HOUSEHOLD WASTE MANAGEMENT SYSTEM

A PROJECT REPORT

Submitted by

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in partial fulfillment of requirements for the award of the course

AGB1211 – DESIGN THINKING

in

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

SAMAYAPURAM – 621 112

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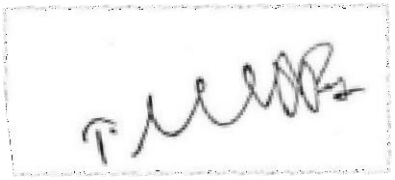
K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY (AUTONOMOUS)

SAMAYAPURAM – 621 112

BONAFIDE CERTIFICATE

Certified that this project report on **"HOUSEHOLD WASTE MANAGEMENT SYSTEM"** is the bonafide work of **S.R.SUDHARSON(2303811714821049), S.THAWFILLFATHEEN(2303811714821051),V.THIRUMURUGAN(23038117 14821052), S.VASANTH(2303811714821053)** who carried out the project work during the academic year 2024 - 2025 under my supervision.



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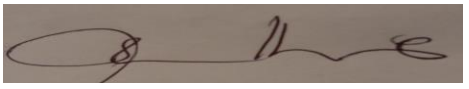

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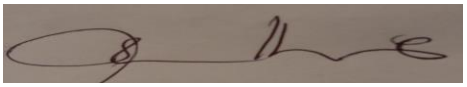
Submitted for the viva-voce examination held on 5.12.24



INTERNAL EXAMINER

EXTERNAL EXAMINER

DECLARATION

I declare that the project report on "**HOUSEHOLD WASTE MANAGEMENT SYSTEM"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to "**ANNA UNIVERSITY CHENNAI**" for the requirement of Degree of **BACHELOR OF ENGINEERING**. This project report is submitted on the partial fulfillment of the requirement of the award of the **AGB1211 – DESIGN THINKING.**

Signature

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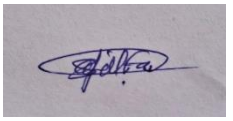

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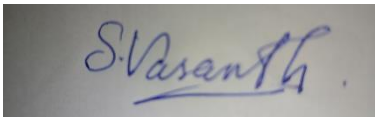

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Place: Samayapuram

Date: 5/12/2024

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VISION OF THE INSTITUTION

To serve the society by offering top-notch technical education on par with global standards.

MISSION OF THE INSTITUTION

- Be a center of excellence for technical education in emerging technologies by exceeding the needs of industry and society.
- Be an institute with world class research facilities.
- Be an institute nurturing talent and enhancing competency of students to transform them as all- round personalities respecting moral and ethical values.

VISION AND MISSION OF THE DEPARTMENT

To become a renowned hub for AIML technologies to producing highly talented globally recognizable technocrats to meet industrial needs and societal expectation.

Mission 1: To impart advanced education in AI and Machine Learning, built upon a foundation in Computer Science and Engineering.

Mission 2: To foster experiential learning equips students with engineering skills to tackle real-world problems.

Mission 3: To promote collaborative innovation in AI, machine learning, and related research and development with industries.

Mission 4: To provide an enjoyable environment for pursuing excellence while upholding strong personal and professional values and ethics.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1: Excel in technical abilities to build intelligent systems in the fields of AI & ML in order to find new opportunities.

PEO 2: Embrace new technology to solve real-world problems, whether alone or as a team, while prioritizing ethics and societal benefits.

PEO 3: Accept lifelong learning to expand future opportunities in research and product development.

PROGRAM OUTCOMES

Engineering students will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Expertise in tailoring ML algorithms and models to excel in designated applications and fields.

PSO 2: Ability to conduct research, contributing to machine learning advancements and innovations that tackle emerging societal challenges.

ABSTRACT

Effective waste management is a pressing challenge for households worldwide, directly impacting environmental sustainability and public health. The House Hold Waste Management system aims to address this issue by providing an efficient and user-friendly platform to manage household waste systematically. The system integrates waste collection, categorization, and disposal mechanisms, leveraging modern technologies such as IoT, AI, and cloud computing to enhance waste handling processes. Key features include automated waste segregation into biodegradable, recyclable, and non- recyclable categories, user-friendly interfaces for waste monitoring, and real-time alerts for waste collection schedules. Additionally, the system promotes community engagement by providing incentives for proper waste disposal practices and recycling. During the development, the project focused on creating a scalable and cost-effective solution that can be adopted by diverse households. Initial results indicate significant improvements in waste segregation accuracy and reductions in landfill contributions. The system's potential to integrate with municipal waste management services further underscores its utility in building sustainable communities. This project demonstrates how innovative technologies can transform waste management, encouraging responsible behavior and contributing to environmental conservation.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Household waste management is a critical component of environmental sustainability and urban living. The improper handling of household waste can lead to severe consequences, including pollution, public health hazards, and the depletion of natural resources. With the increase in population and urbanization, the volume of waste generated by households has risen significantly, necessitating the adoption of efficient and systematic waste management practices. The Household Waste Management System is designed to streamline waste collection, sorting, and disposal processes. By leveraging technology, the system aims to minimize manual intervention, encourage waste recycling, and reduce the environmental impact of improper waste management.

1.2 PROBLEM STATEMENT

The traditional methods of waste management often involve manual segregation, irregular waste collection schedules, and a lack of awareness about proper disposal practices. These inefficiencies result in several challenges, such as:

- Overloaded landfills and improper disposal of recyclable materials.
- Increased greenhouse gas emissions due to unsegregated waste decomposition.
- Health risks arising from the accumulation of waste in residential areas.
- Limited community participation in recycling and waste reduction initiatives.

1.3 OBJECTIVE

- To develop an automated system for the segregation of household waste into biodegradable, recyclable, and non-recyclable categories.

- To enhance the efficiency of waste collection by integrating real-time alerts and schedules.
- To promote recycling by providing users with incentives and educational resources on sustainable practices.
- To reduce the environmental impact of household waste through systematic disposal methods.
- To integrate the system with municipal waste management services, fostering a collaborative approach to waste handling.

CHAPTER 2

PROJECT METHODOLOGY

2.1 BLOCK DIAGRAM

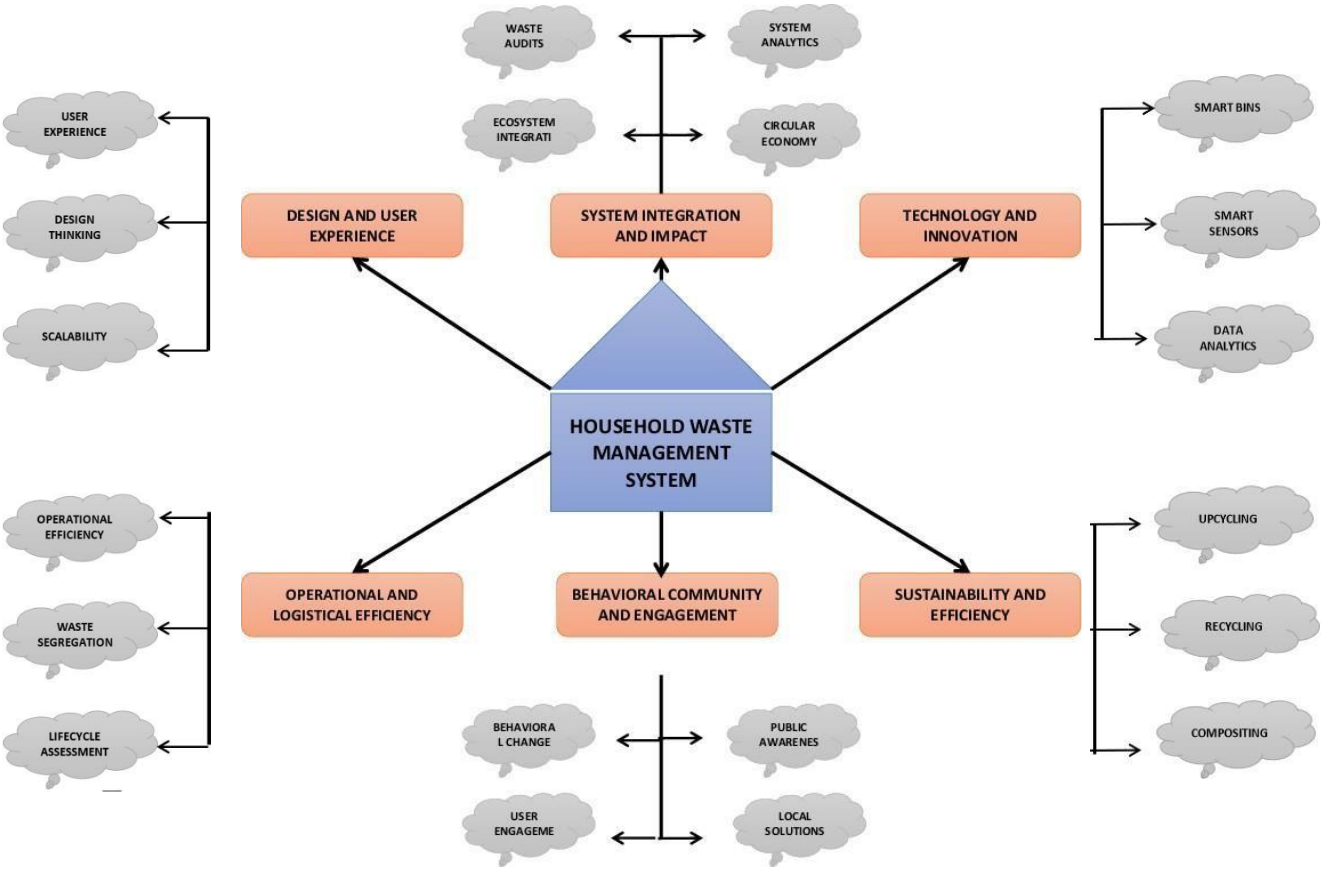

FIGURE NO.2.1 Household Waste Management

The diagram illustrates a holistic Household Waste Management System based on six key components. It focuses on Design and User Experience for accessibility, Operational Efficiency through waste segregation and lifecycle assessments, and Community Engagement via public awareness and behavioral change. Sustainability is achieved through upcycling, recycling, and composting, while Technology leverages smart bins, sensors, and data analytics. Finally, System Integration ensures ecosystem alignment and circular economy practices, fostering an efficient, sustainable, and community-driven waste management approach.

CHAPTER 3
KEY PHASES OF DESIGN THINKING

3.1 Empathize

The first phase of Design Thinking, Empathize, involves gaining a deep understanding of the users and their challenges. For the Household Waste Management System, this was achieved by conducting surveys, interviews, and observations with households and municipal workers. The aim was to identify pain points in current waste management practices, such as the lack of proper segregation, irregular collection schedules, and insufficient awareness about recycling. This phase highlighted the need for a solution that simplifies waste handling while encouraging user participation. The insights gathered during this phase formed the foundation for designing a user-centric system.

3.2 Define

In the Define phase, the insights from the empathize stage are synthesized to create a clear and actionable problem statement. The goal was to articulate the challenges faced by users in a way that directs the design process. For this project, the problem statement was defined as: "How might we create a system that simplifies waste segregation and disposal, promotes sustainable practices, and integrates effectively with municipal services?" This phase ensured that the project was focused on solving real user problems and set the stage for developing innovative solutions.

3.3 Ideate

The Ideate phase involves brainstorming and generating creative solutions to address the defined problem. For the Household Waste Management System, various ideas were explored, including IoT-enabled smart bins for automatic segregation, a mobile app for tracking waste collection schedules, and a rewards system to incentivize proper disposal practices. The team prioritized solutions based on feasibility, scalability, and user-friendliness. This phase encouraged thinking beyond

conventional approaches, fostering innovation to develop a comprehensive waste management system.

3.4 Prototype

The Prototype phase focuses on creating tangible representations of the ideas generated during the ideate phase. In this project, prototypes included a smart bin equipped with sensors for waste segregation, a basic mobile application for notifications and tracking, and a rewards system integrated into the app. These prototypes were developed as cost-effective and scalable models to test the practicality of the solutions. This phase allowed the team to experiment, refine ideas, and prepare for real-world implementation.

3.5 Test

The final phase, Test, involves evaluating the prototypes with real users to gather feedback and refine the solutions. For the Household Waste Management System, smart bins were deployed in a small community for trials, and the mobile application was tested for usability and functionality. Feedback highlighted the effectiveness of automated waste segregation and the user-friendly interface of the app. The rewards system proved successful in encouraging recycling, with increased participation rates. Based on these insights, adjustments were made to enhance the system’s efficiency and user satisfaction. This iterative process ensured that the final product met the users' needs effectively.

CHAPTER 4

MODULE DESCRIPTION

4.1 User Interface Module

The User Interface (UI) module serves as the primary interaction point for the users of the Household Waste Management System. It provides a seamless and intuitive experience, enabling users to register, log in, and access their waste management dashboard. The dashboard allows users to track their waste generation, receive notifications for collection schedules, and access educational resources on waste segregation and recycling. Designed with simplicity and usability in mind, this module ensures that users of all technical skill levels can engage with the system effectively. It plays a crucial role in fostering user participation and adherence to sustainable waste management practices.

4.2 Waste Collection Module

The Waste Collection module is responsible for streamlining the collection process, ensuring efficiency and reliability. This module integrates with IoT-enabled smart bins that monitor waste levels and alert users and municipal authorities when bins are nearing capacity. For areas without smart bins, manual tracking systems are supported. Additionally, the module includes GPS-based route optimization for waste collection vehicles, reducing fuel consumption and ensuring timely pickups. By addressing inefficiencies in traditional waste collection methods, this module enhances service reliability and environmental sustainability.

4.3 Waste Segregation Module

At the core of the system lies the Waste Segregation module, which automates the sorting of household waste into biodegradable, recyclable, and non-recyclable categories. Utilizing advanced sensors, such as proximity, weight, and material detection technologies, coupled with AI algorithms, this module achieves high levels of accuracy in segregation. The automated process significantly reduces the manual

labor involved in sorting and ensures that recyclable materials are not wasted. This module is pivotal in minimizing the environmental impact of waste by enabling efficient disposal and recycling practices.

4.4 Notification and Reward Module

The Notification and Reward module is designed to engage and incentivize users to adopt sustainable waste management practices. It provides real-time alerts and reminders for waste collection schedules, ensuring users never miss a pickup. The module also includes a reward system, where users earn points for proper segregation and recycling efforts, which can be redeemed for discounts or vouchers. This gamified approach encourages active participation and fosters a sense of responsibility among users, driving long-term behavioral change toward waste reduction and recycling

4.5 Monitoring and Reporting Module

The Monitoring and Reporting module collects, analyzes, and shares data on waste generation, segregation, and disposal. This module generates comprehensive reports for individual users, communities, and municipal authorities, offering insights into waste trends and system performance. By leveraging cloud-based analytics, it identifies areas for improvement and helps optimize operations. Municipalities can use this data to plan better waste management strategies, while users can track their contribution to sustainability efforts. This module ensures transparency and accountability, promoting a collaborative approach to waste management.

CHAPTER 5
CONCLUSION

The Household Waste Management System is a practical and innovative solution aimed at addressing the growing challenges of waste management in households. By leveraging advanced technologies such as IoT, AI, and cloud computing, the system enhances the efficiency of waste segregation, collection, and disposal processes. Its user- friendly design promotes community participation and sustainable practices, while its integration with municipal services ensures scalability and broader impact.

The project successfully demonstrates the potential to reduce landfill dependency, encourage recycling, and mitigate environmental harm. Initial testing has shown promising results, with improved waste segregation accuracy and increased user engagement through incentive mechanisms.

Moving forward, the system has the potential for further enhancements, such as advanced machine learning algorithms for segregation, expanded functionality for community-level applications, and the integration of renewable energy-powered waste processing units. With its modular design and focus on user needs, the Household Waste Management System contributes to a cleaner, healthier, and more sustainable future.

Let me know if you'd like to refine this conclusion or add specific results or future work details!

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APPENDIX A – SCREENSHOTS