

Design and Implementation of EcoSwap: A Peer-to-Peer Sustainable Item Exchange Platform with AI-Based Recommendations and Real-Time Communication

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Abstract -

In everyday life, many individuals end up keeping items that are no longer useful to them but could still be valuable to someone else. Instead of being reused, these items are often discarded, which contributes to waste generation and environmental issues. To address this problem, EcoSwap has been developed as a digital platform that enables users to exchange items directly without involving any monetary transactions.

The application allows users to upload details of items they wish to give away, explore listings available in their nearby area, and interact with other users through real-time communication. It also supports secure exchange mechanisms to ensure a reliable swapping process. In addition, the system incorporates intelligent features such as personalized item suggestions, an AI-powered assistant to guide users, and integration with charity organizations for donation purposes. The platform is implemented using technologies like Next.js and Supabase, along with basic machine learning techniques to enhance usability and recommendation accuracy.

Overall, EcoSwap demonstrates how a well-designed technology solution can encourage responsible consumption, reduce unnecessary waste, and foster a collaborative community environment.

Key Words:

Sustainable Platform, Item Exchange, Web Application, Recommendation System, Real-Time Chat, Machine Learning

1. INTRODUCTION

In recent years, changing lifestyle patterns and increased consumption have resulted in people owning many items that eventually go unused. Instead of being reused, these items are often discarded, even though they may still be useful to others. This behavior leads to unnecessary wastage of resources and adds to environmental concerns.

To tackle this issue, EcoSwap has been developed as a platform that encourages people to exchange items rather than throw them away. Users can upload items they no longer require and connect with others who might benefit from them. The core idea behind the system is to promote reuse and minimize waste through a simple and accessible approach.

The platform is designed to be easy to use while providing efficient functionality. It includes features such as location-based item discovery, real-time communication between users, and an AI-based assistant to guide users in finding suitable items. Through this implementation, the project highlights how technology can be effectively used to address everyday problems while promoting sustainability.

2. Body of Paper

The EcoSwap project is designed as a community-focused platform that brings together multiple technologies to support the exchange and reuse of items in a sustainable way. It combines features such as artificial intelligence, location-based services, and natural language processing to improve user interaction and make the system more intuitive. The platform also incorporates mechanisms that promote trust and reliability among users, encouraging safe exchanges and donations.

The overall design of the system follows a modular approach, allowing different components to function efficiently while maintaining scalability. Emphasis is placed on creating a user-friendly experience, ensuring that the platform remains accessible and practical. Through this approach, EcoSwap aims to deliver a

solution that is not only technically efficient but also socially beneficial.

2.1 Literature Survey

Research in the area of collaborative consumption suggests that systems promoting the reuse and exchange of items can play an important role in reducing environmental damage and making better use of available resources. It has been observed that users are more inclined to engage with such platforms when they are easy to navigate, reliable, and support interactions within nearby locations. Elements like location-based discovery, smooth user interaction, and simple item listing processes contribute significantly to the effectiveness of peer-to-peer exchange systems. With continuous technological advancements, many modern applications incorporate recommendation techniques and basic machine learning to improve usability. These systems analyze user behavior and preferences to provide more relevant suggestions, thereby increasing user engagement. Furthermore, features such as real-time communication and AI-driven assistance enhance interaction and make the platform more responsive. These ideas have been considered while designing and developing the EcoSwap platform.

2.2 System Development

2.2.1 Overview

EcoSwap is implemented as a full-stack web application built with technologies that support efficiency, scalability, and ease of use. The user interface is developed using Next.js along with React, enabling quick page loading and a smooth interactive experience. On the server side, Supabase is used to manage data storage, authentication, and real-time features within a single platform. For styling, Tailwind CSS is applied to create a clean layout that adapts well across different devices. The system is designed to support multiple users simultaneously while ensuring that interactions remain fast and responsive.

2.2.2 System Modules

The EcoSwap platform is organized into multiple components, each responsible for a specific set of functionalities that together create a complete user experience. The authentication component ensures secure user access and supports different roles within the system. The item management component allows users to add products by providing images, descriptions, and location information. To improve usability, the recommendation component analyzes user activity and nearby availability to suggest relevant items. The exchange component manages the process of swapping items between users in an organized and reliable way. Along with these, the platform includes a communication component that supports real-time interaction between users, making coordination easier

during exchanges. An AI-based assistant is also integrated to guide users and provide useful suggestions. Additionally, an administrative component is included to oversee user activities, manage charity-related operations, and maintain overall system control. All these components work together to ensure smooth functioning and an efficient user experience.

2.3 System Architecture

EcoSwap is designed using a client-server model in which the user interface interacts with the server through well-defined APIs. The frontend handles all user-facing elements such as display and interaction, while the backend is responsible for processing requests, managing data, and executing core system logic. Supabase is used as the primary backend service, supporting database operations, user authentication, and real-time data handling within a unified environment. The platform is built to support different categories of users, including regular users, charity organizations, and administrators, each having distinct permissions and functionalities. Features like instant messaging are implemented using real-time communication mechanisms, allowing users to receive updates without delay. Additionally, external services such as map integrations and AI-based tools are incorporated to extend the capabilities of the system. This structured approach allows the platform to scale effectively while maintaining smooth and efficient data flow between components.

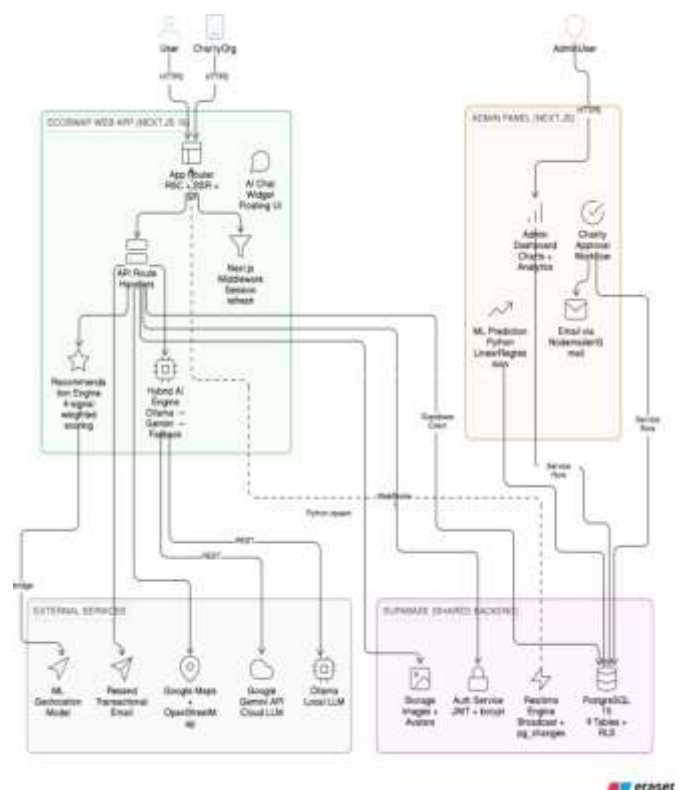


Figure 1: System Architecture Diagram

2.4 Algorithm Description

2.4.1 Recommendation Algorithm

The EcoSwap platform suggests items to users by applying a scoring method that evaluates multiple factors. These factors include the user's preferences, the distance between the user and the item, how popular the item is, and how recently it was added to the platform. Based on these aspects, each item is given a score, and those with higher scores are shown first. This approach helps users discover items that are more relevant to their needs and are conveniently located nearby.

2.4.2 Haversine Distance Calculation

To support location-based suggestions, EcoSwap calculates the distance between users and items using the Haversine method. This approach works by using latitude and longitude values to estimate the shortest path between two points on Earth's surface. By applying this calculation, the system can identify items that are closer to the user and prioritize them in the results. This improves the relevance of recommendations and makes it easier for users to find nearby exchange options.

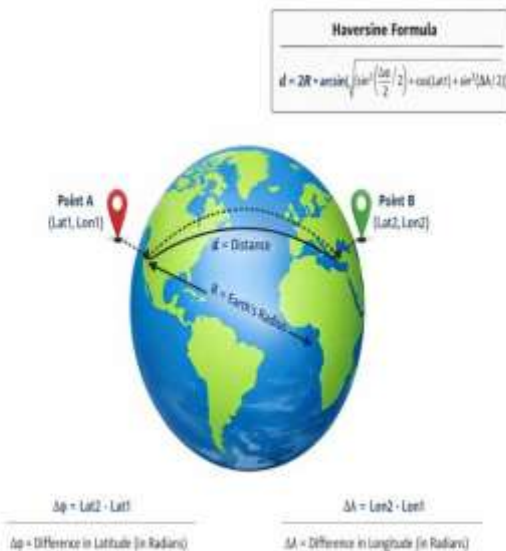


Figure 2: Distance Calculation using Haversine Formula

2.4.3 AI Processing Algorithm

EcoSwap uses a combination of AI methods to deliver smart responses to user queries. The system is designed to first handle requests using a locally available model, and if that option is not accessible, it automatically shifts to a cloud-based service. This approach helps maintain consistent performance and avoid interruptions. The AI component interprets user input, gathers relevant item information from the system, and provides useful suggestions to assist users in finding suitable matches.

2.4.4 Swap Verification Algorithm

To maintain fairness and avoid misuse, EcoSwap follows a two-step confirmation process for completing item exchanges. Both participants involved in a swap are required to verify that the exchange has been successfully completed. The system only finalizes the transaction after confirmations are received from both sides. This method helps ensure reliability, builds user trust, and reduces the chances of incorrect or false completion of swaps.



Figure 3: Swap Process Flow

3. CONCLUSIONS

EcoSwap provides a practical approach to promoting sustainable habits by encouraging users to reuse items rather than discard them. The platform brings together simple concepts and modern technologies to create a system that is both effective and easy to use. Through its implementation, it showcases how features such as real-time interaction, intelligent recommendations, and AI-based assistance can be applied in real-world scenarios.

The project also emphasizes the importance of developing solutions that support community engagement while addressing environmental concerns. Looking ahead, the platform can be further enhanced by introducing a mobile application, improving the recommendation logic, and scaling the system to accommodate a larger user base.

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