



## Eco Textile: Textile Waste Management System

*Preet Shah<sup>1</sup>, Mahek Mewada<sup>2</sup>, Sutej Shah<sup>3</sup>, Aarya Mishra<sup>4</sup>, Ms. Smita Dandge<sup>5</sup>*

<sup>1,2,3,4</sup> Students Pursuing Computer Engineering, Thakur Polytechnic, Mumbai, 400 101, India

<sup>5</sup> Faculty, Computer Engineering Department, Thakur Polytechnic, Mumbai, 400101, India

### ABSTRACT

The fashion and textile industries generate significant environmental waste, contributing to pollution, landfill overflow, and excessive resource consumption. While sustainability is becoming a priority, many businesses and individuals lack access to efficient tools for eco-friendly textile sourcing and waste management.

EcoTextile is a full-stack digital platform designed to address these challenges by integrating sustainable e-commerce with a textile waste exchange system. The platform connects designers, creators, and businesses with eco-friendly textile products and reusable waste materials. Through advanced tracking mechanisms, EcoTextile monitors environmental impact metrics such as waste reduction, carbon footprint savings, and recycling efficiency.

This paper presents the system architecture, core functionalities, and real-world applications of EcoTextile. It also discusses the technical implementation, ethical considerations, and future enhancements aimed at optimizing textile sustainability.

### 1. Introduction

#### 1.1 Problem Statement

The global textile industry produces approximately 92 million tons of waste annually, with much of it ending up in landfills or incineration plants. Fast fashion and mass production have led to severe environmental consequences, including excessive water usage, carbon emissions, and chemical pollution. Despite growing awareness, the industry lacks a centralized digital solution to manage textile sustainability effectively.

EcoTextile aims to solve these issues by providing a sustainable textile marketplace and a waste exchange platform that encourages the repurposing and responsible management of textile materials.

#### 1.2 Objectives

- Promote Sustainable Sourcing – Provide businesses and individuals with easy access to eco-friendly textiles.
- Reduce Textile Waste – Facilitate the exchange and recycling of fabric materials.
- Increase Transparency – Implement sustainability tracking tools to measure environmental impact.
- Encourage Circular Economy Practices – Support textile upcycling, repurposing, and responsible disposal

### System Architecture

EcoTextile follows a **three-tier architecture**:

1. **Frontend (Client-Side)**
2. **Backend (Server-Side)**
3. **Database & Storage**

#### Technology Stack

- **Frontend:** React.js, Material UI, React Router, Axios
- **Backend:** Node.js, Express.js
- **Database:** NeDB (Lightweight Database)

- **Development Tools:** Concurrently, Nodemon

## 2. Architecture Layers

### (A) Presentation Layer (Frontend)

- Built using **React.js**, handling UI rendering and user interactions.
- Uses **Material UI** for modern UI components.
- **React Router** for navigation between different pages.
- Communicates with the backend via **Axios (API calls)**.

### Frontend Components:

1. **Landing Page (EcoTextile Homepage)**
  - Displays an introduction to the platform.
  - Shows featured sustainable products.
  - Provides navigation options to different features.
2. **Textile Waste Marketplace**
  - Allows users to browse available textile waste materials.
  - Includes filters for category, location, material type.
  - Provides options to **contact sellers** or list materials.
3. **Impact Metrics & Sustainability Tracking**
  - Displays statistics (waste diverted, CO2 reduction, transactions).
  - Uses dynamic visualization of environmental impact.
4. **User Profiles & Dashboard**
  - Users can track their purchases, wishlist, and contributions.
  - Shows real-time notifications for material requests and order updates.

### (B) Business Logic Layer (Backend)

- Built using **Node.js and Express.js**, handling API requests.
- Routes are defined for different features (e-commerce, waste exchange, user authentication).
- **Data models stored in NeDB**, a lightweight NoSQL database.

### Key API Endpoints:

1. **Authentication APIs**
  - `/api/auth/register` → User Registration
  - `/api/auth/login` → User Login
  - `/api/auth/profile` → Fetch User Profile
2. **Product APIs (Eco-friendly Marketplace)**
  - `/api/products` → Fetch all sustainable textile products
  - `/api/products/:id` → Fetch specific product details
  - `/api/cart` → Manage user cart items
  - `/api/wishlist` → Manage user wishlist
3. **Waste Exchange APIs**
  - `/api/waste` → Get all available textile waste listings
  - `/api/waste/:id` → Get specific waste material details

- /api/waste/create → Post a new waste material listing
- /api/waste/contact-seller/:id → Contact a seller

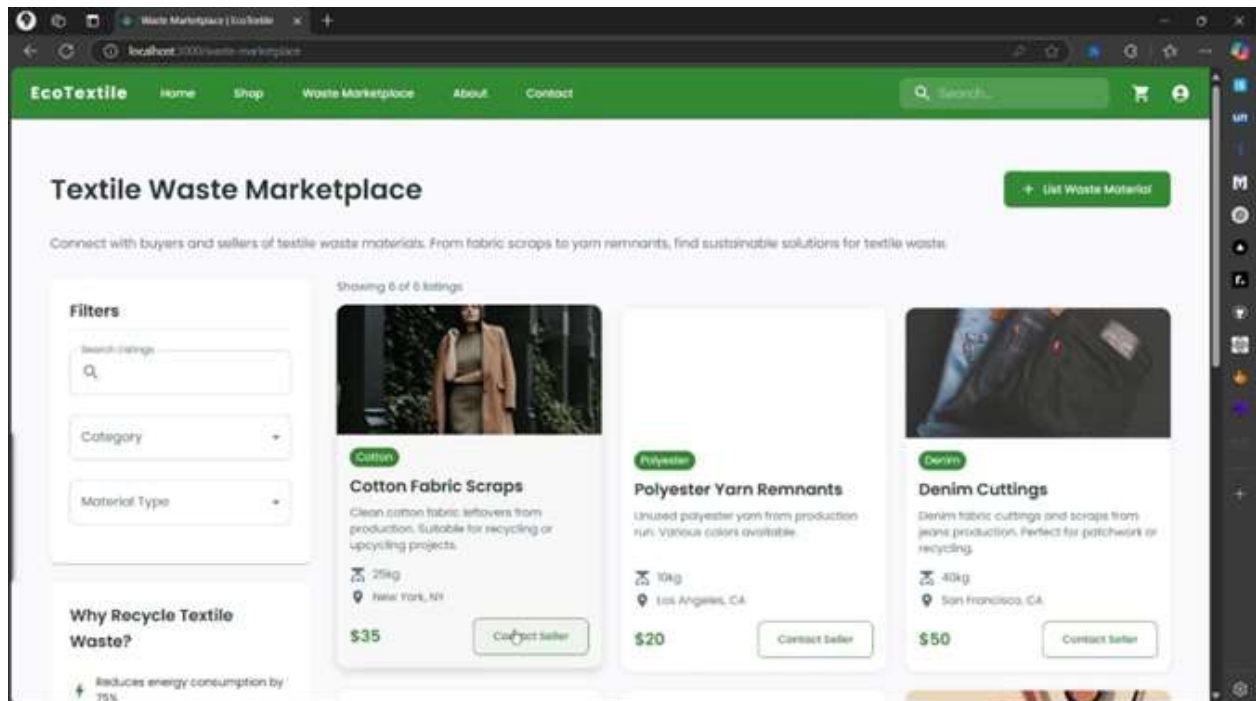
#### 4. Sustainability Tracking

- /api/impact → Get environmental impact statistics
- /api/impact/user → Track individual user contributions

#### (C) Data Layer (Database & Storage)

- **NeDB (NoSQL Database)**
  - Stores **user profiles, product listings, waste exchange data, sustainability impact stats.**
- **File Storage:**
  - **Images and files are stored in a cloud-based solution (or local storage).**
  - Users can upload textile waste images through a submission form.

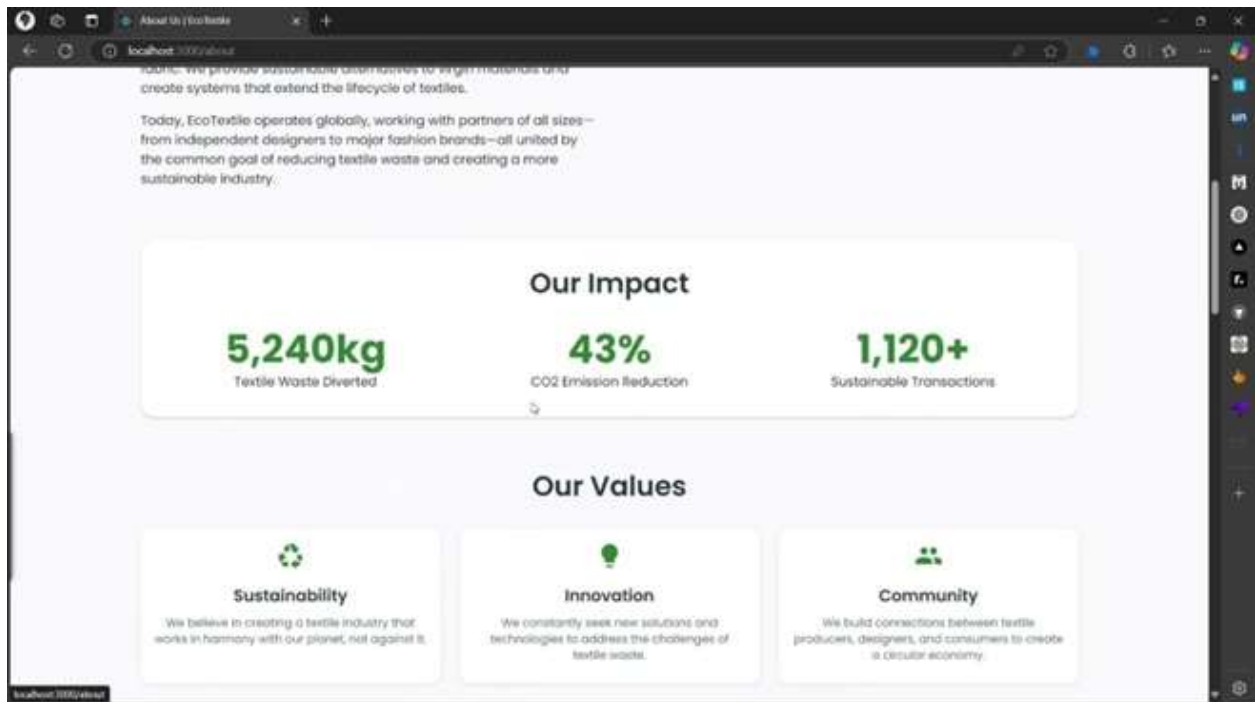
Here's an analysis of the website images and how they relate to the system architecture:



- **Title: "Eco-Friendly Textile Solutions"**
- Features navigation links: **Home, Shop, Waste Marketplace, About, Contact.**
- Two main buttons:
  - **Shop Now** → Redirects to sustainable textile products.
  - **Learn More** → Directs to sustainability information.

#### Backend Interaction:

- Frontend fetches product listings via /api/products
- Navigation is managed via **React Router.**

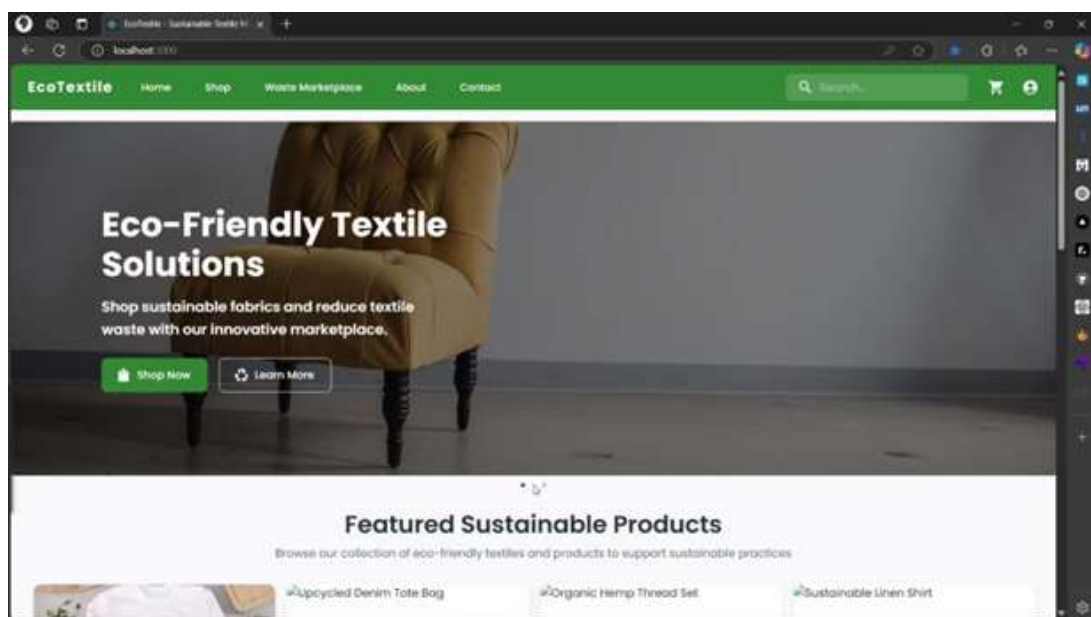


- Displays **statistics**:
  - **5,240kg** Textile Waste Diverted
  - **43%** CO2 Emission Reduction
  - **1,120+** Sustainable Transactions
- Shows **core values**: **Sustainability, Innovation, Community.**

#### Backend Interaction:

- Fetches sustainability data via `/api/impact`

Dynamically updates metrics from the database.



- Lists different **textile waste materials** for purchase or reuse.
- Shows:
  - **Product Image**

- **Material Type (Cotton, Polyester, Denim)**
- **Location**
- **Price**
- **Contact Seller Button**
- Includes **Filters: Category, Material Type, Price.**
- **"List Waste Material" Button** → Allows users to post their own textile waste.

#### Backend Interaction:

- Fetches waste materials via /api/waste
- Users submit new waste listings through /api/waste/create
- "Contact Seller" button triggers a request via /api/waste/contact-seller/:id

#### 4. Additional Features in Development

As per the Readme file, the following enhancements are planned:

- **User Authentication System:** Secure login & registration.
- **Real-Time Notifications:** For new orders, messages, and material requests.
- **Expanded Sustainability Metrics:** More detailed tracking of waste reduction.
- **Social Sharing:** Users can share their impact stats or waste listings.
- **Mobile App Development:** Responsive app for better accessibility.

#### Summary Table

Layer	Technology Stack	Main Responsibilities	Key Features	APIs & Function
Frontend (UI/UX)	React.js, Material UI, Axios, React Router	<ul style="list-style-type: none"> <li>- Provides an interactive and responsive UI for users</li> <li>- Manages navigation and user experience</li> <li>- Communicates with the backend through REST APIs</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Sustainable Shopping</b> (Browse, filter, search)</li> <li>- <b>Textile Waste Marketplace</b> (Buy/Sell waste)</li> <li>- <b>Cart &amp; Wishlist</b> (Add/remove items)</li> <li>- <b>Impact Tracking</b> (View sustainability metrics)</li> <li>- <b>Notifications</b> (Order updates, seller replies)</li> </ul>	<ul style="list-style-type: none"> <li>- /api/products (Fetch eco-friendly products)</li> <li>- /api/waste (Fetch textile waste listings)</li> <li>- /api/cart (Manage cart items)</li> <li>- /api/profile (User data &amp; history)</li> </ul>
Backend (Business Logic & API Layer)	Node.js, Express.js	<ul style="list-style-type: none"> <li>- Handles all API requests &amp; responses</li> <li>- Implements authentication &amp; security</li> <li>- Manages orders, products, and textile waste exchange</li> <li>- Stores and retrieves sustainability impact data</li> </ul>	<ul style="list-style-type: none"> <li>- <b>User Authentication</b> (Login/Register)</li> <li>- <b>Product &amp; Waste Listings</b> (CRUD operations)</li> <li>- <b>Order Management</b> (Track purchases)</li> <li>- <b>Messaging &amp; Notifications</b> (Contact sellers)</li> <li>- <b>Sustainability Metrics</b> (Waste reduction, CO2 tracking)</li> </ul>	<ul style="list-style-type: none"> <li>- /api/auth/register (User registration)</li> <li>- /api/auth/login (User login)</li> <li>- /api/orders (Fetch user orders)</li> <li>- /api/waste/create (Submit textile waste listing)</li> <li>- /api/impact (Retrieve sustainability metrics)</li> </ul>
Database (Storage & Data Management)	NeDB (NoSQL Lightweight Database)	<ul style="list-style-type: none"> <li>- Stores structured data related to users, products, and transactions</li> <li>- Optimized for fast</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Stores User Profiles</b> (Name, email, orders)</li> <li>- <b>Stores Product &amp; Waste Data</b> (Material,</li> </ul>	<ul style="list-style-type: none"> <li>- /api/db/users (Store &amp; fetch user data)</li> <li>- /api/db/products (Store product details)</li> </ul>

		read/write performance - Supports filtering, searching, and sorting of textile waste data	category, price, location) - <b>Search &amp; Filtering Support</b> (Efficient queries) - <b>Sustainability Tracking Data</b> (Waste diverted, CO2 saved)	- /api/db/waste (Store waste materials) - /api/db/impact (Track sustainability metrics)
File Storage & Media Handling	Cloud Storage / Local File System	- Handles image uploads for textile waste and products - Stores and retrieves images efficiently - Ensures secure and scalable file management	- <b>Secure Image Uploads</b> (Products, Waste Listings) - <b>Optimized Image Storage</b> (Performance boost) - <b>User-Generated Content Support</b> (Easy uploads)	- /api/upload/image (Upload product/waste images) - /api/media/fetch/:id (Retrieve stored images)
Authentication & Security	JWT (JSON Web Token), bcrypt.js	- Ensures secure access and authentication - Protects user data with hashed passwords - Implements session management and role-based access	- <b>User Login &amp; Registration</b> (Email & password) - <b>Token-Based Authentication</b> (JWT for security) - <b>Session Management</b> (Auto-login)	- /api/auth/login (Login user) - /api/auth/logout (Logout user) - /api/auth/verify (Verify session)
Future Enhancements	Mobile App, Real-time Updates, AI Recommendations	- Expand to mobile platforms (React Native) - Implement <b>AI-based product recommendations</b> - Add <b>Live Chat for Buyers &amp; Sellers</b> - Improve <b>real-time sustainability tracking</b>	- <b>Mobile App Development</b> (iOS/Android) - <b>AI-powered Recommendations</b> (Sustainable choices) - <b>Real-time Chat Feature</b> (Seller-buyer messaging) - <b>Advanced Impact Analytics</b> (CO2 reduction tracking)	- /api/recommendations (AI-based suggestions) - /api/chat (Live messaging API)

## Key Takeaways

- This architecture follows a **modular, full-stack approach** with **React.js frontend, Node.js backend, and NeDB database**.
- The **Textile Waste Marketplace & Sustainable Shopping** are key features that support the **circular economy** for textiles.
- The system will be enhanced with **AI, real-time chat, and mobile support** in future updates.
- **Security & authentication** (JWT, bcrypt) ensure safe transactions.

---

**CONCLUSION**

EcoTextile is a groundbreaking digital platform that addresses the pressing environmental challenges of the textile industry by integrating sustainable e-commerce, textile waste exchange, and real-time sustainability tracking. The platform provides a centralized solution for businesses, designers, and individuals to access eco-friendly textiles, repurpose textile waste, and monitor their environmental impact. By fostering responsible material management and promoting circular economy practices, EcoTextile plays a crucial role in reducing landfill waste, minimizing carbon footprints, and encouraging ethical consumption.

The system architecture of EcoTextile ensures scalability, efficiency, and ease of integration with future technologies. With a robust backend powered by Node.js and Express, a modern and user-friendly React frontend, and an intelligent sustainability tracking module, the platform delivers seamless user

experiences while maintaining high performance. The incorporation of AI-powered textile sorting and blockchain-based supply chain transparency in future developments will further enhance the platform's ability to promote sustainable practices and trace the lifecycle of textile products.

A strong emphasis on ethical and privacy considerations ensures that EcoTextile is not only an innovative solution but also a fair and secure platform. User data protection measures such as encryption, role-based access control, and GDPR compliance provide a secure browsing and transaction experience. Meanwhile, sustainability transparency, supplier verification, and AI bias mitigation ensure that the platform remains an inclusive and trustworthy space for ethical textile trade.

Despite its potential, EcoTextile faces challenges such as adoption barriers, scalability constraints, and quality assurance for listed textile waste. However, through strategic improvements, including AI-driven material classification, expanded global accessibility, and increased industry collaborations, these obstacles can be overcome. The platform's ability to provide actionable sustainability insights and real-time tracking of environmental impact gives businesses and individuals the necessary tools to make informed, responsible choices.

Looking ahead, EcoTextile aims to revolutionize sustainable textile management by continuously innovating and expanding its capabilities. The planned introduction of mobile applications will increase accessibility, allowing more users to engage with sustainable textile practices conveniently. Furthermore, enhanced data analytics and reporting tools will provide deeper insights into waste reduction efforts and carbon footprint savings, strengthening the platform's role as a leader in sustainable fashion and textile trade.

In conclusion, EcoTextile is more than just a platform—it is a movement toward a more responsible, ethical, and sustainable textile industry. By leveraging technology, fostering collaboration, and prioritizing environmental stewardship, EcoTextile empowers businesses and individuals to make sustainability an achievable and impactful reality. As the demand for eco-friendly solutions grows, EcoTextile stands as a pioneering force, shaping the future of textiles with innovation, responsibility, and commitment to a greener planet.

### Case Study

#### 1. Project Goal

##### Objective

EcoTextile is a full-stack web platform designed to **reduce textile waste and promote sustainability**. The platform serves as a **marketplace for eco-friendly textiles and a textile waste exchange**, connecting businesses, designers, and consumers to help create a **circular economy**.

##### Key Goals

- **Reduce Textile Waste** – Prevent reusable textiles from ending up in landfills.
- **Promote Sustainable Commerce** – Provide a marketplace for sustainable textile products.
- **Encourage Upcycling & Recycling** – Connect waste producers with designers who can repurpose materials.
- **Track Environmental Impact** – Measure waste reduction and CO2 emissions saved.

#### 2. System Features

##### A. Textile Waste Marketplace

- **Buy & Sell Waste Materials** – Users can list textile waste for sale or find materials for upcycling.
- **Filter & Search** – Browse by material type, location, and price.
- **Contact Seller Option** – Direct negotiation between buyers and sellers.
- **Listing Submission** – Users can upload textile waste materials for others to reuse.

*Example:* A fashion designer purchases **cotton fabric scraps** from a manufacturer instead of using new material.

##### B. Sustainable Textile E-Commerce

- **Browse Eco-Friendly Products** – Users can shop for sustainable fabrics, clothing, and accessories.
- **Add to Cart & Wishlist** – Save items for future purchases.
- **Secure Checkout Process** – Payments handled securely.

*Example:* An ethical clothing brand purchases **organic hemp thread sets** instead of synthetic threads, reducing microplastic pollution.

##### C. Sustainability Tracking & Analytics

- **Monitor Impact Metrics** – Track waste diverted, CO2 emission reduction, and total sustainable transactions.
- **User & Business Reports** – Users can see their sustainability contributions.

*Example:* A sustainable fashion company reports **50% waste reduction**, improving its **brand reputation**.

### 3. Administration Module

The **Admin Panel** is responsible for overseeing the system and ensuring smooth operations.

Key Admin Features

- **User Management** – View, verify, and manage user accounts.
- **Product & Waste Listings Approval** – Moderate submissions for quality control.
- **Transaction Monitoring** – Track orders, payments, and dispute resolution.
- **Impact Reports** – Generate sustainability impact reports.
- **Security & Authentication** – Manage platform security and prevent fraudulent activities.

*Example:* Admins approve **new textile waste listings** to ensure quality control before they appear in the marketplace.

### 4. Development Process

#### A. Technology Stack

Component	Technology Used
<b>Frontend (UI/UX)</b>	React.js, Material UI, Axios
<b>Backend (API &amp; Business Logic)</b>	Node.js, Express.js
<b>Database (Storage &amp; Management)</b>	NeDB (NoSQL)
<b>Authentication &amp; Security</b>	JWT (JSON Web Token), bcrypt.js
<b>File Storage</b>	Cloud / Local Storage

#### B. Development Phases

##### 1. Planning & Research

- Conducted industry research on textile waste management.
- Identified user needs and target audience.

##### 2. System Design & Prototyping

- Designed the **database schema** and API structure.
- Created wireframes for UI using **Figma**.

##### 3. Frontend & Backend Development

- Developed the **React.js frontend** for an intuitive user experience.
- Implemented the **Node.js backend** for API handling.
- Integrated **NeDB for storing products, users, and sustainability metrics**.

##### 4. Testing & Deployment

- Conducted **unit testing, integration testing, and UI testing**.
- Optimized performance and **deployed the system on a cloud server**.

##### 5. Future Enhancements

- **Mobile App Development** – Expanding to iOS & Android.
- **Real-Time Chat Feature** – Enabling direct communication between buyers and sellers.
- **AI-Based Sustainable Recommendations** – Suggesting eco-friendly alternatives.
- **Blockchain for Supply Chain Transparency** – Ensuring traceability of sustainable textiles.



---

#### 4. BIBLIOGRAPHY

---

- Ellen MacArthur Foundation. (2017). *A New Textiles Economy: Redesigning Fashion's Future*. Retrieved from [www.ellenmacarthurfoundation.org](http://www.ellenmacarthurfoundation.org)
- Fletcher, K., &Tham, M. (2019). *Sustainable Fashion and Textiles: Design Journeys*. Routledge.
- Sandin, G., & Peters, G. M. (2018). Environmental impact of textile reuse and recycling – A review. *Journal of Cleaner Production*, 184, 353-365.
- Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., &Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, 1(4), 189-200.
- Payne, A. (2015). Open and closed-loop recycling of textile and apparel products. *Textile Progress*, 47(4), 219-317.
- Bocken, N. M. P., de Pauw, I., Bakker, C., & van der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering*, 33(5), 308-320.
- MacArthur, E. (2013). *Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition*. Ellen MacArthur Foundation.
- Gwilt, A. (2020). *Fashion Design for Sustainability*. Bloomsbury Publishing.
- Koszewska, M. (2018). Circular economy—Challenges for the textile and clothing industry. *Autex Research Journal*, 18(4), 337-347.
- European Environment Agency. (2019). *Textiles in Europe's Circular Economy*. Retrieved from [www.eea.europa.eu](http://www.eea.europa.eu)