EcoSwap: Bridging Users and Charitable Trusts through Intelligent Item Exchange and Donation Management

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Abstract - EcoSwap is a community-driven platform designed to promote sustainable consumption by enabling intelligent item exchange and donation management between individual users and charitable organizations. The project addresses the growing issue of unused or discarded items by offering a digital ecosystem that combines artificial intelligence for demand prediction, geofencing for hyperlocal matching, and trust frameworks for safe peer-to-peer interaction. The system architecture integrates Firebase and MySQL to ensure secure authentication, scalable storage, and efficient real-time data handling. Key features include user profile ratings, automated agreements, dual ID verification for charities, and localized donation networks, all of which foster transparency and accountability. The platform not only empowers users to exchange items conveniently but also provides charitable trusts with structured tools to manage donations effectively. By merging sustainability goals with technological innovation, EcoSwap minimizes waste, reduces logistical challenges, and builds stronger community ties. The proposed solution demonstrates how AI-driven insights, secure cloud infrastructure, and user-centric design can collectively enhance reuse practices, offering a replicable model for sustainable digital platforms that contribute to both environmental and social well-being.

Key Words: Sustainable consumption, Item exchange, Charitable donations, Machine learning, Geofencing, Trust frameworks.

1. Introduction

The rapid growth of consumerism has resulted in a significant increase in unused, discarded, or underutilized items, many of which could still serve value if redirected appropriately. Traditional donation and resale platforms often lack intelligent mechanisms to ensure timely redistribution, trust between participants, and efficient management of items. This leads to inefficiencies, logistical challenges, and missed opportunities to support both communities and charitable organizations. Recent advances in artificial intelligence, geofencing, and trust-based systems have opened new possibilities for building smarter, more sustainable platforms that address these issues.

EcoSwap is designed as a unified platform that bridges individual users and charitable trusts by enabling secure item exchange and donation management. Unlike existing applications that primarily serve as listing portals, EcoSwap integrates machine learning for demand prediction, natural language processing for content summarization, and explainable AI for decision transparency. Geofencing further enables localized exchanges, ensuring that redistribution occurs within practical and sustainable boundaries. The system combines Firebase for secure authentication and real-time notifications with MySQL for structured data handling, offering a scalable and reliable architecture.

By addressing both environmental and social challenges, EcoSwap aims to reduce waste, empower charitable organizations, and build trust-driven community networks. This research presents the project's conceptual design, system architecture, and potential societal impact, contributing to the growing body of knowledge on AI-powered sustainable platforms.

2. Body of Paper

The proposed project EcoSwap is conceptualized as a community-driven intelligent platform that integrates artificial intelligence (AI), geolocation-based services, natural language processing (NLP), and secure trust frameworks to encourage sustainable reuse, donation, and exchange of items. The methodology emphasizes modular system design, scalable architecture, and user-centric functionality to ensure a robust, efficient, and socially impactful solution.

2.1 System Architecture

EcoSwap adopts a hybrid multi-tier architecture designed to ensure both scalability and reliability:

- Frontend Layer – A responsive web and mobile interface developed using React.js/Flutter ensures seamless interaction for end-users and charitable trusts.

- Application Layer – Business logic, AI-based recommendation models, and geofencing modules operate here to handle dynamic decision-making.
- Database Layer – Firebase manages authentication, push notifications, and real-time updates, while MySQL handles structured data such as user profiles, listed items, donations, and transaction logs.
- Explainable AI (XAI) Module – Provides reasoning for system actions, such as why a certain item was prioritized, ensuring transparency.
- Cloud Services Integration – Hosting and data backup through scalable cloud servers improve system reliability.
- Security Framework – Includes identity verification, encrypted transactions, and multi-level trust scores.
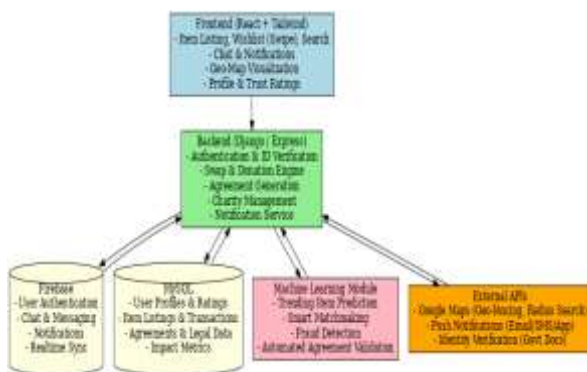

Fig. 2.1: System Architecture Diagram

2.2 Data Flow Design

The Data Flow Diagram (DFD) provides a detailed representation of how data moves across different system entities:

- Users input data such as item listings, preferences, and availability.
- Charitable Trusts input bulk donation requests, event details, and verification documents.
- System processes inputs using ML algorithms for demand prediction and geolocation-based matching.
- Databases (MySQL & Firebase) store structured data and real-time updates, enabling seamless synchronization.
- Outputs include suggested matches, donation tracking, notifications, and analytics.
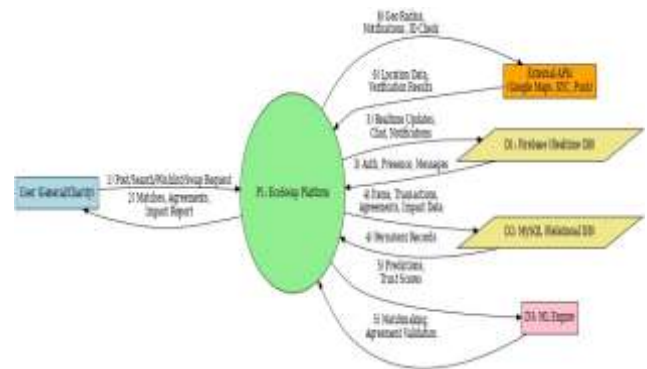
Fig.2.2: Data Flow Diagram

2.3 Functional Requirements

EcoSwap's functionality has been divided into User-Centric Functions and Charitable Trust Functions, ensuring inclusivity and relevance:

User Functions:

- Register/Login through verified accounts.
- List items for exchange or donation.
- Apply filters and search tools to find nearby items.
- Track exchange/donation history.
- Access reputation score and peer feedback.
- Receive real-time notifications of matched exchanges.

Charitable Trust Functions:

- Create verified charity accounts.
- Manage bulk donation requests.
- Post charity events requiring specific items.
- Issue digital acknowledgments and receipts.
- Monitor donor activity through analytics dashboards.

Functionality	Users	Charitable Trusts
Account	Register/Login, manage profile	Verified charity accounts
Items	Post items to swap, lend, donate	Post donation requests
Search	Find items nearby	Find donors/supporters
Verification	Reputation & ratings	Official verification, acknowledgments
Notifications	Alerts for matches/offers	Alerts for donations/events
Communication	In-app chat	Contact donors via chat
Tracking	Exchange/donation history	Monitor donations, generate reports

Table 2.1: Functional Requirements (Users vs Trusts)

2.4 Key Features of EcoSwap

EcoSwap stands out from existing platforms by integrating multiple advanced modules:

- Adaptive Scheduling Engine – Dynamically prioritizes exchange/donation tasks based on urgency, demand prediction, and user availability.

- NLP Summarizer – Automatically generates concise, clear descriptions of items for better readability and accessibility.
- Geo-fenced Matching System – Ensures hyperlocal connectivity by enabling society, campus, or community-level matching of donors and recipients.
- Trust Framework – Combines verified ID, ratings, feedback, and digital agreements to build accountability and prevent fraud.
- Explainable AI (XAI) – Provides transparent insights into decision-making (e.g., why an item was recommended to a user).
- Sustainability Integration – Tracks environmental impact, such as items diverted from waste and resources saved.

Feature	EcoSwap	Existing Platforms
Adaptive Scheduling Engine	✅	❌
NLP Summarizer	✅	❌ / Limited
Geo-fenced Matching System	✅	❌ / Limited
Trust Framework	✅	❌ Basic
Explainable AI (XAI)	✅	❌ Basic
Sustainability Integration	✅	❌ Minimal
Hyperlocal Connectivity	✅	❌ Minimal
Automated Recommendations	✅	❌ Minimal
User Ratings & Feedback		

Chart 2.1: Feature Comparison btween EcoSwap and Existing Platforms

2.5 Methodology Flow

The methodology for developing EcoSwap follows a phased approach:

- **Requirement Gathering –** Analyzing existing donation/exchange platforms and identifying gaps.
- **System Design –** Developing DFDs, architectural diagrams, and database schema.
- **Module Development –** Implementing frontend, backend, AI models, and trust framework.
- **Integration –** Merging ML, NLP, and geofencing modules with Firebase and MySQL.
- **Testing –** Performing unit testing, integration testing, and user acceptance testing.
- **Deployment –** Hosting on scalable cloud infrastructure.
- **Evaluation –** Collecting feedback from pilot users and charitable trusts for continuous improvement.

3. CONCLUSIONS

The EcoSwap platform is designed as a scalable, intelligent, and user-centric system that seamlessly integrates AI, NLP, geolocation services, and secure trust frameworks to promote sustainable item exchange and donation. Its modular architecture, comprising frontend, application, database, and explainable AI layers, ensures efficiency, transparency, and reliability. Detailed data flow, well-defined functional requirements for users and charitable trusts, and advanced features such as adaptive scheduling, geo-fenced matching, and sustainability tracking highlight the platform's innovation. Following a structured methodology—from requirement analysis to deployment and evaluation—EcoSwap demonstrates a practical and research-backed approach to fostering community-driven resource sharing while minimizing environmental impact.

ACKNOWLEDGEMENT

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