Navigating E-Commerce Frontiers: AI and Machine Learning in Women's Empowerment

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Article Info	ABSTRACT

This research examines the transformative role that Artificial Intelligence (AI) plays in advancing women's empowerment, with a particular focus on the e-commerce industry. The study's focus is on the integration process of cutting-edge machine learning algorithms and assessing their impact through the System Usability Scale (SUS). This approach ensures not only the technical efficacy of the AI solutions but also their user-centered design, focusing on actual user satisfaction. The beta version of the proposed system has been rigorously tested in real-life scenarios, achieving a favorable SUS score. This outcome validates the system's usability and its potential effectiveness in real-world applications.

Ultimately, this project aims to have a global impact by using AI not only as a technological tool but also as a catalyst for creating new business opportunities, providing online support, and elevating the discourse around women's empowerment in the digital world. By doing so, it seeks to offer a scalable and impactful solution to empower women, leveraging the vast potential of AI in the e-commerce sector.

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1. INTRODUCTION

Women's empowerment, a movement that began in earnest in the 1970s, has consistently aimed at social justice and gender equality [1, 2]. Initially responding to the needs of oppressed women who lacked the ability to make their own life decisions, the concept has since evolved [3]. Today, women's empowerment is widely understood as the process by which women, particularly those facing oppression, gain the capacity to make autonomous and strategic decisions based on their personal priorities, and then implement these decisions by utilizing resources, agency, and capabilities [4].

While strides have been made, women continue to encounter unfavorable socioeconomic determinants of health, such as being disproportionately represented in low-paying [5], insecure jobs, and experiencing lower levels of education and literacy, especially in rural and immigrant populations. Furthermore, their predominant roles in child-rearing and household management contribute to a global disadvantage [6]. This is exacerbated by the scarcity of affordable, high-quality childcare options, leading to a greater prevalence of women in part-time work and perpetuating their presence in low-income households. In this context, gender emerges as a critical social determinant of health, influenced by cultural norms, roles, personality traits, attitudes, relative power, and influence [7].

In this landscape, the potential of Artificial Intelligence (AI) and Machine Learning (ML) in revolutionizing women's empowerment, especially through e-commerce, is immense. This paper introduces a

novel web application that integrates machine learning, designed specifically to facilitate women's access to employment opportunities. The application not only recommends potential job opportunities but also provides insights and guidance tailored to the unique profiles of its women users. By doing so, it addresses key barriers to women's empowerment, offering a technologically advanced solution that aligns with their need for flexible, accessible, and empowering employment opportunities. This study aims to demonstrate how AI and ML can be instrumental in navigating the new frontiers of e-commerce, thereby contributing significantly to the empowerment of women in a digital age.

The paper is organized into several key sections to ensure a coherent and comprehensive exploration of the subject. It begins with an Introduction that sets the stage for the research, outlining its objectives and significance. This is followed by the Literature Review in Section 2, where existing research is critically examined to provide context and identify gaps that this study addresses. In Section 3, the Methodology is presented, detailing the approaches and techniques employed in the research. The Result Analysis is explored in Section 4, where the findings of the study are presented and scrutinized. Finally, Section 5 is dedicated to Discussions, where the implications of the findings are explored, and their relevance to the broader context of women's empowerment in e-commerce is discussed

2. Literature Review

The growing cost and demand for energy have motivated many organizations to seek efficient ways to monitor, control, and reduce energy consumption [8]. An intelligent Energy Management System (EMS) can help cut costs while still meeting energy needs. The emerging technologies of the Internet of Things (IoT) and Big Data can be harnessed to optimize energy consumption in the residential, commercial, and industrial sectors. This paper [9] presents an EMS designed for smart homes. Each home device is interconnected with a data acquisition module, which is an IoT object with a unique IP address, resulting in a vast wireless mesh network of devices. The proposed system [10] on Chip (SoC) module collects energy consumption data from each smart home device and transmits the data to a centralized server for analysis and processing. This information from all residential areas is accumulated in the utility's server as Big Data. The suggested EMS employs off-the-shelf Business Intelligence (BI) and Big Data analytics software packages to manage energy consumption more effectively and meet consumer demand. As air conditioning accounts for 60% of electricity consumption in Arab Gulf countries, HVAC (Heating, Ventilation and Air Conditioning) units have been chosen as a case study to validate the system. However, a prototype was constructed and tested in the lab to simulate small residential HVAC systems.

The authors of this study [11] driven by major corporations such as Amazon, Google, Facebook, Uber, Alibaba, Tencent, etc., is drastically reshaping how we work and socialize, and is significantly impacting employment. The disruption caused by key technologies including artificial intelligence, the Internet of Things (IoT), big data, behavioral/predictive analytics, and blockchain technologies, presents the greatest potential for the public sector to revolutionize the way governments interact with citizens, make policy decisions, and manage national infrastructure. The integration of sophisticated data and analytics infrastructures with trusted record-keeping concepts, such as blockchain distributed ledger and smart contract technologies, may offer a viable framework for redefining public services in a decentralized, cost-effective, efficient, and personalized manner.

Potential application [12] areas for these technologies in the public sector include the use of big data and behavioral predictive analytics for policy development, the automation of courts using AI-based judicial systems and online dispute resolution, and the real-time management of national infrastructure using IoT technology. This paper utilizes a simple taxonomy of government as the basis for discussing public sector automation, which includes the following categories: public services (interaction and delivery of services to citizens, answering inquiries, automating services, election processes, etc.), supporting civil servants (intelligent tools to support civil servants, robo-advisors, case management, impact/performance monitoring), national public records (maintaining public records and correspondence, forms and submissions, correspondences, personal/citizen data), national physical infrastructure (maintaining and operating public infrastructure, smart environments, infrastructure planning, transport/communication/ environment/ health/ education/ security), statutes and compliance (maintaining laws and statutes, managing courts, judiciary, police, etc., laws and statutes, trials and prosecution, dispute resolution), and public policy development (developing public policy, supporting civil servants and politicians, evidence base, robo-advisors for policymakers).

The concept of CSDS [13] makes the computing process more actionable and intelligent than traditional cybersecurity methods. In today's era, with the increasing literacy rate of women, their involvement in various fields, including the digital world, is on the rise. While the invention of the digital world, the World Wide Web, mobile phones, and tabs have improved women's living standards, they have also brought negative effects, such as cybercrime, which poses a threat to women's safety. Women are now being harassed not only in the workplace, streets, and public transportation but also in cyberspace, where they are exposed to cyber defamation, sexual harassment, abuse, pornography, and email misrepresentation.

The above study in question did not focus on machine learning and web application solutions for women's empowerment. Notably, there appears to be a lack of research on using machine learning or similar techniques to address issues faced by women globally. Our goal extended beyond just developing a system; we aimed to create a cutting-edge web application technology. This technology is designed to assist women and other individuals in finding employment or other daily necessities easily through our system. Consequently, we have proposed a comprehensive solution that enables users to access a variety of options in one place, ensuring that women and other vulnerable individuals can simultaneously find all the alternative solutions they need.

3. Methodology

The methodology of this research is two folds: Proposed System Model (PSM) and AI-Enabled System Modeling (ASM).
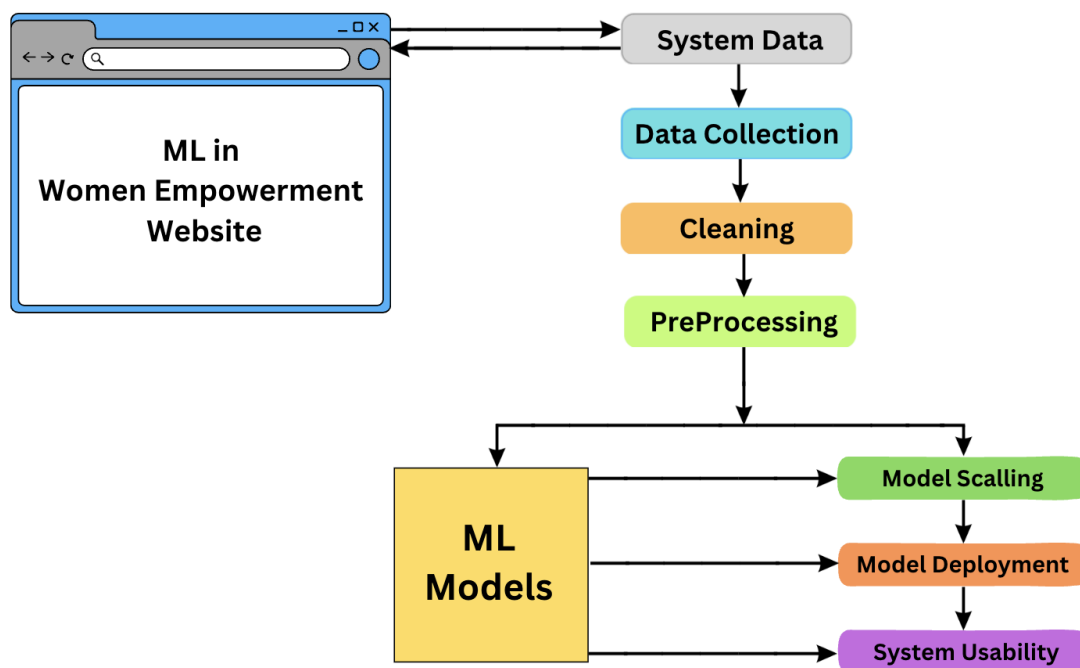

Figure 1. Conceptual representation of the machine learning models and their potential application in the women in empowerment based applicaton

3.1 Proposed System Model (PSM)

Use case analysis is a fundamental approach in software and system engineering that aims to understand how a user interacts with a system to achieve a specific goal. This method is crucial in defining the functionalities to be implemented and addressing any potential issues. In a use case, there are three main elements: Actors, who represent the types of users interacting with the system; the System itself, which includes the functional requirements and the intended behavior of the system; and Goals, which describe the

activities and variations involved in achieving an objective. Use cases are commonly represented using the Unified Modeling Language (UML), depicted as ovals containing the name of the use case. Actors are shown as lines with their names written below, while a line connecting an actor and the use case indicates their participation. The system boundary is indicated by boxes surrounding the use case.

Use cases have several characteristics, including organizing functional requirements, modeling the goals of user interactions with the system, recording scenarios from initial trigger events to final goals, describing standard and exceptional event flows, and allowing users to access the functionality of another event. The process of designing use cases begins with identifying the system's users, followed by creating detailed profiles for each user category relevant to the system. Each significant goal for each role is identified, in line with the system's value proposition. For every identified goal, a use case is created using a consistent template, maintaining the same leve l of abstraction. Each higher-level use case step is treated as a goal for the lower level. Finally, the use cases are structured, reviewed, and validated with the users to ensure they effectively meet the system's objectives.

In our study, the PSM consists of several modules: About, Training, Products, Blog, FAQ, Approve, Login and Register. These modules will be accessible by the two controllers such as admin and users. In Figure 1, the architecture of the PSM is demonstrated where user and admin can access certain modules.
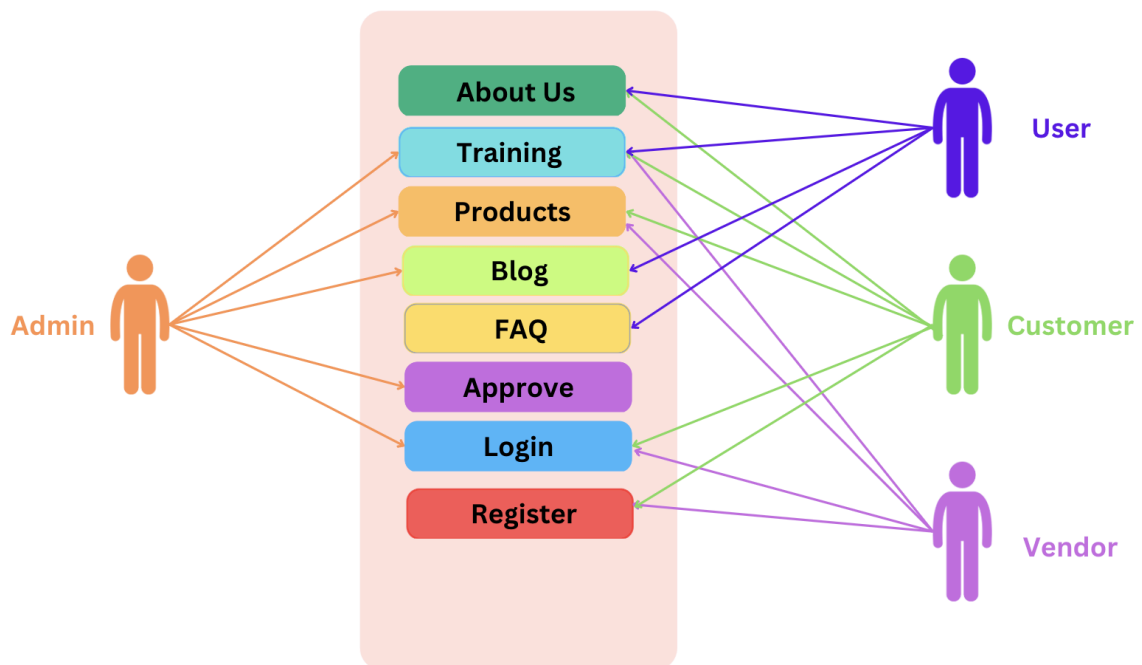

Figure 2: Demonstrating the use case diagram for the proposed application in terms of the women empowerment

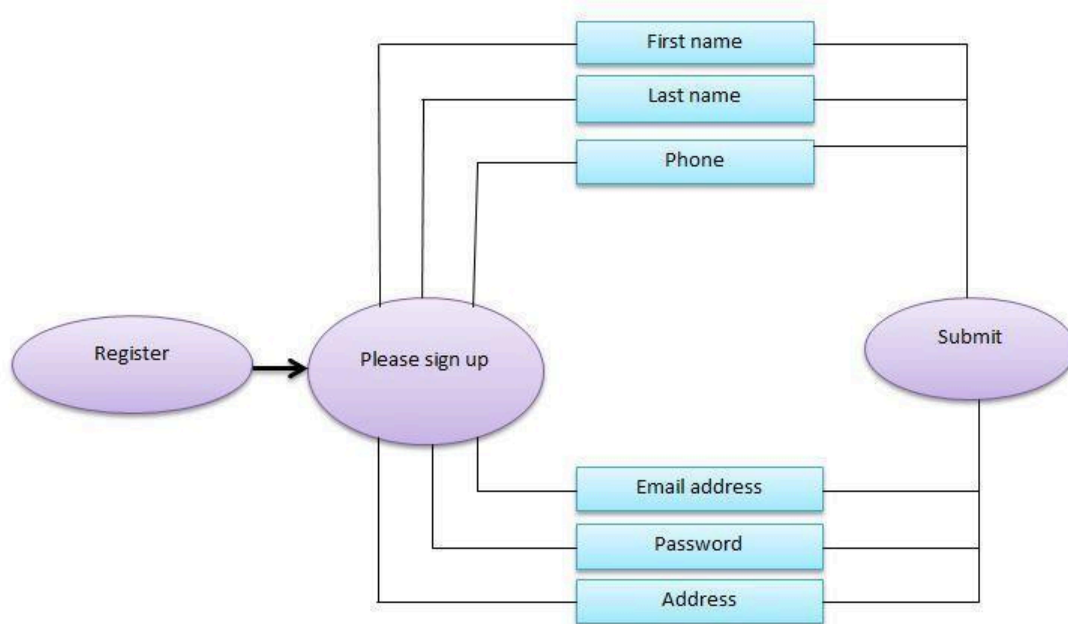### 3.1.1 Registering Customer into PSM

Figure 3: Architecture design of the customer registration process in PSM

3.1.2 System Controlling via Administration

Administration involves a wide range of activities that are focused on organizing and supervising the operations within an organization or institution. It comprises various modules that are essential for the effective functioning of the system. These modules include the 'Go to Site' module, which serves as the entry point into the system; the 'Dashboard', which provides an overview and control panel for various activities; the 'Product Categories' and 'Product' modules, which manage the classification and details of products; the 'Customer' and 'Vendor' modules, which are responsible for managing information and interactions with customers and vendors respectively; the 'Users' module, which handles the administration of user accounts; the 'Posts' module, which manages content or updates; the 'Settings' module, which allows for customization and configuration of the system; and finally, the 'Logout' module, which ensures secure exits from the system. Each of these modules is crucial for the efficient administration of the organization's operations.

3.1.3 Payment Gateway

The relationship between customers and vendors is a vital element of our platform that necessitates diligent administration to guarantee smooth transactions and interactions. It is essential for customers to possess efficient control mechanisms when collaborating with vendors, particularly when it comes to product information. One of the significant enhancements we are implementing is the display of the seller's phone number within the product details section. This addition aims to improve communication between customers and vendors, fostering a more direct and personal connection.

In terms of payment methods, our system is structured in such a way that the overall payment process primarily relies on the seller. This approach empowers vendors to select payment options that best align with their business model, offering flexibility and catering to a wide range of customer preferences.

3.2 AI-Enabled System Modeling (ASM)

This section is divided into several parts: Data Collection Paradigm (DCP), Real-time Data Cleaning Pipeline, Mathematical ML-enabled Model and Model Scaling and Integration to PSM.

3.2.1 Data Collection Paradigm (DCP)

Incorporating machine learning into the proposed women empowerment-focused PSM system necessitates a strategic approach to data collection. Our method centers on gathering data through user

interactions, with a primary focus on information obtained during user registration, transactional data, and engagement on the platform. When users register, they provide valuable demographic information like name, age, location, and interests, forming a foundational dataset for our machine learning algorithms. Additionally, we collect transactional data from subscriptions, donations, or purchases to gain insights into user financial behaviors and preferences. User interactions, including website navigation, resource utilization, forum participation, and responses to empowerment initiatives, are meticulously tracked to understand engagement levels and effectiveness. We also place a strong emphasis on user feedback and surveys to gain direct insights into user experiences and areas for improvement. Paramount to our approach is the commitment to data privacy and security, adhering to stringent data protection regulations and ensuring users are well-informed about the use and safety of their data. This rich collection of data enables our machine learning algorithms to personalize user experiences, identify patterns and trends, and develop predictive models, thus continually enhancing the effectiveness of the PSM system in empowering women globally.

3.2.2 Real-time Data Cleaning Pipeline

In the PSM system, real-time data collection is a key feature, enabling the platform to dynamically adapt and personalize the user experience as interactions occur. This involves continuous gathering of data from user registrations, transactions, and activities. To maintain the quality and relevance of this data, a robust data cleaning process is implemented. Initially, as data streams in, it undergoes an initial filtering to remove errors or irrelevant information. This is followed by validation and verification checks to ensure data consistency and accuracy, such as verifying registration details for logical consistency. Data from various sources is then normalized to a standard format, essential for handling diverse data types like transactional information and user interactions. The system also addresses missing data, employing strategies like data imputation or exclusion based on the context. Anomaly detection through machine learning algorithms plays a crucial role in identifying outliers that could indicate errors or emerging trends. Importantly, this data cleaning process is not static but involves regular updates and maintenance to adapt to changing data patterns and user behavior. Regular audits and quality checks ensure the integrity and quality of the cleaned data, allowing the PSM system to effectively leverage machine learning in empowering women, ensuring that the data reflects true user behaviors and preferences.

3.2.3 Mathematical ML-enabled Model
For the PSM system focusing on women's empowerment, incorporating machine learning models can significantly enhance the effectiveness of your platform.
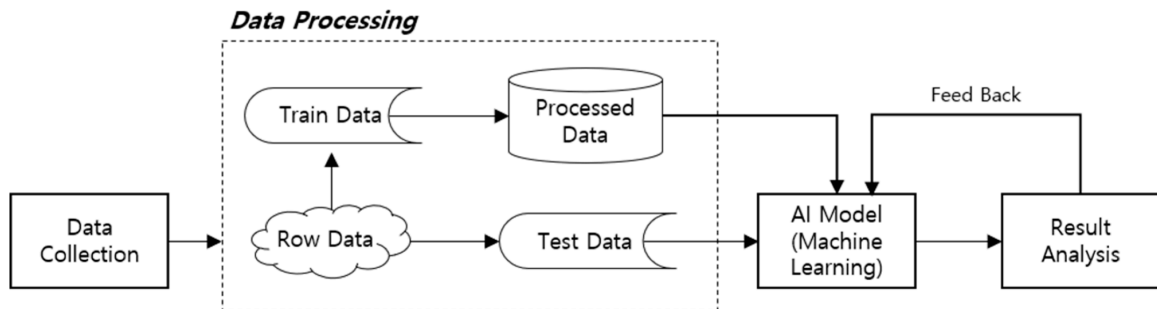

Figure 4: AI/ML-driven pipeline in terms of collecting data, cleaning and modeling for the proposed system

Here are two mathematical models that will be integrated:

- **User Engagement Prediction Model:** This model predicts user engagement levels based on their interactions with the platform. It can help in identifying users who are most likely to benefit from additional resources or support. The mathematical framework can be interpreted below:

Model: Logistic Regression

$$P(Y = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n)}}$$

Here, Y: User engagement level (1 for high engagement, 0 for low engagement. User features (e.g., frequency of logins, time spent on platform, interaction with content, transaction history). $X_1, X_2, ..., X_n$: User features (e.g., frequency of logins, time spent on platform, interaction with content, transaction history). $\beta_0, \beta_1, ..., \beta_n$: Coefficients representing the impact of each feature on engagement. By training this model with historical user data, the system can predict which users are likely to be more engaged and thus may benefit from targeted empowerment initiatives.

- **Personalized Recommendation Model:** This model provides personalized content and resource recommendations to users, enhancing their experience and engagement with the platform. The model learns from user-item interactions (such as resource usage, forum participation) to predict user preferences. This enables the system to recommend resources, events, or discussions that are most relevant and beneficial to individual users.

Model Type: Collaborative Filtering using Matrix Factorization

$$\hat{r}_{ui} = \mu + b_u + b_i + q_i^T p_u$$

Here, $\hat{r}_{ui}$: Predicted rating of item i by user u, μ: Global average rating. b_u, b_i: User and item bias terms. q_i, p_u: Latent factors for items and users.

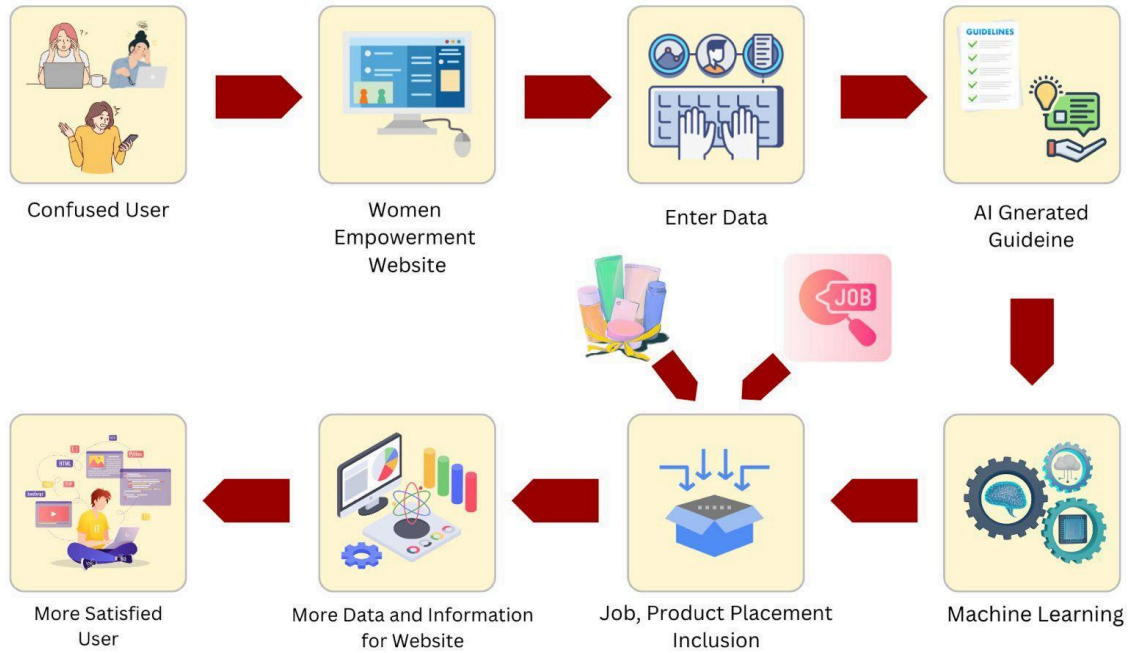### 3.2.4 Model Scaling and Integration to PSM

Figure 5: AI/ML-driven pipeline in terms of collecting data, cleaning and modeling for the proposed system

Integrating and scaling the User Engagement Prediction Model and the Personalized Recommendation Model within the PSM system is a multi-faceted process. Initially, the models are embedded into the platform's architecture, which involves setting up APIs or microservices for real-time data exchange. Simultaneously, a robust data pipeline is developed to ensure continuous and efficient data flow for model inputs, encompassing collection, cleaning, normalization, and structuring of user data. The user interface of the PSM system is also adapted to display model outputs, like personalized recommendations or engagement insights, enhancing user interaction. For scaling, cloud computing resources are employed to

manage the increased data volume and computational needs, ensuring the models can handle growing user numbers without compromising performance. Automated scaling techniques are applied to dynamically adjust resources based on the load, ensuring cost-efficiency and system responsiveness. Moreover, continuous monitoring and updating mechanisms are established, not only to track the models' performance but also to refine them regularly based on new data and user feedback. This comprehensive approach to integration and scaling ensures that the PSM system remains agile, user-centric, and capable of leveraging machine learning to effectively empower women.

4. Result Analysis

4.1 Measuring the System Usability (MSU)

Measuring the System Usability (MSU) in the PSM platform involves a comprehensive approach to ensure the platform is user-friendly and effective in its mission to empower women [14]. This assessment starts with conducting regular user satisfaction surveys, which provide direct feedback on various aspects such as ease of use, navigation, content relevance, and overall user satisfaction with the platform. Alongside, usability testing sessions are organized periodically, where users are observed performing specific tasks on the platform, allowing for the identification of any user experience issues or barriers. Additionally, system interaction analytics play a crucial role [15], where key performance indicators (KPIs) such as average session duration, bounce rate, and user retention rates are closely monitored. These metrics offer quantitative insights into how users interact with the system, highlighting areas for improvement. The combination of direct user feedback, observational testing, and analytical data ensures a thorough understanding of the system's usability, guiding continuous enhancements to make the PSM platform more intuitive, engaging, and supportive for its users.
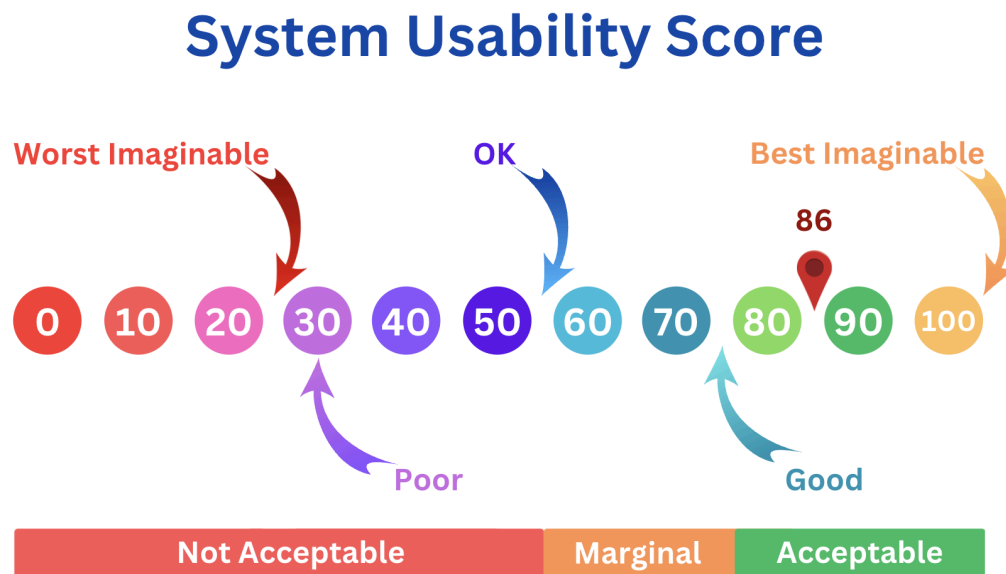
Figure 6: System Usability Scale (SUS) for the proposed system

4.2 User Interface of the Proposed System

On this page, targeted visitors can access training videos. Watching these videos equips users with the knowledge to easily create products at home and sell them on our website. The platform specifically caters to women sellers. Additionally, users can avail themselves of free training resources available across our country, enhancing their skills and business capabilities.

Aware Women! Home About Us Training Products Blog FAQ Contact Log In / Register

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সমাজের প্রতিটি পদক্ষেপে আজ নারীরা এগিয়ে। দেশের প্রধানমন্ত্রী থেকে শুরু করে বিভিন্ন জরুরি বিভাগে নারীদের পদচারণা। কিন্তু ঘরে ঘরে নারীদের নিগ্রহ আর অবহেলা আজও শেষ হয়নি। পরিবার, সমাজ তথা দেশ নারীকে দিতে পারছে না তার প্রাপ্য অধিকার, নিরাপত্তা আর সহযোগিতা। নারীদের এগিয়ে চলার পথে সঙ্গী হতে পারে আমাদের এই ওয়েবসাইটটি। এখানে সবাই সাহায্য পেতে পারেন। কিন্তু নারীদের জন্য রয়েছে বিশেষ কিছু ব্যবস্থা। যে কোন নারী ইচ্ছে করলে যেকোনো পণ্য কেনাবেচা করতে পারবেন। হতে পারে তা হাতের তৈরি কোন কিছু থাবার অথবা আমদানিকৃত দ্রব্য। অনেকেই কাজ শেখার জন্য বাইরে যেতে চান না তাদের জন্য রয়েছে অনলাইন ট্রেনিং ব্যবস্থা। উল্লেখ্য যে এখানে ক্রেতা যে কেউ হতে পারবেন কিন্তু বিক্রেতা হবেন শুধু নারীরা। দেরী না করে আজই রেজিস্টার করুন।

(a)

Aware Women Home About Us Training Products Blog FAQ Helpline Log In / Register

পৃথিবীর সবচেয়ে সুন্দর সৃষ্টির নাম নারী। আপনি একজন নারী হলে গর্ববোধ করুন। আজকের পৃথিবী নারীদের জন্য নিরাপদ নয়। আপনি নারী হয়েছেন বলে এর মানে এই নয় যে আপনি সারাজীবন শুধু বাচ্চা লালন-পালন আর রান্না করবেন। সুতরাং সচেতন হন। আপনার মুক্তি আপনার ইচ্ছা শক্তিতে লুকিয়ে আছে।

TRAINING

নানা ধরণের সেলাই শিখে ফেলবেন এক মুহূর্তে

এখানে অনেক গুলো সেলাই দেখানো হয়েছে। ইচ্ছে করলে নিজের সাধারণ একটা জামায় সহজ কিছু সেলাইয়ের মাধ্যমে তা অসাধারণ করে তুলতে পারেন।

Hand Embroidery for Beginners - Part 2 | 10 Basic Stitch...

(b)

4.3 Comparing with the Existing System

Comparing the Measuring the System Usability (MSU) approach in the PSM platform with existing systems involves evaluating how our methods enhance user experience and system effectiveness, particularly in the context of women's empowerment. In many existing systems [16, 17], usability measurement often relies heavily on user feedback and satisfaction surveys[18]. While these are integral to our approach as well, the PSM platform goes a step further by incorporating usability testing sessions[19]. These sessions provide a more interactive and observational method to identify usability issues, a practice that may not be as extensively utilized in some existing systems. This allows for a more nuanced understanding of user interactions and challenges. Moreover, the emphasis on system interaction analytics in the PSM platform is more data-driven compared to some existing systems. By closely monitoring KPIs such as session durations, bounce rates, and user retention rates, we gain quantitative insights that are crucial for making informed decisions about system improvements. This analytical approach ensures that changes are not just based on subjective feedback, but are also backed by solid data[14]. While the PSM platform incorporates standard usability measurement techniques like user surveys, it distinguishes itself by adding in-depth usability testing and a strong emphasis on data analytics[20]. This combination ensures a more comprehensive understanding of user needs and behaviors, leading to a more user-centric and effective platform, especially in the realm of women's empowerment[21].

5. Discussions

In the context of the PSM system and similar women's empowerment platforms, several research gaps are evident. Firstly, there is a need for more comprehensive studies on the unique interaction patterns and preferences of women in digital empowerment platforms [22]. Understanding these nuances is crucial for designing more effective and engaging user experiences. Additionally, research on long-term impacts of such platforms on women's empowerment is relatively sparse. More longitudinal studies are required to assess the sustained effectiveness of digital empowerment initiatives. The PSM system, like many in its field, faces several challenges. One major challenge is ensuring the inclusivity and accessibility of the platform to a diverse range of women, particularly those with limited tech proficiency or access. Another challenge is maintaining user engagement over time. As user needs and digital landscapes evolve, keeping the platform relevant and continuously engaging becomes increasingly complex [23]. Additionally, data privacy and security remain critical concerns, especially given the sensitive nature of some of the data collected for machine learning purposes.

To effectively address the current challenges and research gaps in the PSM system, a multi-faceted approach for improvements is essential. Firstly, enhancing the platform's design to be more inclusive and accessible is crucial, taking into account varying levels of digital literacy and access among women. This could involve integrating multilingual support, creating more intuitive user interfaces, and possibly developing offline capabilities for broader reach [24]. Secondly, adopting a user-centric development process is vital. This involves actively engaging users in the development process through continuous feedback loops, usability testing sessions, and co-creation workshops, ensuring the platform evolves in alignment with the actual needs and preferences of its users. In terms of data security, implementing advanced and regularly updated data security protocols is paramount to protect user privacy. Maintaining transparent communication with users about the use and security of their data is also crucial for building trust. Another key area is the diversification of content and resources available on the platform. Regular updates and the introduction of varied materials, possibly through partnerships with experts, organizations, and content creators, will keep the platform engaging and relevant. Finally, ongoing research and collaboration with academic and research institutions are essential to address the existing research gaps. Such collaborations can bring more robust and evidence-based improvements to the platform, ensuring its effectiveness in empowering women in the digital age.
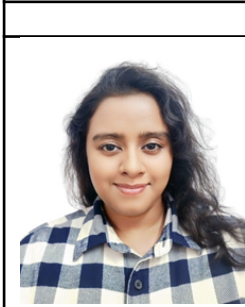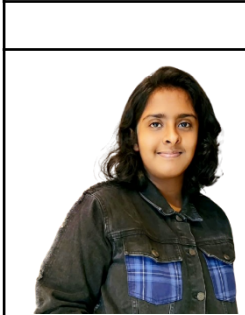
6. Conclusions

In conclusion, the PSM system represents a significant step forward in leveraging digital technology for women's empowerment. Through the integration of machine learning models like the User Engagement Prediction Model and the Personalized Recommendation Model, the system has the potential to offer a highly personalized and engaging experience to its users. However, the journey towards creating an impactful digital empowerment platform is ongoing and requires continuous refinement and adaptation. The identified challenges, such as ensuring inclusivity and accessibility, maintaining user engagement, and securing data privacy, highlight the complex nature of this endeavor. The suggested improvements, including adopting an inclusive design, focusing on user-centric development, enhancing data security measures, diversifying content, and fostering ongoing research collaborations, are not just solutions but stepping stones towards creating a more effective and impactful platform. As the PSM system evolves, it must remain agile and responsive to the changing needs and behaviors of its users. The commitment to addressing these challenges and continuously improving based on user feedback and research insights is what will ultimately drive the success of the platform. The PSM system, therefore, stands not just as a tool for empowerment but as a symbol of the transformative power of technology when aligned with the needs and aspirations of women worldwide.

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