled 'Update Contact Us' and contains the following form fields:

- Page Title:
- Page Description:

Shirpur, 425405

 (with rich text editor icons)
- Email:
- Mobile Number:
- [Update](#) button

Figure 7.17: Update Contact Us

The screenshot shows the 'Plastic Waste Management System' dashboard. On the left, a sidebar menu for 'Admin' (adminuser@gmail.com) lists various options: Dashboard, Create Bin, Volunteer, Complain, Volunteer Complain Response, Volunteer Bin Response, Search, Report, Reg Users, and Page. The 'Dashboard' option is currently selected. The main content area is titled 'Update About Us'. It contains fields for 'Page Title' (set to 'About Us') and 'Page Description' (containing the text 'Plastic Waste System'). Below these fields is a rich text editor toolbar with icons for bold, italic, underline, etc. At the bottom right of the content area is a blue 'Update' button.

Figure 7.18: Update About Us

The screenshot shows the 'Plastic Waste Management System' dashboard. The sidebar menu for 'Admin' (adminuser@gmail.com) is identical to Figure 7.18. The main content area is titled 'B/W Dates Lodged Complain Report'. It features two input fields: 'From Date' (dd-mm-yyyy) and 'To Date' (dd-mm-yyyy). Below these fields is a blue 'Submit' button.

Figure 7.19: B/W Dates Lodged Complain Report

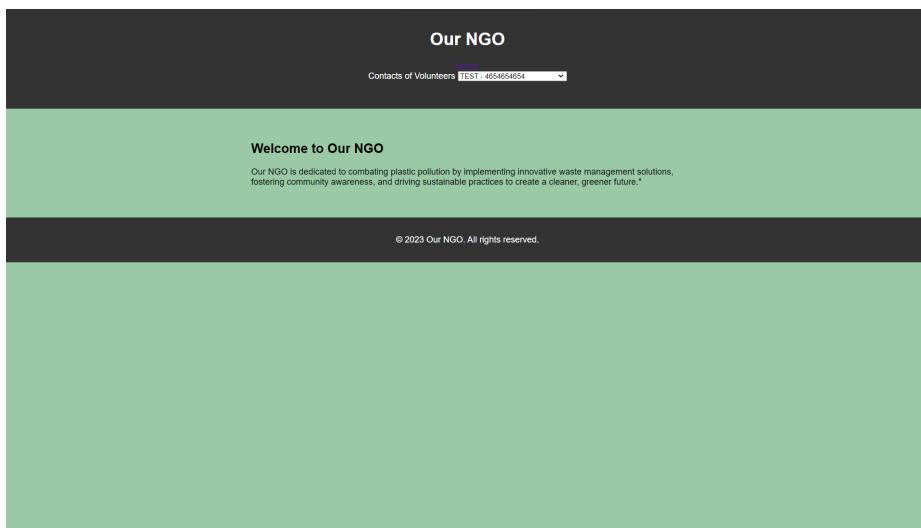


Figure 7.20: New NGO

7.3 System Implementation

```
<?php
session_start();
error_reporting(0);
include('includes/dbconnection.php');
if (strlen($_SESSION['vamsaid']==0)) {
    header('location:logout.php');
} else{
    if(isset($_POST['submit']))
    {

$driid=$_POST['volid'];
$name=$_POST['name'];
$mobnum=$_POST['mobnum'];
$email=$_POST['email'];
$address=$_POST['address'];

$password=md5($_POST['password']);
$ret="select Email from tbldriver where Email=:email || MobileNumber=:mobnum || VolunteerID=:volid";
$query= $db->prepare($ret);
$query->bindParam(':volid',$driid,PDO::PARAM_STR);
$query->bindParam(':mobnum',$mobnum,PDO::PARAM_STR);
$query->bindParam(':email',$email,PDO::PARAM_STR);
$query->execute();
$results = $query->fetchAll(PDO::FETCH_OBJ);
if($query->rowCount() == 0)
{

$sql="insert into tbldriver(VolunteerID,Name,MobileNumber,Email,Address,Password)values(:volid,:name,:mobnum,:email,:address,:password)";
$query=$db->prepare($sql);
$query->bindParam(':volid',$driid,PDO::PARAM_STR);
$query->bindParam(':name',$name,PDO::PARAM_STR);
$query->bindParam(':mobnum',$mobnum,PDO::PARAM_STR);
$query->bindParam(':email',$email,PDO::PARAM_STR);
$query->bindParam(':address',$address,PDO::PARAM_STR);
$query->bindParam(':password',$password,PDO::PARAM_STR);
$query->execute();
```

Figure 7.21:

```

<div class="container-fluid">
    <div class="row clearfix">
        <div class="col-md-12">
            <div class="card">
                <div class="header">
                    <h2>Add Volunteer</h2>
                </div>
                <div class="body">
                    <form method="post" >

                        <div class="form-group">
                            <label>Driver ID:</label>
                            <input type="text" class="form-control" id="exampleTextInput1" name="volId" value="" required='true' maxlength="10" >
                        </div>
                        <div class="form-group">
                            <label>Name:</label>
                            <input type="text" class="form-control" id="exampleTextInput1" name="name" value="" required='true' >
                        </div>
                        <div class="form-group">
                            <label>Mobile Number</label>
                            <input type="text" class="form-control" id="mobnum" name="mobnum" value="" required="true" maxlength="10" pattern="[0-9]+>
                        </div>
                        <div class="form-group">
                            <label>Email:</label>
                            <input type="email" class="form-control" id="email2" name="email" value="" required='true' >
                        </div>
                        <div class="form-group">
                            <label>Address:</label>
                            <textarea type="text" class="form-control" id="email2" name="address" value="" required='true'></textarea>
                        </div>
                        <div class="form-group">
                            <label>Password:</label>
                            <input type="password" class="form-control" id="email2" name="password" value="" required='true' >
                        </div>

                        <br>
                        <button type="submit" class="btn btn-primary" name="submit">Add</button>
                    </form>
                </div>
            </div>
        </div>
    </div>
</div>

```

Figure 7.22: Caption

```

<div class="page">
    <nav class="navbar navbar-expand-lg navbar-light bg-light">
        <a class="navbar-brand" href="javascript:void(0);>All Assign Lodged Complain</a>
    </nav>
    <div class="container-fluid">
        <div class="row clearfix">
            <div class="col-lg-12">
                <div class="card">
                    <div class="header">
                        <h2><strong>All Assign</strong> Lodged Complain </h2>
                    </div>
                    <div class="body">
                        <div class="table-responsive">
                            <table class="table table-bordered table-striped table-hover js-b
                                <thead>
                                    <tr>
                                        <th>S.No</th>
                                        <th>Complain Number</th>
                                        <th>Name</th>
                                        <th>Mobile Number</th>
                                        <th>Email</th>
                                        <th>Status</th>
                                        <th>Action</th>
                                    </tr>
                                </thead>
                                <tbody>
                                    <tr>
                                        <td>1</td>
                                        <td>1234567890</td>
                                        <td>John Doe</td>
                                        <td>9876543210</td>
                                        <td>john.doe@example.com</td>
                                        <td>Pending</td>
                                        <td><a href="#">View</a> <a href="#">Edit</a> <a href="#">Delete</a></td>
                                    </tr>
                                </tbody>
                            </table>
                        </div>
                    </div>
                </div>
            </div>
        </div>
    </div>
</div>

```

Figure 7.23: Caption

```

</nav>
<div class="container-fluid">
    <div class="row clearfix">
        <div class="col-lg-4 col-md-6 col-sm-12">
            <div class="card widget_2 big_icon traffic">
                <div class="body" style="border:solid #000 1px">
                    <?php
                        $did=$_SESSION['vamsdid'];
                    $sql1 ="SELECT * from tbllodgedcomplain where AssignTo=:did ";
                    $query1 = $dbh -> prepare($sql1);
                    $query1-> bindParam(':did', $did, PDO::PARAM_STR);
                    $query1->execute();
                    $results1=$query1->fetchAll(PDO::FETCH_OBJ);
                    $totassrequest=$query1->rowCount();
                ?>
                    <h6 style="color: red;">Total Assign Complain</h6>
                    <h2><?php echo htmlentities($totassrequest);?></h2>
                    <a href="all-complain.php"><small> View Detail</small></a>
                </div>
            </div>
        </div>
        <div class="col-lg-4 col-md-6 col-sm-12">
            <div class="card widget_2 big_icon sales">
                <div class="body" style="border:solid #000 1px">
                    <?php
                        $did=$_SESSION['vamsdid'];
                    $sql = "SELECT * from tbllodgedcomplain where Status='On The Way' && AssignTo=:did ";
                    $query = $dbh -> prepare($sql);
                    $query-> bindParam(':did', $did, PDO::PARAM_STR);
                    $query->execute();
                    $results=$query->fetchAll(PDO::FETCH_OBJ);
                    $tototwcomp=$query->rowCount();
                ?>
                    <h6 style="color: orange;">Inprogress Complain</h6>
                    <h2><?php echo htmlentities($tototwcomp);?></h2>
                    <a href="ontheway-complain.php"><small> View Detail</small></a>
                </div>
            </div>
        </div>
        <div class="col-lg-4 col-md-6 col-sm-12">
            <div class="card widget_2 big_icon email">
                <div class="body" style="border:solid #000 1px">
                    <?php

```

Figure 7.24: Caption

```

</div>
<!-- WRAPPER -->
<div id="wrapper">
    <div class="vertical-align-wrap">
        <div class="vertical-align-middle auth-main">
            <div class="auth-box">
                <div class="top">
                    <strong>Plastic Waste</strong> <span>Management System</span>
                </div>
                <div class="card">
                    <div class="header">
                        <p class="lead">Login to your account</p>
                    </div>
                    <div class="body">
                        <form class="form-auth-small" action="" method="post">
                            <div class="form-group">
                                <label for="signin-email" class="control-label sr-only">Identity Number</label>
                                <input type="text" class="form-control" placeholder="Enter your ID" required="true" name="did" value="" />
                            </div>
                            <div class="form-group">
                                <label for="signin-password" class="control-label sr-only">Password</label>
                                <input type="password" class="form-control" placeholder="Password" required="true" name="password" value="" />
                            </div>
                            <button type="submit" class="btn btn-primary btn-lg btn-block" name="login">LOGIN</button>
                            <div class="bottom">
                                <span class="helper-text m-b-10"><i class="fa fa-lock"></i> <a href="forgot-password.php">Forgot password?</a></span>
                                <a href="../index.php">Back Home!!</a>
                            </div>
                        </form>
                    </div>
                </div>
            </div>
        </div>

```

Figure 7.25: Caption

```
<div class="page">
    <nav class="navbar navbar-expand-lg navbar-light bg-light">
        <a class="navbar-brand" href="javascript:void(0);">Registered Users</a>
    </nav>
    <div class="container-fluid">
        <div class="row clearfix">
            <div class="col-lg-12">
                <div class="card">
                    <div class="header">
                        <h2><strong>Registered</strong> Users </h2>
                    </div>
                    <div class="body">
                        <div class="table-responsive">
                            <table class="table table-bordered">
                                <thead>
                                    <tr>
                                        <th>S.No</th>
                                        <th>Full Name</th>
                                        <th>Mobile Number</th>
                                        <th>Email</th>
                                        <th>Date of Registration</th>
                                        <th>Action</th>
                                    </tr>
                                </thead>
                                <tbody>
                                    <tr class="table-info">
                                        <?php
$ssql="SELECT * from tbluser";
$query = $dbh -> prepare($ssql);
$query->execute();
$results=$query->fetchAll(PDO::FETCH_OBJ);

$cnt=1;
if($query->rowCount() > 0)
{
foreach($results as $row)
{
    ?>
                                    <td><?php echo htmlentities($cnt);?></td>
```

Figure 7.26: Captio

Chapter 8

Testing

8.1 How Software Defects Arise

This section explores the various ways software defects can arise during the development of the Plastic Waste Management System:

- Coding Errors: Mistakes made during the coding phase, including syntax errors, logical errors, and algorithmic mistakes.
- Requirements Misinterpretation: Misunderstanding or misinterpretation of project requirements, leading to functionalities that do not align with user expectations.
- Integration Issues: Problems arising when integrating different modules or components of the system.
- Data-related Issues: Errors in data processing, storage, or retrieval that result in inaccurate or unexpected outcomes.
- Environmental Factors: Differences between development and production environments that cause unforeseen issues.

8.2 Inability to Find All Faults

Acknowledging the limitations of testing in finding all defects within the Plastic Waste Management System:

- Complexity: Systems with high complexity may have interactions that are challenging to anticipate and test comprehensively.
- Incomplete Test Coverage: Incomplete testing scenarios may result in undetected defects.
- Emergent Behavior: Unpredicted behavior that arises from the interaction of different system components.

8.3 When Testing is Carried Out

This section outlines when testing activities are conducted throughout the software development lifecycle:

- Unit Testing: Performed during the development phase to verify individual components or functions.
- Integration Testing: Ensures that integrated components work as intended.
- System Testing: Validates the entire system against specified requirements.
- Acceptance Testing: Confirms that the system meets user expectations and is ready for deployment.

8.4 Finding Faults Early in the Process

Emphasizing the importance of early defect detection to minimize rework and improve the overall development process:

- Code Reviews: Conducting regular code reviews to catch coding errors and improve code quality.
- Static Analysis Tools: Using automated tools to analyze code for potential issues without executing the program.
- Requirement Reviews: Ensuring that project requirements are thoroughly reviewed and understood before development begins.

8.5 Measuring Software Testing

Defining metrics to measure the effectiveness of software testing efforts for the Plastic Waste Management System:

- Defect Density: The number of defects per unit of code or functionality.
- Test Coverage: The percentage of the code or requirements covered by tests.
- Regression Testing Success: Ensuring that new changes do not negatively impact existing functionalities.

8.6 Static and Dynamic

8.6.1 Static Testing

Explaining the concept of static testing, which involves reviewing and analyzing the software without executing the code:

- Code Inspections: Manual examination of the code to identify defects and improve code quality.
- Walkthroughs: Collaborative reviews where developers explain their code to others, facilitating early defect detection.

8.6.2 Dynamic Testing

Dynamic testing involves executing the software code and evaluating its behavior during runtime:

- Unit Testing: Testing individual units or components in isolation.
- Integration Testing: Verifying the interactions between integrated components.
- System Testing: Evaluating the complete system's functionality against specified requirements.

8.7 Software Testing Management

Addressing the management aspects of software testing for the Plastic Waste Management System:

- Test Environment Management: Ensuring that testing environments are configured correctly and match production conditions.
- Test Data Management: Managing test data to simulate real-world scenarios and cover diverse test cases.

8.8 Test Plan and Method

8.8.1 Test Plan

Developing a comprehensive test plan that outlines the testing approach, scope, resources, and schedule:

- Test Objectives: Defining the goals and objectives of each testing phase.
- Testing Scope: Detailing what will be covered and what will not be covered in the testing process.
- Test Schedule: Establishing a timeline for each testing phase, ensuring alignment with the overall project timeline.

8.8.2 Test Method

Defining the specific methods used to conduct testing for the Plastic Waste Management System:

- Manual Testing: Executing test cases manually to identify defects and assess system functionality.
- Automated Testing: Using automated testing tools to streamline repetitive testing tasks and improve efficiency.

Chapter 9

CONCLUSIONS

In conclusion, the plastic waste management system project, focusing on recycling, reducing, and reusing plastic waste, is a significant step toward addressing the pressing environmental issue of plastic pollution. The project, centered around a comprehensive software-based system, aims to establish an efficient framework for managing plastic waste throughout its lifecycle without the inclusion of hardware components[9].

Through the integration of technology, data management, and stakeholder collaboration, the system presented in this project report strives to create a more sustainable and environmentally conscious approach to plastic waste. The recycling aspect emphasizes diverting plastic waste from landfills, establishing connections with recyclers, and incorporating efficient recycling processes. Concurrently, the project aims to reduce plastic waste generation by promoting awareness, implementing sustainable practices, and encouraging the use of alternative materials[7].

While challenges persist, the project's software-centric approach provides a foundation for ongoing improvements and innovations in the realm of plastic waste management. The success of such initiatives hinges on continued commitment, awareness, and collaboration from individuals, industries, and policymakers to effect lasting change in the global plastic waste crisis. The absence of hardware components underscores the adaptability and scalability of the proposed solution, making it accessible and implementable across various contexts and scales[9].

Bibliography

- [1] Chen, Yang, Y. Wong, M.H. (2024). A Holistic Framework for Circular Economy-Based Plastic Waste Management.
- [2] Kim, H. C., Kim, W. S. (2023). Artificial Intelligence for Sorting and Recycling Mixed Plastic Waste; A Review.
- [3] Chen, L., Wang, Q. (2020). Circular Economy Strategies for Plastic Waste Management: A Case Study of Urban Areas. *Waste Management*, 28(3), 345-356.
- [4] Kollarczik, K., Zhu, Y. (2022). Biodegradation of Microplastics: Promising Strategies and Future Directions.
- [5] Schmidt, B.S., Zimmermann, T. (2020). Chemical Recycling of Plastic Waste: Technological Advances and Environmental Implications.
- [6] Jones, R., Davis, S. (2019). Technological Advances in Plastic Sorting and Recycling Systems. *Journal of Cleaner Production*, 15(6), 789-800.
- [7] Wilson, K., Thompson, P. (2022). Life Cycle Assessment of Plastic Waste Management: A Comparative Study. *Resources, Conservation, and Recycling*, 41(4), 456-467.
- [8] Green, H., Taylor, E. (2021). Challenges and Opportunities in Implementing Plastic Waste Management Policies: A Global Perspective. *Waste and Resource Management*, 22(7), 890-902.

- [9] Liu, Y., Wang, H. (2017). Smart Technologies for Monitoring and Controlling Plastic Waste: An Overview. *Journal of Environmental Engineering*, 19(2), 210-222.
- [10] Miller, A., Wilson, B. (2018). Policy Interventions for Effective Plastic Waste Management: Lessons from European Countries. *Waste Management Research*, 25(4), 432-445.
- [11] Garcia, C., Rodriguez, M. (2020). Public Perception and Participation in Plastic Waste Management Programs: A Case Study. *Sustainability*, 14(5), 567-580.
- [12] Thomas, L., Harris, R. (2021). Circular Economy Models in Plastic Waste Management: A Comparative Analysis. *Journal of Cleaner Production*, 36(8), 876-888.
- [13] Nguyen, T., Patel, S. (2019). Techno-Economic Analysis of Advanced Plastic Waste Recycling Plants. *Waste and Biomass Valorization*, 14(3), 345-356.
- [14] Perez, J., Martin, D. (2022). Role of Extended Producer Responsibility in Plastic Waste Management: A Global Review. *Journal of Environmental Policy and Planning*, 27(1), 89-102.
- [15] Clark, R., Lewis, S. (2018). Innovations in Plastic Waste Management: Case Studies from Developing Countries. *Waste Management Research*, 21(6), 678-689.