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ReWearify: A Sustainable Clothing Donation Platform

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ABSTRACT- One of the best ways to decrease the number of wasted clothes and contribute to the development of communities is to donate them. However, because of the lack of controlled channels, unused clothes do not always go to the target audience and instead become waste instead of fulfilling them. The purpose of this project is to develop Rewearify an AI Based Sustainable Clothing Donation Platform that will help bridge the donors and NGOs in a transparent and seamless manner! It is based on the established MERN stack (MongoDB, Express.js, React.js, Node.js) to manage user roles, the item submission and approval process. Increment in the level of automation, Python FastAPI AI Service has been created, which employs Finite State Machines (FSM) to track statuses, Content-Based Filtering to combine words co-occurring and semantic matching using similarity of terms, Decision Trees to detect Fraud, K-Means Clustering due to logistic reasons. The site supports Socket notification in realtime.IO and status tracking and analytics dashboards, which are useful in facilitating the donation process. Rewearify also shifts to a more demand-based model of supply and introduces transparency and intelligent automation to the humanitarian supply chain.

KEYWORDS- Blockchain Architecture, Consensus Mechanism, Smart Contract Automation, Cryptographic Protocols, Decentralised Payment Systems, and Real-Time Transaction Processing.

I. INTRODUCTION

The project is called Sustainable Clothing Donation Platform and it is a revolutionary step at the border of technology, social well-being and sustainability. Sustainable Clothing Donation Platform is one of the game changers in the equation of technology, social welfare and sustainability. He can dream of a time where the act of giving donations in form of clothing is not a simple case of charity, but a systematic and intelligent service, and is handled and disseminated effectively to the needy. It sees a scenario whereby clothing donations are not piecemeal charity donations, but a systematic, intelligent donation properly managed and appropriately distributed to the needy. In the modern environment, high-quality clothing is not used, as there is no structured channel of donation, which causes waste and inefficiency. the current environment, high-quality clothing is not used, as there is no organized channel of donation that leads to waste and inefficiency.

The study of the reuse-based clothing value chain reveals that the efficacy of redistribution is very sensitive on the business systems as well as the standardized product attributes. into the reuse-based clothing value chain. Paras et al. [1] note that legal and legislative frameworks and consumer attitudes are key factors that need to be understood to create effective charity-based models. But due to operational issues like manual execution, and absence of donors' feedback, bottlenecks often emerge. tracking and absence of donors' feedback often emerge. Duggan et coll. al. [2] found out that in the absence of automated tracking and inventory monitoring, initiatives cannot assure transparency and worker safety. oversight, initiatives cannot assure transparency and worker safety. Besides, within the framework of humanitarian logistics, the lack of centralized platform may cause overstocking and delay in the delivery of aid.

Moreover, the lack of centralized platforms may cause overstocking and delays in the delivery of aid in the environment of humanitarian logistics. Hidayat et coll. al. [3] pointed at the necessity of online platforms to streamline the supply chains and resource allocation in crisis situations. necessity of online platforms to streamline the supply chains and resource allocation in crisis situation. Rewearify is able to fill these particular gaps through the use of modern web technologies which facilitate the creation of a smooth connection between the donors and the NGOs. transparent bridge between donors and NGOs. It is based on a finite state machine (FSM) which allows it to track the entire lifecycle of a donation and a Content-Based Filtering that matches goods by type, condition, and location.

II. RELATED WORK

There is a lot of research that has laid the groundwork of digital giving systems which can become web-based or based on mobile applications. A lot of research has provided a base on digital donation systems, both web-based and mobile apps.

Archites Web et mobiles: Joshi et al.

Web and Mobile Architectures Joshi et al. [4] introduced the full-stack platform Parhit, which uses ReactJS, showing

how dynamic routing can simplify the work between donors and charities. Fatima et al. Fathima et al. [5] emphasized that NGOs can be verified by centralized mobile applications, which will increase the confidence of donors. On the same note, Abdul Rahim and Rahmalan [6] came up with the concept of the Clothing Recycling Management System (CRMS), which applies incentive schemes to keep the people going.

The Clothes Recycle Management System (CRMS), the system that operates on the incentive schemes to provide the lead on continuous participation. AI and Innovation: Artificial intelligence is increasingly becoming popular. Wang and Sun [7] offered an AI-based wardrobe platform based on computer vision which categorizes items which is shown to be extremely beneficial in increasing user engagement. Rajeswari et coll. al. [8] placed emphasis on GPS-based applications in order to ease the process of collections.

Disaster Response: Islam et al. [9] also showed that online registries are effective in emergency situations that match the intentions of donors with the real needs. Singh et coll. al. [10] created an awareness gap between the donors and local shelters by creating DONAPP. DONAPP to reduce the knowledge gap between the donors and the local shelters.

Dedication and control: Galvez-Rodriguez et al.

Engagement & Management Galvez-Rodriguez et al. [11] discovered that management of online platforms is essential towards ensuring continuous donor engagement. platform management is essential to ensuring continued donor engagement. Lynn-Sze and Fathi [12] examined how social media influencers can be used to increase fundraising awareness and creating fundraising awareness.

III. PROBLEM STATEMENT

Systemic inefficiencies have currently affected the charitable clothing supply chain and led to wastage of resources that can be put into good use and overworking of aid organizations. Although there is an increased readiness of people and companies to give donation, the lack of a properly designed, visibly, and conveniently available system of redistributing excess clothes in an efficient manner poses a substantial obstacle.

The narrow issues covered by this study include:

- Absence of Standardization and information asymmetry: Clothes are a heterogeneous good unlike non-perishable food products because they have unique characteristics like condition, fabric and style. Studies on value chains based on reuse show that the effectiveness of redistribution depends on the standardized product features[13]. The current lack of an agreed metadata poses a disconnect whereby the donors do not know what specific NGO needs and the NGOs are not aware of what is in stock. Such information asymmetry is not conducive to the matching and logistical planning.
- Inefficiency and Manual Bottlenecks in Operation: Operation NGOs and social organisations are prone to inefficient and manual bottlenecks, hand sorting and insufficient data-driven applications. The most effective plateau of donation programs has been set with manual tracking whereby the supply was unable to satisfy the demand in the most effective way [14].The fact that these manual procedures are not transparent also plays a central role in deterring the donor who is in the majority cases. When cases enquire about the way their donations are being used, they are not answered.
- Second Disaster in the Humanitarian Aid: In disaster situations, the unsolicited and unplanned donations are the most source of a second disaster. Without a formal way of matching the wishes of people who want to donate, and the actual needs, relief organizations are deluged with miscellaneous-quality items that are not correlated with the direct needs [15].This leads to the NGOs directing the wrong funds and human resources to waste management and disposal instead of delivering aid.
- The Awareness and Connectivity Gap: The gap between the local and the donors is extremely large recipients. The number of potential donors that know nothing about local NGOs, orphanages, and shelters requiring particular attention is very high assistance .The existing systems are not very effective in this regard and what has emerged is a push model that implies dumping store, but not with any consideration of demand, a pull model is a reaction to a particular request [16].
- Trust Deficit and Transparency: The traditional donor channels are normally the black boxes that cannot be traced. This is what makes people question whether the donations are reaching, since there are no such records, which cannot be modified beneficiaries are misappropriated. The transparent systems are important and need to be introduced to minimize the security issues and set the trust-based relationships in the donation ecosystem in the long run [17].

A. Objectives of the Proposed System

The Rewearify project will be a complete digital ecosystem that can solve the inefficiencies of the traditional charitable supply chain. The intended goals are as follows:

- To make the donations smooth and consumer-friendly: The overall goal is to make the process of the donations more democratic through reducing the entry threshold. The platform offers an easy-to-use and simplified user interface where donors are able to list items and schedule pickups, and monitor their donations in real-time, which is a good solution to the convenience and security issues that conventional approaches can create [18].
- To optimise the Processes by the Intelligent Automation: To resolve the operational bottlenecks, the platform will automate the process of categories and evaluation of items through the use of Artificial Intelligence. With the help of an implementation of a Finite State Machine (FSM) to monitor the entire process of a donation- submission to delivery- the system guarantees efficiency in the work of the operational system and centralization of inventory coordination. This enables in containing some of the more frequent issues such as hand tracking errors and also relief being overstocked goods during crises [19].
- To Enhance Accessibility and Interconnectedness of NGOs : The system will handle the challenge of the awareness gap between the donor and the locals at the local level. As the platform shifts between the supply-based model which is a push (demand), the NGOs can

determine their short-term needs and this has been proven to be an effective method of matching the purposes of the charitable that are real [20].

- To Build Trust and Promote Sustainability: This is an essential necessity to combat the deficiency of trust providing the charity by providing complete disclosure of the final receipts of the donations. With the system, the environmental impact of the textile waste is minimized because the system promotes the circular economy comparing the data so that the non-useful products are not dumped, and the value creation is based on the standardized one attributes [21].

IV. METHODOLOGY

The designing of Sustainable Clothing Donation Platform was achieved through the assistance of the systematic process:

A. Requirement Analysis and System Design

Key stakeholders were defined and specified on the system as roles and interactions. The system architecture has been designed in a way that it has functional blocks of authentication and donation management which are supported on UML diagrams and state transition models in the manner of representing the system logic also as retaining modular development.

B. Data Collection and Synthesis:

The synthetic data sets have been developed so that they can simulate the real-world operations develop and test. These were donationlogs.csv (Lifecycle of transactions), clothingmetadata.csv (Attributes of items (type, condition, size), and ngo_dataset.csv (Needs and location profiling of NGO) which were pivotal to the validation of AI capabilities.

C. Frontend Development

Frontend developed using the support of ReactJS which provides fast responsive user interface. The clear elements were created to enable the Donors to adopt forms, the NGOs to browse requests and the Admins to discretionary approvals, and convenient dashboards and feedback to improve the user experience.

D. Backend Development

The back end will be developed in nodejs using Expressjs to accommodate RESTful APIs of authentication and status updates. The security was secured with the help of the JWT and password hash and it was the MongoDB that was used to organize the user, NGO, etc. and donation items collections.

E. AI Integration and Logic Layer

- The donation is controlled by the use of a Finite state machine (FSM).
- Lifecycle The objects of which are placed under logical states including Submitted, and Delivered against which the tracking integrity is put in place
- AI Microservices: A python service was added to perform heavy computations.

F. Admin Management Logic

This allowed administrative logic to provide regional managers with positions in sub-admin allow more scalability. Changes in submissions, description checking and updating of the statuses would be made through the FSM model by the admins assured that the donations could be good when the latter came to them

G. Tracking and analytics

All user and donation history would be stored with time stamps to have the details of each action is readily tracked and the performance traced. The advancement made in the form of these logs was the focus of the further advancements, including Predicting demand and forecasting with the assistance of AI to make data-driven decisions.

H. Testing and validation

Frontend and backend components were also tested to make sure that they stable the platform. Individual unit tests were run and integration tests were passed to rub off marking that there is good interaction between the specialized modules were developed that focused on the user authentication, FSM transitions and the correctness of API.

V. SYSTEM DESIGN

In the below Figure 1 presents the system architecture of the proposed AI-powered clothing donation model. It is composed of important parts, such as user interfaces, intelligent microservices, middleware APIs, and centralized database, which provides smooth integration and transparency of information across the network.

- User Layer (Donors, Recipients, and Admins): Web interfaces: These are used by the end users to interact with the system. This layer contains entities that initiate donations, receive items or govern the platform, such as individual donors, NGOs, and system administrators. Each user is authenticated using secure login mechanisms, and is routed to his/her particular dashboard based on his/her role. Users make donation requests or approvals, which are encapsulations and are sent to the frontend layer.
- Authentication and Security Layer: The purpose of this layer is to provide user identity and access control. It uses the passport.js middleware in the node.js environment to implement the secure authentication strategies. JSON Web Tokens (JWT) is used to deal with the sessions in a secured manner to ensure or to make sure that any sensitive data or transaction history of users is safe from unauthorized access of any other person.
- Real-Time Communication Layer: In order to bridge this communication gap between what takes place in the backend of the application and the awareness in the frontend, this layer consists of a Socket.IO server. It supports and allows bi-directional communication and broadcast update in real time to connected clients whenever a status update takes place (e.g. “Request Approved”), that creates more user engagement and transparency.

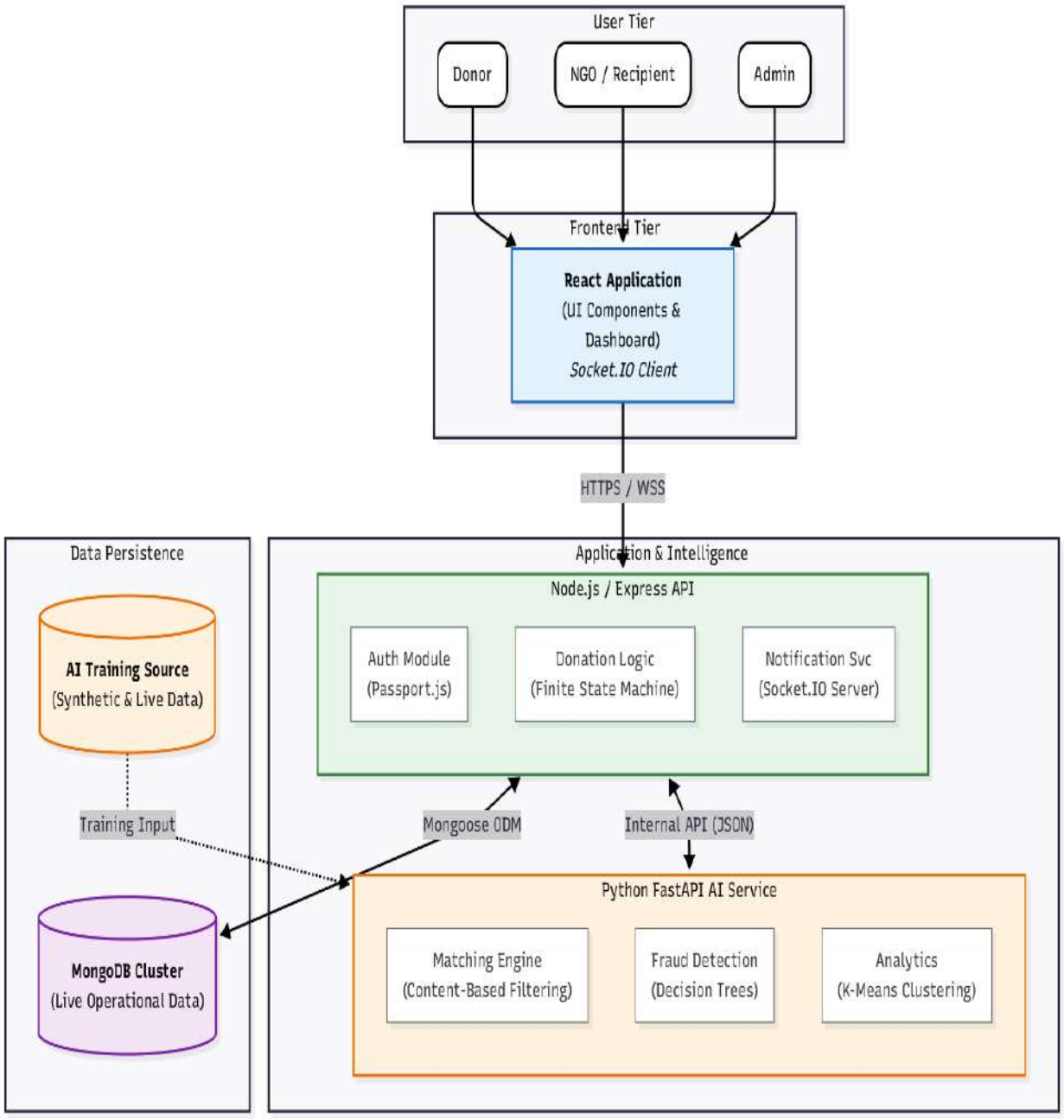

Figure 1: System Architecture of Rewearify Platform

- Frontend Interface Layer: The representation logic is dealt with the client-side application with the help of React.Js to make sure a responsive user experience. This layer handles form submissions, dashboard visualization, and real-time interaction. It integrates a Socket.IO client to have a persistent connection with the server and users can get instant push notifications about status updates without page reloads.
- Application and Integration Layer: This layer is responsible for managing the logic of orchestration between the user layer and the intelligence services. It uses Node.js and Express.js environment to use API routing, secure authentication using Passport.js and business logic. It contains the Finite State Machine (FSM) logic for validating donation transitions (i.e. from "Submitted" to "Approved") and uses the WebSocket server for notifying notifications.
- AI Service Layer (Intelligence Engine): A separate Python FastAPI service is utilized which is service providing advanced computational facilities. This layer communicates with the main application through the use of internal APIs and possesses the core algorithms. It executes Content-Based Filtering for donor and NGO matching, runs Decision Tree classifiers for fraud detection, and performs K-Means for logistics optimization which provides the Admin and NGO modules with intelligent decision support.
- Data Persistence Layer: A secured structure of NoSQL database is being used to store the data with the live operation. The MongoDB cluster maintains synchronized information of user profiles, donation items and donation transaction logs. This layer also includes the AI Training Source which includes the

synthetic and historical data sets which are utilized to continuously refine the machine learning models.

A. Algorithms Used

- Finite State Machine (FSM): The donation lifecycle would be managed using the Finite State Machine to ensure that logical consistency and auditability. The process is started when a donor submit an item which sets state as SUBMITTED. Transitions to next states e.g. APPROVED, REQUESTED, IN_TRANSIT, and DELIVERED are defined by a strict validation with backend controller. For example, an item cannot change to DELIVERED without requesting it first. This mechanism avoids "zombie" states- suture where the things are claimed but not managed at all and the fact that the database is more secure through the donation journey, solves the inefficiencies of tracking as mentioned in humanitarian logistics.
- Content-Based Filtering (CBF): To overcome cold start problem that arises when new NGOs are registered, the platform utilizes Content-Based Filtering during semantic matching. First is the description of donations (e.g., Warm wool coat) and description of NGOs request (e.g., Winter jackets).TF-IDF (Term Frequency- Inverse Document Frequency) vectorised. The similarity of the vectors is then calculated by use of those vectors to determine the cosine similarity of the vector's relevance. When the recommendation engine is being run, matches with higher scores of similarities with 1 are prioritized, because the NGOs should be interested in the most relevant things as early as possible, without a priori interaction history. This can be compared to demand and supply, and this will avoid the second catastrophe of the unwanted goods.
- Random Forest Classifier Automated Fraud detection is being imposed with the help of Random Forest classifier which conglomerates the choices of several decision trees to determine whether the anomalous listing exists or not . Account age, velocity of submissions and hash duplicates of the images are then analysed with the model flagging for possible spam or malicious activities, Training on the synthetic datasets balanced with variations of these techniques e.g. SMote (Synthetic Minority Over-sampling Technique) the model is very accurate in identifying the fraudulent behaviour and therefore, guards the platform cost borne by the bad actor and decreasing the manual moderation cost.
- K-Means Clustering: K-Means Clustering is a strategic logistic planning tool. Grouping the NGOs based on spatial coordinates.
- The algorithm classifies the NGOs into K (k) distinct classes and the ordinary point of each group is then determined as the centre of the group as well as sound theoretical logistical nexuses Administrators apply these visualizations to decide the optimal points of regional warehouses or collection drives and affirm donation deserts, i.e. high demand and low donor density, so as to distribute resources in that way.

VI. SYSTEM IMPLEMENTATION SNAPSHOTS

In the next section, selected snapshots (Figure 1 to Figure 10) of the developed Rewearify platform are provided; they demonstrate the key functional modules in the system through the various user functions. The system entry point, which is the front page that shows the sustainable mission of the platform, is presented in Figure 1. Figure 2, Figure 3 and Figure 4 show the donor workflow including the personalized donor dashboard, the item submission interface to add new contributions, and the tracking system in order to track the status of a donation. Switching to beneficiary perspective we could see Figure 5, Figure 6, Figure 7 which illustrate the experience of the recipient organization featuring the dashboard of their operations, the catalogue of browsing the inventory, and the particular mechanism of ordering items. Lastly, administrative control potentials are summarized in Figure 8, Figure 9, Figure 10, including the control center, user management lists, and the workflow of donations. Together these interfaces ensure the feasibility of the operationality, role-based security and the practical implementation of the proposed model of donation supply chain.

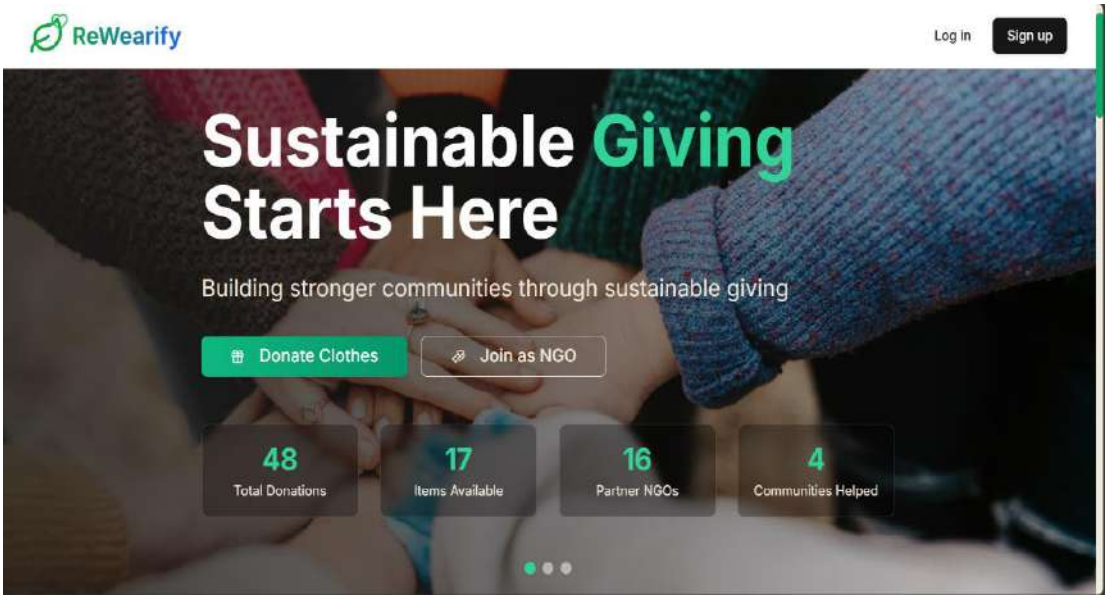

Figure 2: This is the home page where the users have the option of logging in or registering.

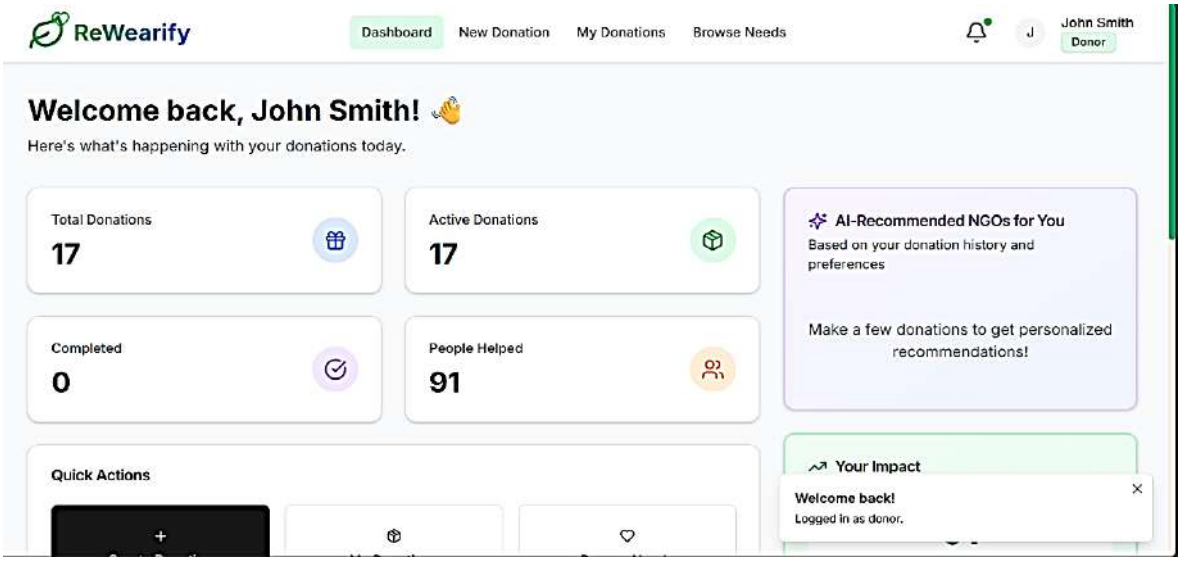

Figure 3: The donor dashboard to monitor their activity and statistics

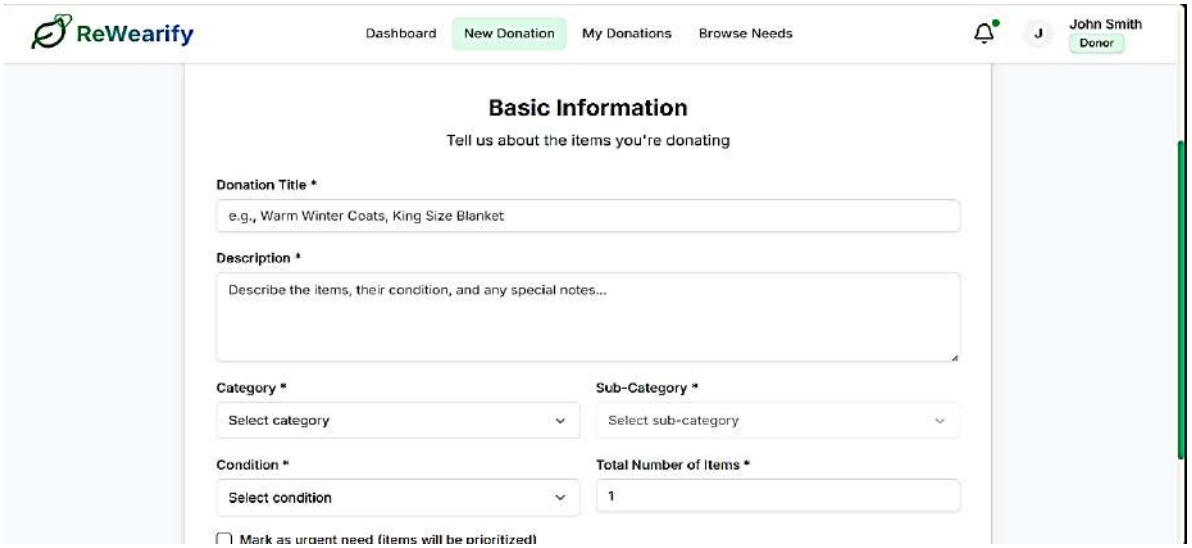

Figure 4: One of the forms where information can be entered to make a new donation

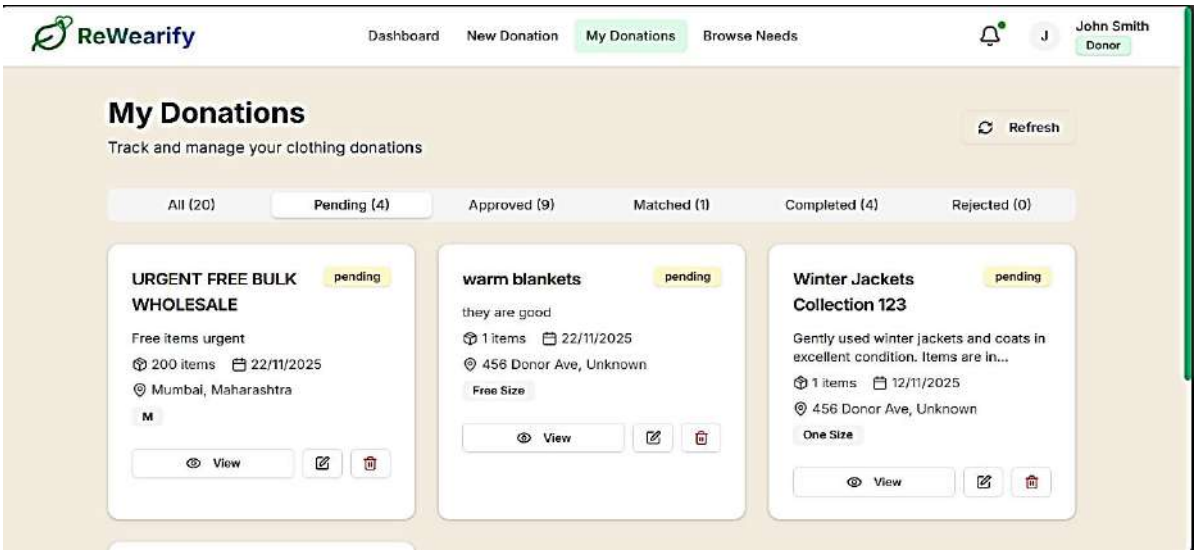

Figure 5: A table indicating the condition of items of the donor

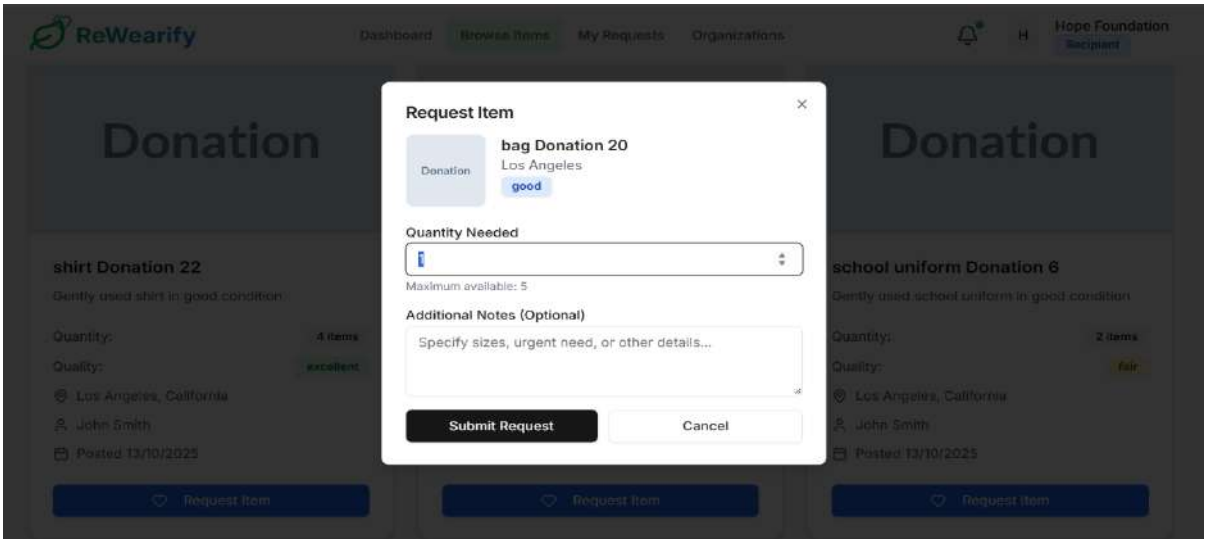

Figure 8: A pop-up window with a request of a given item

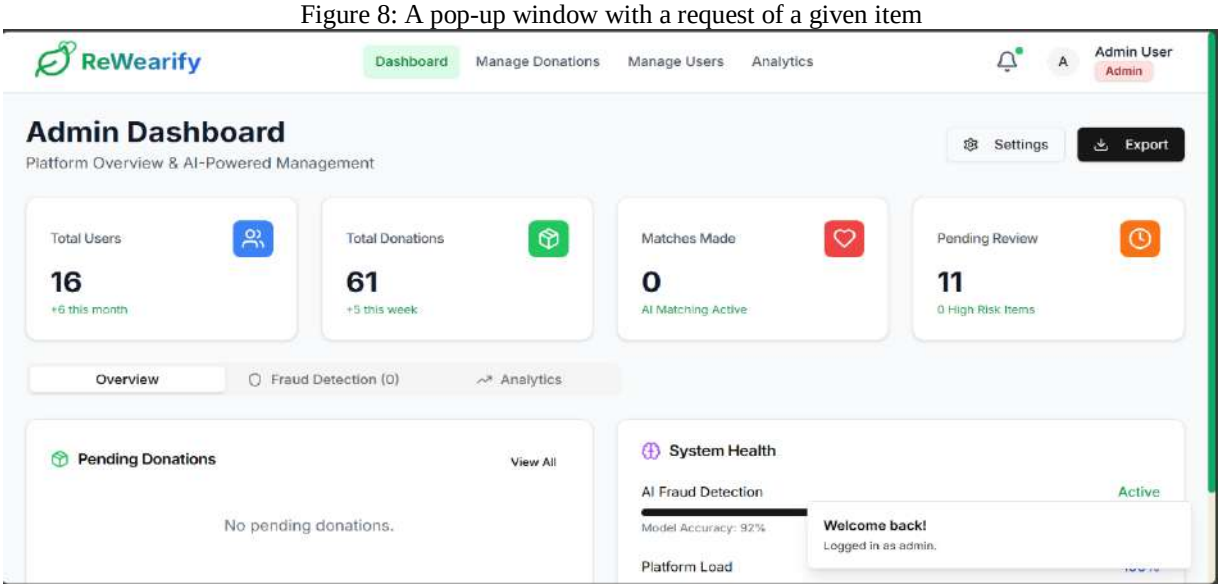

Figure 9: The administration panel with a general view of the site statistics

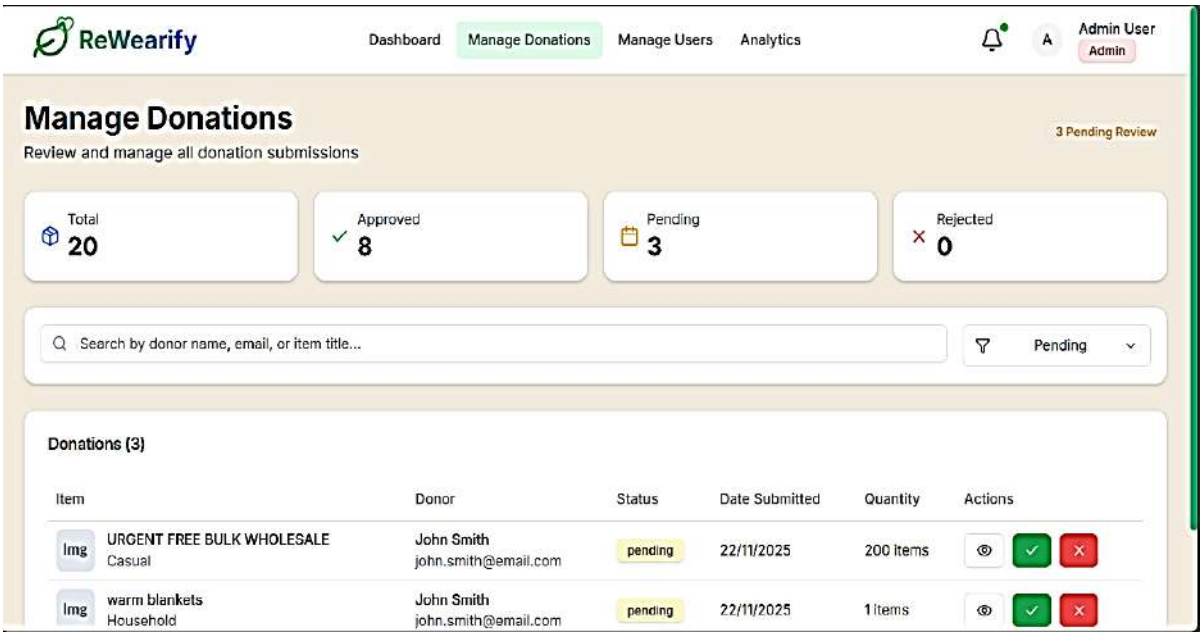

Figure 10: A table where admins can see user accounts and manage them

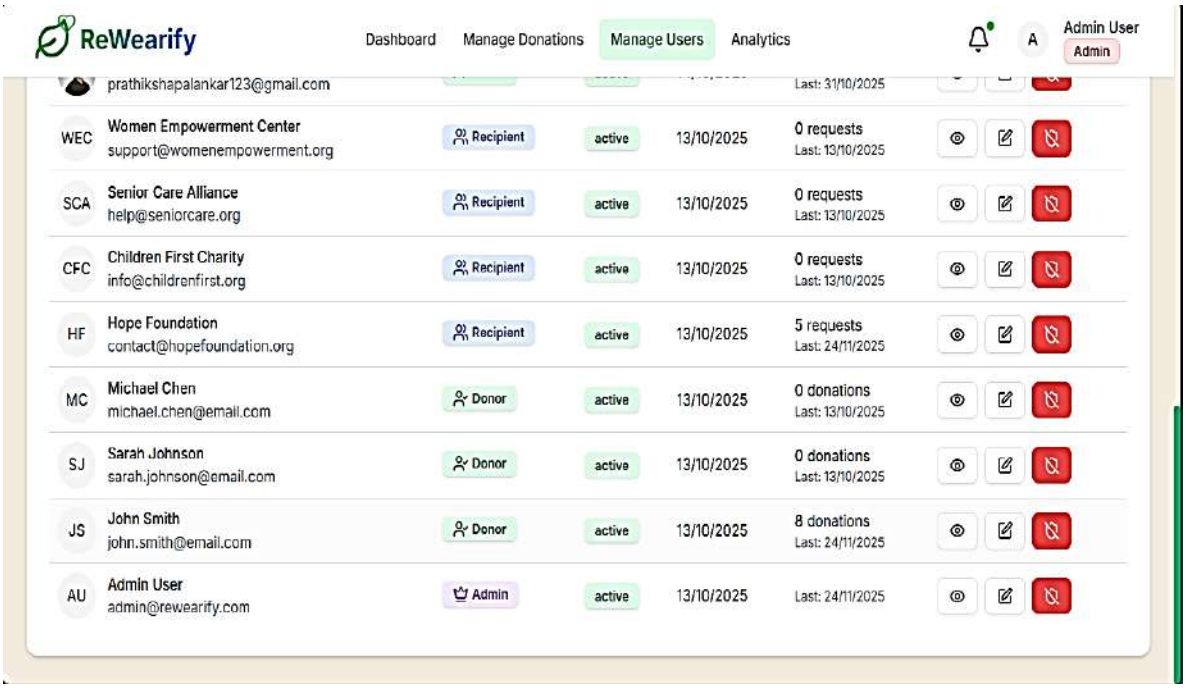

Figure 11: A screen that allows the admins to approve or reject new donations

VII. CONCLUSIONS

Rewearify is a paradigm shift in digital philanthropy, and proves the fact that the systemic inefficiencies of the charitable supply chain can be tackled effectively by modern engineering. By combining the capacity for instant inception of a response and predictive power of the MERN stack with the very purpose-artificial intelligence- we make a donation ecosystem which is transparent, which is efficient, which is dignified. The combination of Finite State Machines ensures lifecycle integrity and Content-Based Filtering and Clustering algorithms optimize the "last mile" of aid delivery. In turn, converting the "second disaster" of unsolicited waste into a structured resource, Rewearify enables a replicable model for the future of humanitarian logistics, where the donor's intention for impact meets the NGO's need for a given resource. Future iterations will further work to increase trust by integrating the functionality of blockchain technology for immutable provenance.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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