ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

RAWLINK-SMART RECYCLEABLE WASTE AND E-WASTE MARKETPLACE

[1]Faruq MD Omar, [2]Abdul Rahman Bin Ahmad Dahlan (Ts.)

[1]Department of Information System, International Islamic University of Malaysia

[2]Department of Information System, International Islamic University Malaysia

DOI: https://doi.org/10.5281/zenodo.20855084

Published Date: 26-June-2026

Abstract: **RawLink is a smart, multi-sided digital marketplace where anyone can sell and buy waste. Informal waste collectors and small vendors, particularly from B40/B70 communities, face unfair pricing, lack of market access, and unsafe working conditions, while industries struggle to source reliable and affordable recycled raw materials. RawLink bridges this gap digitally by connecting people. RawLink ensures both technical feasibility and social impact. The project strongly 'aligns with the United Nations Sustainable Development Goals (SDGs), RawLink demonstrates how digital platforms can transform waste into economic value while promoting environmental sustainability and inclusive growth.**

Keywords: **RawLink, Smart digital marketplace, Waste Management, Multi-sided platform, SDLC, Design Thinking (DT), B40/B70 Communities, SDGs**.

I. INTRODUCTION

A. Problem Description

1. *Background of the Problem*

People and the environment are suffering in the urban areas where there is no such good and smart waste management system. It is one of the most pressing challenges in South and Southeast Asia. RawLink seeks to bridge this gap by introducing a smart digital system, multi-country waste and E-waste management platform where anyone can sell their waste.

2. *Problem Statement*

There is no such system for selling waste where anyone can sell the waste in urban areas including Malaysia. It indicates the absence of a single digital marketplace which may connect ***people***, small vendors, recycled companies who produced raw materials from garbage and e-waste collectors**.**

B. Project Objectives

RawLink is designed to remove the absence of a digital marketplace of waste selling and buying. The objective below defines what's the system wants to achieve from the people.

The main objectives of RawLink are:

- Develop an integrated, reliable and simple user-friendly website for the users to sell their waste to the buyers**.**
- Encourage low-income areas by offering chances for entrepreneurship.
- Focused on SDGs pertaining to responsible production, poverty alleviation and climate action.
- Reduce environmental pollution and improper waste management to advance sustainability and the circular economy.

- Create a regional cross-regional digital network that links buyers or enterprises.
- Provide investors and policymakers with analytical information on recycling trends, trash types and carbon effects.

C. Project Scope

1. Scope

Table 1: Project Scopes

Module	Description
Trading	Users will be buying and selling waste through the system.
Vendors	Vendors can list recyclable waste and e-waste with detailed pricing.
Tracking Order	Vendors will be able to track their orders, payment, shipping.
Earning Report	After buyer purchase seller can see the item sold in the sales for the earnings.
Admin View	Admin will be able to manage users accounts and monitor system activity.

2. Target Audience

Table 2: Target Audience

Users	Description
Vendors	Anyone can sell waste.
Buyers	Anyone can buy waste.
Administrators	System admin (Policies & regulations followed by policy holders.

3. Specific Platform

Table 3: Platform Specifications

Platform	**Descriptions**
Web based Application	Web based platform.
React	Frontend Interface.
Tailwind CSS	For designing system.
JavaScript	System interactivity.
Fast API(Python)	Backend development.
PostgreSQL	Backend service DBMS.
Vercel	Frontend hosting.
Render	Backend hosting.

D. Constraint

Six constraints may affect the system development of the system. Firstly, Time constraints, due to lack of hours it might not be able to go according to plan. Secondly, Scope constraints due to time and resources limitations may not fulfill all scopes. Thirdly, Cost constraints, due to lack of funding, may not reach some of realistic features. Next risk constraints, there are potential risks of data accuracy. Quality constraints, quality may affect based on the resources. Resource constraints, access to regional waste and e-waste data is limited.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

II. LITERATURE REVIEW

A. System Review

Existing System

There are several of companies throughout the world for waste management systems, but we have compared ours only on south and southeast Asia's existing waste management systems. But none of these meets with our business model or main purpose which is waste trading.

A. Geocycle Bangladesh

Geocycle Bangladesh specializes in co-processing waste within the cement manufacturing industry by converting waste into alternative fuels and raw materials. The company demonstrates strong industrial collaboration and contributes positively to environmental sustainability.

B. Kabadiwala Connect - India

Kabadiwala Connect utilizes digital technology to map waste collectors and recycling flows, improving traceability and efficiency within India's waste supply chain. While the platform successfully demonstrates the potential of digitalization in waste management, its scope remains country-specific and does not fully integrate e-waste handling or industrial buyer marketplaces.

C. Waste4Change- Indonesia

Waste4Change focuses on community-based recycling and socially inclusive waste collection services, creating positive social and environmental impacts. Despite its strong community engagement, the platform operates primarily within Indonesia and lacks cross-border scalability and a fully integrated digital marketplace model.

B. Advantages of Existing System

Geocycle Bangladesh demonstrates strong industrial collaboration by integrating waste co-processing into cement manufacturing, reducing landfill dependency and fossil fuel usage. Kabadiwala Connect successfully digitizes waste collection networks by mapping waste collectors and recycling flows, improving traceability, efficiency, and transparency. Waste4Change emphasizes community-based recycling and social inclusion, creating employment opportunities and improving recycling awareness.

Table 4: Advantage of existing system

Platforms / Criteria	Geocycle	Kabadiwala	Waste4Chnage
Primary Focus	Cement Manufacturing.	Digital mapping and traceability of waste.	Community based waste collection.
Waste Types	Non-hazard industrial waste.	Dry recyclables (Plastics, paper, metals).	Household and commercial waste.
Target Users	Large industries and cement plants.	Waste collectors and recyclers.	Community and recycling partners.
Geographical Coverage	Bangladesh only.	India only.	Indonesia only.
Sustainability Impact	Environmental focused.	Economic inclusion.	Social impact focused.

C. Disadvantages of Existing System

Geocycle platform focuses primarily on non-hazardous industrial waste and does not cover e-waste management. Kabadiwala Connect platform is limited to operations within India and lacks cross-border scalability. Waste4change system operates mainly within Indonesia and remains geographically localized.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

Table 5: disadvantage of existing system

Platforms / Criteria	Geocycle	Kabadiwala	Waste4Chnage
E-waste	No e-waste management	Limited handling	Limited initiatives
Digital Marketplace	No marketplace	Partial digital platforms	Service based model
Support for informal vendors	No	Yes	Yes
Cross border capability	No	No	No

D. System adaptation

Based on the review of existing digital marketplace and waste management platforms, I aim to incorporate the most effective features into the RawLink system. At the same time, I have recognized certain limitations in current systems, such as no trading (buying & selling) of waste, lack of transparency, inefficient waste handling processes, and limited accessibility. Affordability and accessibility, efficient waste trading platforms unlike traditional marketplaces, real time order and payment management, user friendly, transparent, and trustworthy also the system is designed to be scalable, allowing future integration of advanced features.

III. METHODOLOGY

RawLink will be developed using an iterative approach that combines prototyping with Agile/XP principles. This is suitable because the system has multiple modules that need quick development, continuous testing, and regular improvement based on feedback. A questionnaire was also conducted to understand user preferences and challenges, which supports the need for a smart digital marketplace platform.

A. Development Approach

1. Extreme Programming (XP)

In the development of RawLink, XP supports iterative implementation of core features such as "user management, product listing, order processing, and payment handling". Each iteration involves planning, coding, testing, and evaluation, ensuring that defects are identified early and system quality is continuously improved. Regular feedback from stakeholders helps refine system functionalities and ensures that the platform meets user expectations effectively.

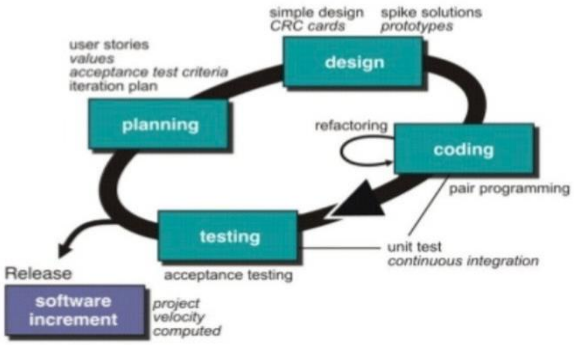

Fig 1: Prototyping Methodology

Key XP practices applied include iterative planning, modular design, continuous integration using version control, regular refactoring, and frequent testing during development.

2. Survey Questionnaire

To clearly identify the 'functional and non-functional' requirements of the RawLink system, an initial requirement analysis was conducted by reviewing existing online marketplace platforms and analyzing user expectations from both buyers and sellers. The requirement specification focuses on the core needs of RawLink's primary stakeholders, buyers, and sellers. Based on this analysis, RawLink is designed to provide a user-friendly interface, secure authentication, reliable database management, and scalable backend services. These requirements ensure that the system supports efficient transactions, maintains data accuracy, and delivers a consistent and trustworthy online marketplace experience.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

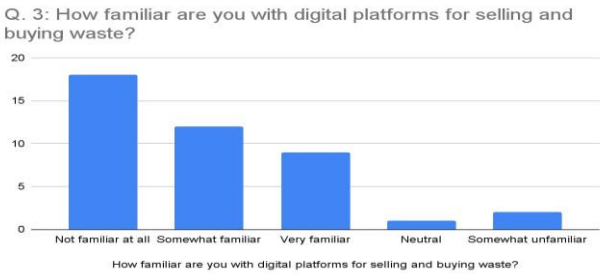

Fig 2: Survey Section 1

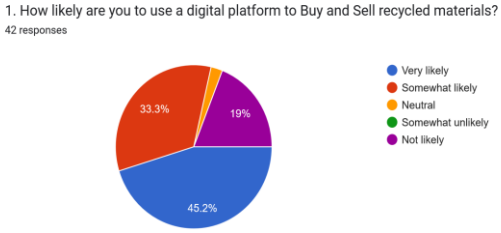

Fig 3: Survey Section 2

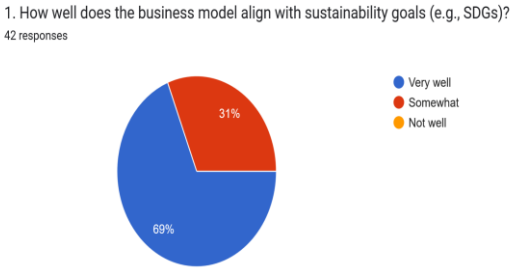

Fig 4: Survey Section 3

B. Requirement Specification

1. Functional Requirements

Table 6: Functional requirements

Req. ID	Statement
FR_AUTH_01	The system shall allow users to register an account.
FR_AUTH_02	The system shall allow users to log in and log out securely.
FR-ROLE-03	The system shall support role-based access for buyer and seller
FR-SELL-04	The system allows sellers to list, update, and sell products.
FR-BUY-05	The system allows buyers to browse, view, and buy products.
FR-PAYMENT-05	The system allows buyers to make payment through the system.
FR_SLS_06	The system allows sellers to view product sales.
FR_ODR_06	The system allows users to view product orders.
FR_PRF_07	The system allows users to update profiles.
FR_CRDT_08	The system allows users add credit into their acc.
FR_CHAT_09	The system allows users to make contacts within the system.
FR_ADMIN_10	The system allows admin to control and monitor system.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

2. Non-Functional Requirements

Table 7: Quality requirements

Req. ID	Statement
NFR_USR_01	The system should be simple, clear, and easy to navigate for all roles.
NFR_ACT_02	The system should respond quickly for common actions (login, loading dashboard, trading & listing).
NFR_DB_03	The system should store users records reliably and prevent data loss during normal use.
NFR_STR_04	The system should protect user accounts and data using secure authentication and authorization.
NFR_RSP_04	The system should work on common web browsers and support different screen sizes.
NFR_MTN_04	The system should be maintainable with modular code to support future updates and scalability.

C. Logical Design

The logical design of RawLink describes how the system works before full implementation. It identifies the main users (Buyer and Seller), key processes such as products, listing, orders, sales, feedback, and progress updates, and how these processes interact through the frontend, backend, and database. This design helps keep the system structured, reduces development errors, and ensures all features match the project requirements.

1. System Analysis and Design Diagram

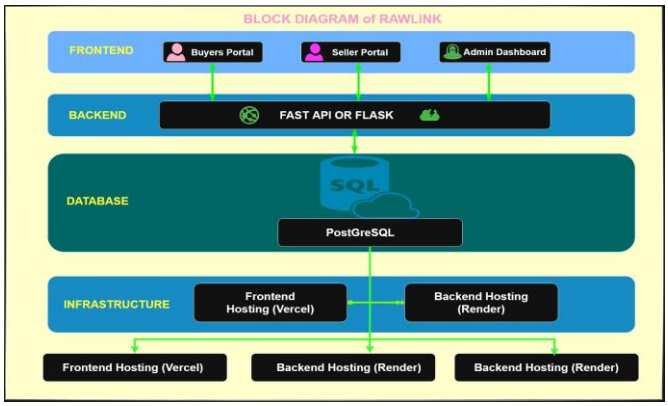

Fig 5: System Architecture

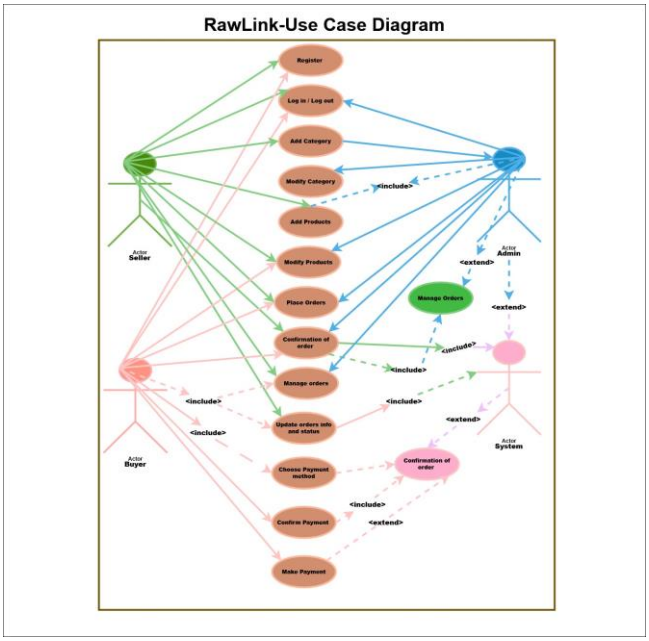

Fig 6: Use Case Diagram

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

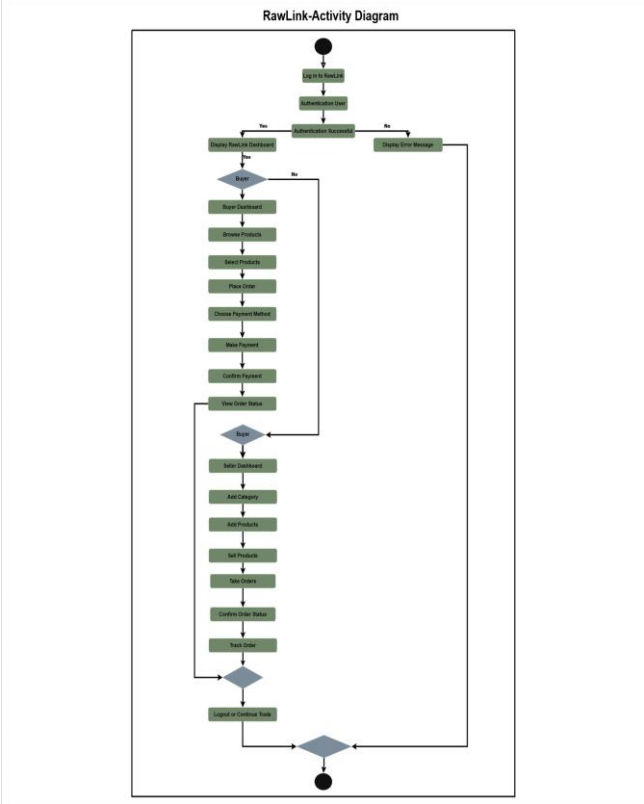

Fig 7: Activity Diagram

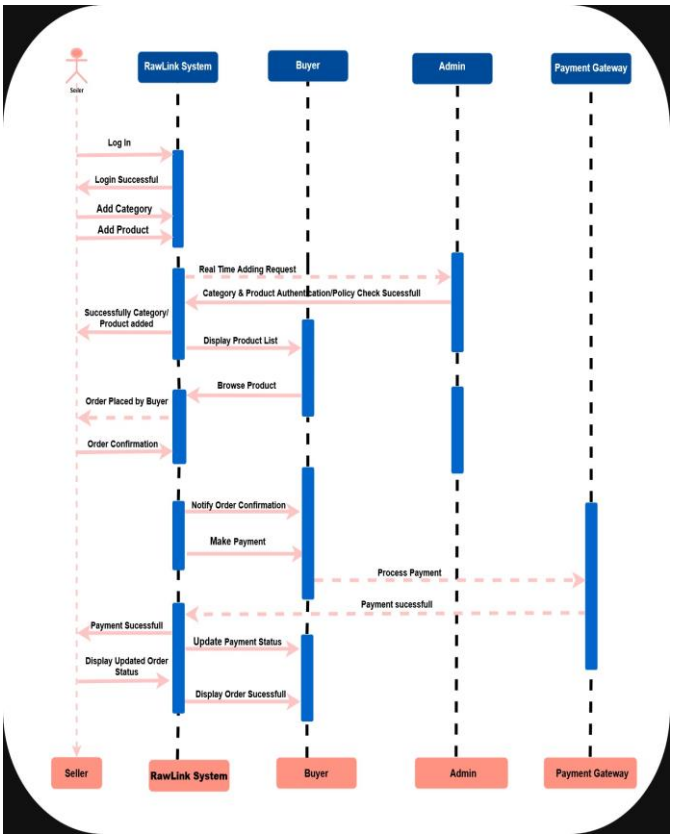

Fig 8: Sequence Diagram (Seller, Buyer, Admin and Payment process)

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

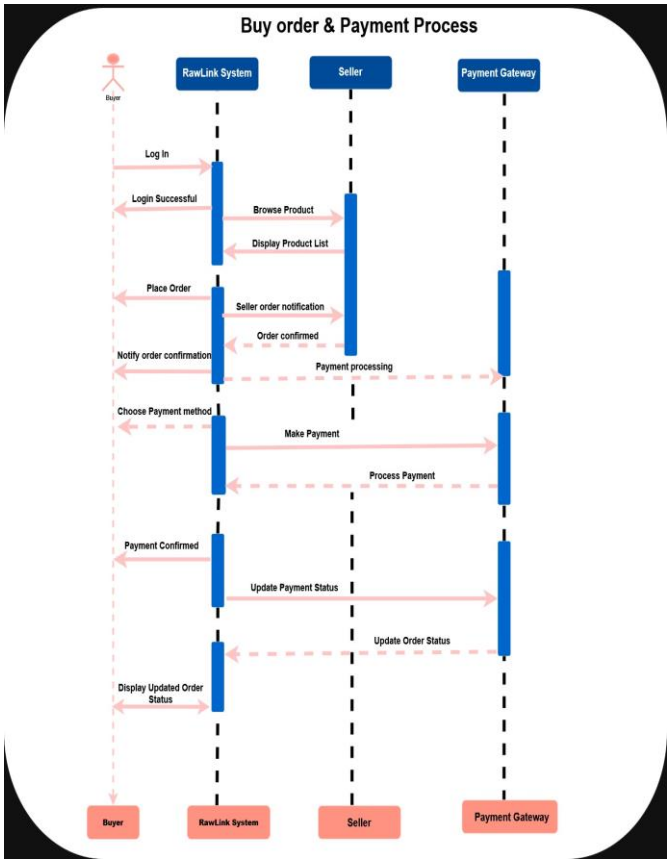

Fig 9: Sequence Diagram (Buyer, order and Payment process)

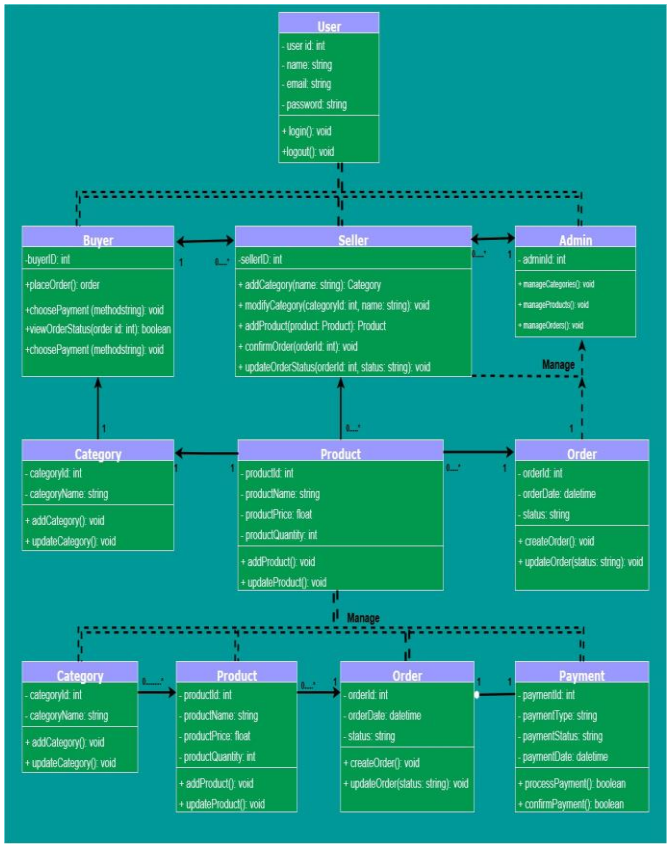

Fig 10: Class Diagram

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

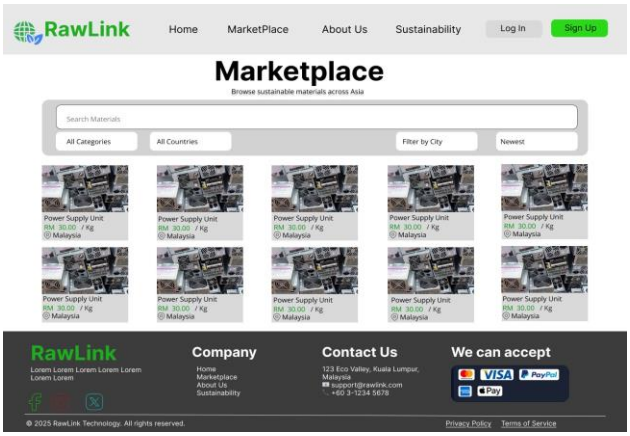

Fig 11: Prototype Sample

D. Design Language Implementation

The system architecture of RawLink follows a modular, three-tier structure consisting of a 'web-based frontend', a Python-based backend and a PostgreSQL database. The frontend handles user interactions while the backend manages business logic, authentication, and API communication. Data is securely 'stored and retrieved from the database, and external services such as payment gateways are integrated to support transaction processing'. This architecture ensures scalability, security and efficient system performance.

IV. RESULTS

This chapter presents the actual project development, implementation, and evaluation results for the RawLink smart recyclable waste and e-waste marketplace platform. Following the Agile-based Extreme Programming (XP) methodology selected during the design phase, the conceptual designs, logical wireframes, use cases, and database architectures have been fully translated into functional, deployable programming modules. This section covers how the frontend user interfaces and the backend computational workflows were integrated, documents the core system outputs generated for both administrative and user roles, and presents the comprehensive testing strategies utilized to evaluate operational integrity, performance stability, and data security standards.

A. System Integration

RawLink was developed as a web-based system with two main parts. The first part is the frontend. The second part is the backend. These two parts communicate through REST API requests.

1. Frontend Integration (React, Tailwind CSS & Next.js)

The frontend user interface was developed using React, Tailwind CSS and Next.js. React was used to build the pages as components. Tailwind was used for layout and styling. It keeps the design consistent. It also supports responsive display. JavaScript has used Client-side logic and interactivity within the system. For the hosting it has used Vercel which has provided free hosting to deploy the frontend application.

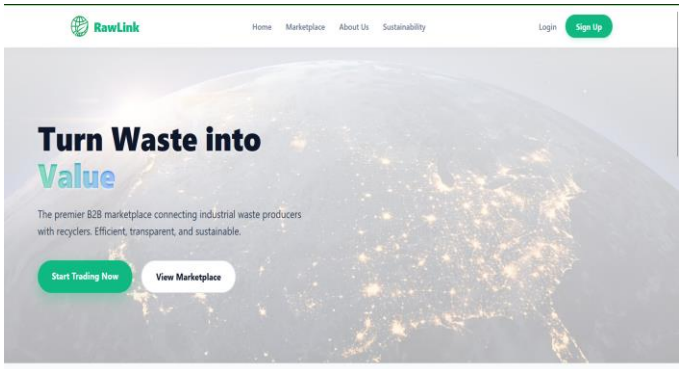

Fig 12: RawLink frontend mainpage

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 14, Issue 2, pp: (265-276), Month: April – June 2026, Available at: www.researchpublish.com

2. Backend Integration (Python)

The backend was developed using Python. It handles the main business logic of the system. It provides API endpoints for login, user role checking, products listing and trading, managing profiles, wallet, transaction and other updates. The backend validates each request before returning data. For backend hosting it has used by render which used to host FAST API(Python) to deploy the backend.

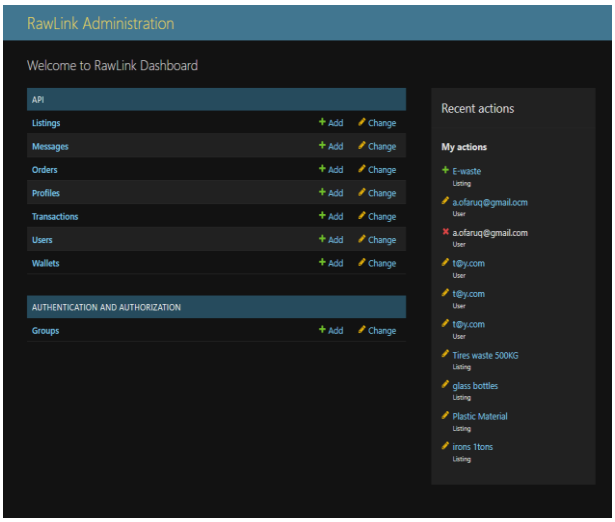

Fig 13: RawLink Backend mainpage

3. Database Integration (PostgreSQL)

The system stores data in PostgreSQL. It has used as a relational database management system to store structured data. It saves user products listing, orders, users messages, transactions, wallet history, and users profile. Seller can list products materials to be sold. The listed products are linked to the selected buyers or vendors. Admin features use the same stored data. This allows the admin to manage users' trading and the history in one place.

B. System Output

This section presents the main outputs of RawLink based on the implemented interface. The system output is shown through the key screens used by different roles. It includes the admin monitoring pages, public pages, and seller/ buyer dashboard. The following subsections describe the outputs for each part of the system.

1. Administrator

The admin interface focuses on control and monitoring. RawLink Admin dashboard shows listing, messages, orders, profile, wallet, and so on. Admins can manage users and their products from the below panel. A system status box is also shown. It indicates API status, database connection, and the upload directory. This helps the admin track whether the system is running normally.

2. User- Buyer

The buyer in the RawLink platform is individual or business that purchases reusable materials. Buyers can browse available listings, compare prices, and place orders securely through the system. The platform ensures transparency, making it easy for buyers to find suitable materials efficiently and at fair prices.

3. User- Seller

The seller is an individual, business, waste collectors that list recyclable waste materials for sale on RawLink. Sellers can upload product details, set prices, and manage orders through the platform. RawLink helps sellers reach a wider market, generate income from waste, and contribute to sustainable resource management.

C. System Testing

System testing was done after the core modules of RawLink were implemented. The aim was to confirm that the system works as expected. It also checks that the system is stable during normal use. Testing was carried out from the user point of view. This means the testers followed real tasks that a buyer, seller, or admin would do.

The testing covered the full flow of the system. It starts from the Home page and sign-in role selection. It continues with registration and login. After login, it checks if the correct dashboard is shown. It also verifies that each role only sees the modules allowed for them. For example, buyer should not see admin functions. Seller should not access admin management pages. This helps confirm role-based access control.

Functional testing was applied to the key modules. For buyers, the tests include viewing products, prices of materials, attempting transactions, and using the full system. For seller, the tests include uploading the products or materials and generating the prices. For admins, the tests include viewing system statistics and managing users and products. During testing, the expected results were compared with the actual results. Any mismatch was recorded. After that, fixes were applied and the test was repeated. This approach helps ensure RawLink meets the main project requirements and provides smooth experience for users.

1. Test Plan

The test plan uses task-based functional testing. Each tester followed a set of common tasks in RawLink. The tasks were based on the main modules shown in the interface. Testing involved different roles such as Buyer, Seller, and Admin. All the test case includes pre-conditions, dependencies, and step-by-step actions. The expected output and actual output were recorded. The test status was marked as Pass or Fail. This method helps verify that RawLink meets the key project requirements and works smoothly for users.

2. Testers

User-1: Tanvir Ahmad Forazi – Product Manager (Seller Testing)

Company: Moitry Infinity SDN BHD.

User-2: Md Ahsanul Mahbub Zobayer – (Buyer Testing)

User-3: Abdul Rahman – (Admin Testing)

Status: Web Developer

V. CONCLUSION

A. Project Requirements

RawLink platform successfully completed the requirement of the identification and implementation of both functional and non-functional requirements for the development to ensure user-friendly system. The first requirement to accomplish was user testing which was to find the correct user for each testing such as buyer, seller and admin testing. So far after the system completed it was done. Furthermore, non-functionality of RawLink describe several important qualities for instance usability, reliability, scalability, and system performance. Through the constant and continuous code review and changing codes according to the feature was challenging but as per requirements it has fulfilled. The platform is designed with a simple and intuitive user interface to ensure accessibility for users with varying levels of technical knowledge, including small-scale waste collectors and businesses. Finally, the **uncompleted** requirements were adding real credit which required a verified financial system. So far without having an enough resources, access and budget it was incomplete but to display the payment system was added by an auto credit feature to purchase the products. Next uncompleted requirement was after testing user suggested to do the update message option which should real time between buyer & seller.

B. Project Enhancement

In the future, RawLink will be expanded by integrating advanced technologies and additional features with larger system capabilities. First future implementation will be a system-preference aware dark theme for low-light usage. Next, integration will be a map interface for the Marketplace to visualize listings geographically. Furthermore, Multi-Language Support, given the southeast Asian focus, adding local languages (Bahasa, Mandarin, etc.) would significantly boost system adoption to the users. Also, Artificial Intelligence (AI) module will be implemented to provide smart recommendations, demand forecasting, and price optimization. A data analytics dashboard can help users track waste trends and business performance more easily than at present. Moreover, If the website goes well and able to add more functionalities and feature next step will go to the mobile application development can improve accessibility and user engagement. Features such as rating and review systems, automated logistics support, and sustainability tracking into the platform. Lastly but not the least, Integration with governmental or environment agencies which is significant to enhance credibility, support and promote wider adoption of the system.

C. Conclusion

RawLink presents a sustainable and innovative solution for managing recyclable and reusable waste materials through a digital marketplace through connecting buyers and sellers easily where the system promotes transparency, it also reduces waste from the environment which supports environmental sustainability. Throughout the development process, consideration was given to the functional and non-functional requirements to ensure that the system meet the user needs. Despite facing several constraints such as time, scope, cost, quality and so on but the project successfully demonstrates the feasibility of implementing a practical and reliable solution. The challenges also highlight the areas of improvement and have provided valuable insights for future development. Moreover, RawLink would have a great societal and environmental impact throughout the trading if it reaches to the target audience properly. In addition, there will be a job opportunity with the peoples who are connecting with waste or waste management. They can easily sell and more their products to their targeted customers. For further expansion with advanced technology and AI adaptation in the system will have a positive impact for the users to do the trading more easily also it will provide a multi-language extension to be more user friendly. Overall, RawLink platform emphasizes as a smart modern, efficient and sustainable digital solution. It only addresses the current waste challenges but also lays the foundation for future innovations that can contribute to economic growth, environmental sustainability and social well-being.

REFERENCES

[1] Geocycle Bangladesh. (2017). Launch of "Geocycle sustainable waste management service in Bangladesh". Retrieved from 'https://www.geocycle.com/'

[2] Kabadiwala Connect. (2014). About "Kabadiwala Connect – digital waste management platform in India". Retrieved from 'https://www.Kabadiwala.com/'

[3] Waste4Change. (2014). "Waste4Change-social enterprise for responsible waste management in Indonesia". Retrieved from 'https://www.waste4change.com/'

[4] Juchelkova, D., & Síťař, V. (2020)'. "Renewable waste-to-energy in Southeast Asia: Status, challenges, opportunities, and selection of waste-to-energy technologies". Applied Sciences, 10(20), 7312. 'Google Scholar-https://www. mdpi.com/'

[5] Lu, J., & Shi, X. (2025)'. "The impact of digital literacy on farmers' pesticide packaging wasterecycling behavior".Sustainability,17(6),2471.'Googlescholar-https://www.mdpi.com/2 071'

[6] International Solid Waste Association. (2025)'. "Regional brief: Waste management challenges & opportunities in Southeast Asia". https://www.iswa.org/wp

[7] Arya, S., Gupta, A., & Bhardwaj, A. (2023)'. "Development of a strategic framework for effective E-waste management in developing countries". In Global e-Waste Management Strategies and Future Implications (pp. 357–370). Elsevier. 'https://www.sciencedirect.com/'

[8] Soares, M., Ribeiro, A., Vasconcelos, T., Barros, M., Castro, C., Vilarinho, C., & Carvalho, J. (2023)'. "Challenges of digital waste marketplace—The Upvalue platform". Sustainability, 15(14), 11235. 'Google Schoalr-https://www. mdpi.com/2071-1050'

[9] Amin, S. B., Jamasb, T., Llorca, M., & Marsiliani, L. (2022)'. "The case of waste to energy in Bangladesh. In L. Arthur, D. Hondo, M. Hughes, & R. Kohonen (Eds.), Prospects for transitioning from a linear to circular economy in developing Asia (pp. 127–144). Asian Development Bank Institute". Retrieved from 'https://www.researchgate. net/'

[10] Ashraf, A. I., Mohareb, E., & Vahdati, M., & Khandakar, A. (2025)'. "Social life cycle assessment (S-LCA) of formal and informal waste collectors in decentralized waste to compost facilities. Environmental and Sustainability Indicators", ??(??), Article 100284. 'https://www.sciencedirect.com/'

[11] Allu, H., Bharti, A., & Satapathy, S. M. (2024)'. "Tackling E-Waste Management Using Decentralized Marketplace Leveraging Ethereum Blockchain". In 2024 International Conference on Signal Processing, Computation, Electronics, Power and Telecommunication' (IConSCEPT) (pp. xx–xx). IEEE. 'https://ieeexplore.ieee.org/'