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Optimization Of An Online Store Price Recommendation System Using Hybrid

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Abstract – Recommender Systems (RSs) are software tools and techniques that provide suggestions for items that are most likely of interest to a particular user. We take a look at the online-store price recommendation system, the processes and methodology and the steps taken to design the system. We will also evaluate the research methodology and elaborate on the basic functionalities of the recommendation system. Store price Recommender Systems (RSs) are software tools and techniques that provide suggestions for products that are most likely of interest to a particular user. This paper aim to design and develop an online store price recommendation system using Hybrid techniques, its goal is to suggest viable products to users and also provide real time cost/price of products. The system is based on user's evaluation of items or previous purchases records. However, this has been known to expose two major issues: sparsity problem and scalability problem The proposed system is designed using the Object-Oriented Analysis and Design Methodology (OOADM) owing to the fact that it is a data driven methodology and concentrates on several views and perspectives of data. The system to be developed is an online web application that allows interaction from both user and administrator.

Keywords – ***Online store, recommendation system, Hybrid techniques.***

I. INTRODUCTION

Recommender Systems (RSs) are software tools and techniques that provide suggestions for items that are most likely of interest to a particular user [1]. The suggestions relating to various decision-making processes, such as what items to buy, what music to listen to, or what online news to read. "Item" is the general term used to denote what the system recommends to users. An RS normally focuses on a specific type of item (e.g., products or news) and, accordingly its design, its graphical user interface, and the core recommendation technique used to generate the recommendations are all customized to provide useful and effective suggestions for that specific type of item. RSs are primarily directed toward individuals who lack sufficient personal experience or competence in order to evaluate the potentially overwhelming number of alternative items that a website, for example, may offer [2]. On the popular website, Amazon.com, the site employs an RS to personalize the online store for each customer [3]. Since recommendations are usually personalized, different users or user groups benefit from diverse, tailored suggestions. In addition, there are also non-personalized recommendations. The development of RSs initiated from a rather simple observation: individuals often rely on recommendations provided by others in making routine, daily decisions [4]. For example, it is common to rely on what one's peers recommend when selecting a book to read; employers count on recommendation letters in their recruiting decisions; and when selecting a movie to watch, individuals tend to read and rely on the movie reviews that a film critic has written, which appear in the newspaper they read. In seeking to mimic this behavior, the first RSs applied algorithms in order to leverage recommendations

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produced by a community of users and deliver these recommendations to an "active" user, or a user looking for suggestions. The recommendations were for items that similar users, or those with similar tastes, had liked. As e-commerce websites began to develop, a pressing need emerged for providing recommendations derived from filtering the whole range of available alternatives. Users found it difficult to arrive at the most appropriate choices from the immense variety of items (products and services) that these websites offer.

II. THEORITICAL BACKGROUND

Recommender systems have become an important research field since the emergence of the first paper on collaborative filtering in the mid-1990s [5], [6]. Recommender systems are broadly classified into collaborative filtering (CF) and content-based filtering (CB). CF is an information filtering technique based on user's evaluation of items or previous purchases records. However, this has been known to expose two major issues: sparsity problem and scalability problem [7]. CB analyzes a set of items rated by an individual user and uses the content of these items, as well as the provided ratings, to infer profile that can be used to recommend additional item of interest [8]. However, syntactic nature of CB to detect similarity between items that share the same attributes or features causes overspecialized recommendations that only include very similar items to those the user already knows [9]. Over the last decade, lots of researchers have studied new approaches of recommender systems to solve these problems of CF and CB, and to apply them into real world problems. Especially, applications of data mining techniques to recommender systems have been effective to offer personalized information to the user through analysis of his/her preference.

2.1 THE TECHNOLOGICAL APPROACH

The choice of technologies for the development of this research work comprise of **Visual Studio code**, **Python**, **MySQL, JavaScript**, **Bootstrap, Bootstrap.** Below are some illustrations on how the above listed technologies were used in the development of this research. The following includes the different technologies used during the creation of this project work.

1. **Visual Studio code**: Visual Studio Code is a source-code editor developed by Microsoft for Windows, Linux and macOS. It includes support for debugging, embedded Git control and GitHub, syntax highlighting, intelligent code completion, snippets, and code refactoring. I choose to use VSC it is one of the best text editors for web development. It is fast, light weight and has powerful tools which makes development easier.

2. **Python**:

   Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Python had to be used because it is the best language currently for data science projects. The website will make use of models and algorithm which can only best be implemented in python.

3. **MySQL**

MySQL is an open-source relational database. "SQL", the abbreviation for Structured Query Language. The web application will need a database to interact with, MySQL is one of the best and most used databases for adding, accessing and managing contents in a database. It is very flexible, reliable and easy to use. It also has quick response.

4. **JavaScript**:

   JavaScript is a high-level, interpreted programming language that conforms to the ECMAScript specification. JavaScript has curly-bracket syntax, dynamic typing, prototype-based object-orientation, and first-class functions.

5. **jQuery**:

   JQuery is a JavaScript library designed to simplify HTML DOM tree traversal and manipulation, as well as event handling, CSS animation, and Ajax. It is free, open-source software using the permissive MIT License.

6. **Bootstrap**:

   Bootstrap is an open source toolkit for developing with HTML, CSS, and JS. Quickly prototype your ideas or build your entire app with our Sass variables and mixings, responsive grid system, extensive prebuilt components, and powerful

plugins built on jQuery. One of the major reasons of choosing bootstrap is for responsiveness of the system i.e. the website can fit in a display correctly.

2.2 REVIEW OF RELATED LITERATURE

In this section, we survey some of the previous approaches used by researchers for online-store price recommendation system. Various approaches have been used and they can be roughly grouped into collaborative filtering (CF) and content-based filtering (CB). Below, we give a brief review of research studies that have been conducted using these approaches. CF is an information filtering technique based on user's evaluation of items or previous purchases records. However, this has been known to expose two major issues: sparsity problem and scalability problem [7]. CB analyzes a set of items rated by an individual user and uses the content of these items, as well as the provided ratings, to infer profile that can be used to recommend additional item of interest.

According to [10], Presented a personalized news system, named PIN. PIN retrieves and ranks news articles according to the user's profile, which is initially defined by the user as a list of keywords and then learned from user feedback using neural network technology. When interacting with PIN, users provide explicit feedback by rating the articles. These systems build user profiles from information explicitly provided by the user or implicitly observed in user activities. The profiles are then compared with the content of news articles to generate personalized recommendations.

In [11], implemented a WebClipping2 uses a Bayesian Classifier in order to calculate the probability that a specific article would be interesting to the user. Rather than requiring users to provide explicit feedbacks, WebClipping2 observes the total reading time, number of lines read and some other characteristics of user behavior to infer the user's interests.

According to [12], uses a proxy to collect user's page clicks and the browsing time, in order to construct a "personal view" that reflects user interests. PVA is applied and evaluated to provide personalized news access. Unlike these news personalization systems, the online-store price recommendation system infers user interest based on the rating they give to products available in the system and from there, the algorithm can predict the likely other products the user will like. For privacy protection reasons, Google News does not record detailed information about the clicks, such as the amount of time spent on the page. Thus, the system needs to make reasonable prediction with the limited and noisy information of user activity on the website.

According to [13] proposed a time-based approach to build user profiles from browsing behavior, which considered of the time spent by the user on reading the articles and the recent of user activity. Tourism domain is another sector the recommendation system has greatly improved. Most of the recommender system applications in tourism domain involve proposing travel destinations, trip and activity recommendations and hotel suggestions in a destination within a given set of user defined constraints. Users can define budget limits, time intervals, interests, desired locations or similar necessities.

In [14], developed a mobile recommendation system which generates a user profile by considering users which are having similar interests on items. System tries to determine a list of activities for the target user and based on these activities, it generates trip plans. Proposed approach contains an ontology model. Recommendations were generated by the past experience of the system with similar users.

According to [15], developed a system which generates personalized recommendations of touristic attractions. Proposed system integrates heterogeneous online travel information using a tourism ontology. Travel behavior of the target user and similar users were analyzed to generate recommendations. Bayesian network technique and the analytic hierarchy process method used for recommendation engine.

In [16], developed an expert travel agent for assisting tourists by suggesting package holidays and tours. The proposed method employs a hybrid approach containing both content-based and collaborative filtering methods. Demographic data was also used in recommendation system. Authors emphasized that the choice of this hybrid approach was made to cover shortcomings of each of the individual recommendation methods.

According to [17], a semantic hotel recommender system was developed. To generate recommendations, hotel ontology was combined with a fuzzy logic approach. To involve customer experience, system contains a feedback mechanism which allows users to rate the generated recommendations. In order to generate more accurate recommendations, these ratings were used for updating fuzzy rules

In [18], proposed a decision support system for tourist attractions was implemented by combining Engel–Blackwell–Miniard model and Bayesian network approaches. Data which was published by the Tourism Bureau of Taiwan was used while building the proposed recommendation system. Generated recommendations were displayed on Google Maps to provide more detailed information for tourists.

In [19], proposed a mobile tourism recommendation system was implemented using a location based collaborative filtering method. The proposed system generates recommendations by considering other tourists' ratings on their visited attractions. Users exchange their rating through a mobile peer to peer connection. Three data exchange methods were proposed for effectively exchanging ratings about visited attractions.

According to [20], proposed a travel schedule planning algorithm which generates customized recommendations based on user requirements. With a user-adapted interface, users can make changes on recommendation results and the provided feedback mechanism improves system's accuracy for later recommendations.

In [21], study which focused on social media-based recommendation includes a method for city travel recommendation system. Researchers applied principals from both contents based and collaborative filtering techniques. User preferences were mined from community contributed geotagged photos archive. User similarities were considered for improving accuracy of the proposed model.

III. ANALYSIS OF THE PROPOSED SYSTEM

The proposed system is aimed at developing a web-based system that will help combat the problems stated earlier in the description of the existing system. The designed system will help users to easily get the price of any product they like as well as also upload products they will like to sell. The system although does not have a buy feature but will help users to easily meetup in cases where the product is actually needed. The users will get the prices of this products by recommendation. The recommendation will work based on the rating the user has provided on some specific products. Users will be given recommendation on similar products to the rated products and the prices of these products. The proposed system is also designed using the Object-Oriented Analysis and Design Methodology (OOADM) owing to the fact that it is a data driven methodology and concentrates on several views and perspectives of data. The system to be developed is an online web application that allows interaction from both user and administrator.

3.1 USE CASE DIAGRAM

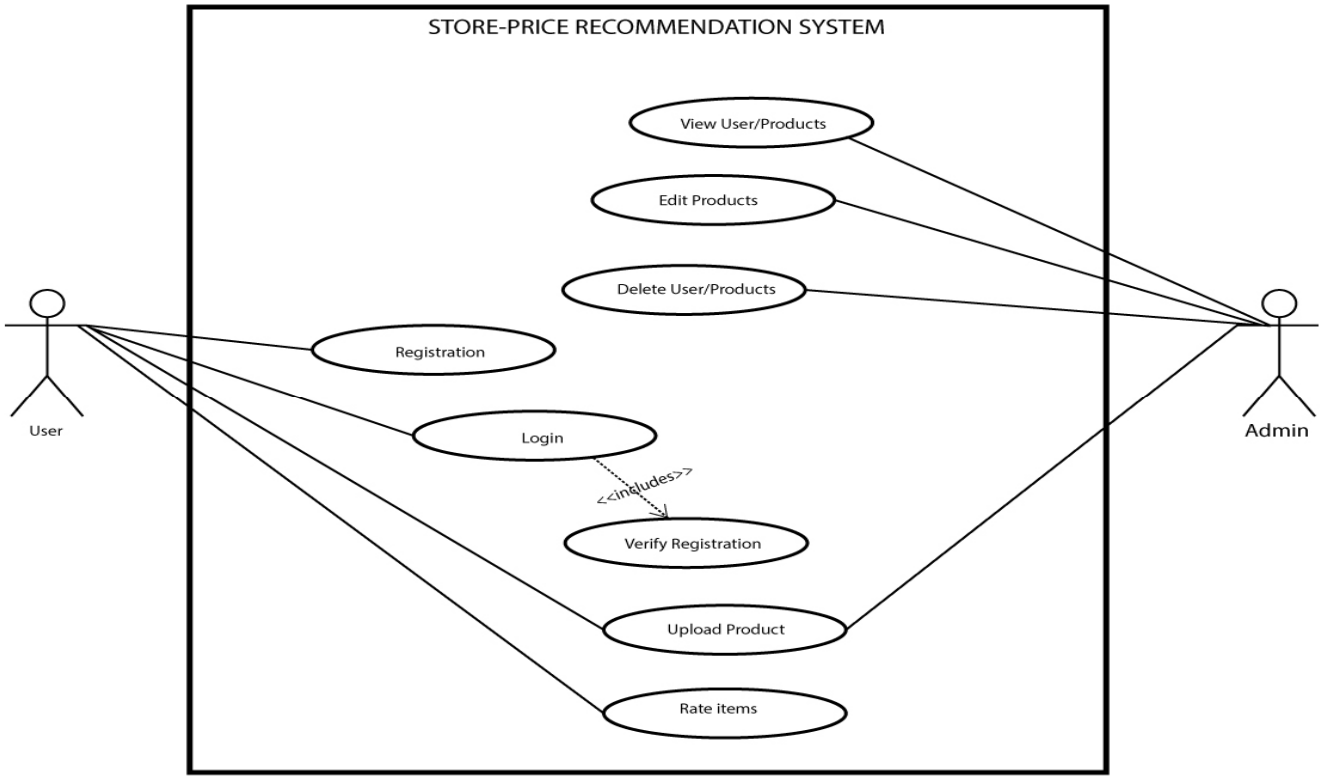

Figure 3.1: Diagram showing use case of the proposed system

3.2 SYSTEM ARCHITECTURE

In the development of this paper, a 3-tier architecture was employed in the system design. A three-tier architecture is a client-server architecture in which the functional process logic, data access, computer data storage and user interface are developed and maintained as independent modules on separate platforms. The tiers are presentation tier, application tier also called the middle tier or logic tier and the data tier. The presentation tier which is the user interface was designed using HTML, CSS and JavaScript. The middle or logic tier was designed using PHP and Python. The data tier which stores data (user information, product information etc.). MySQL is the database used.

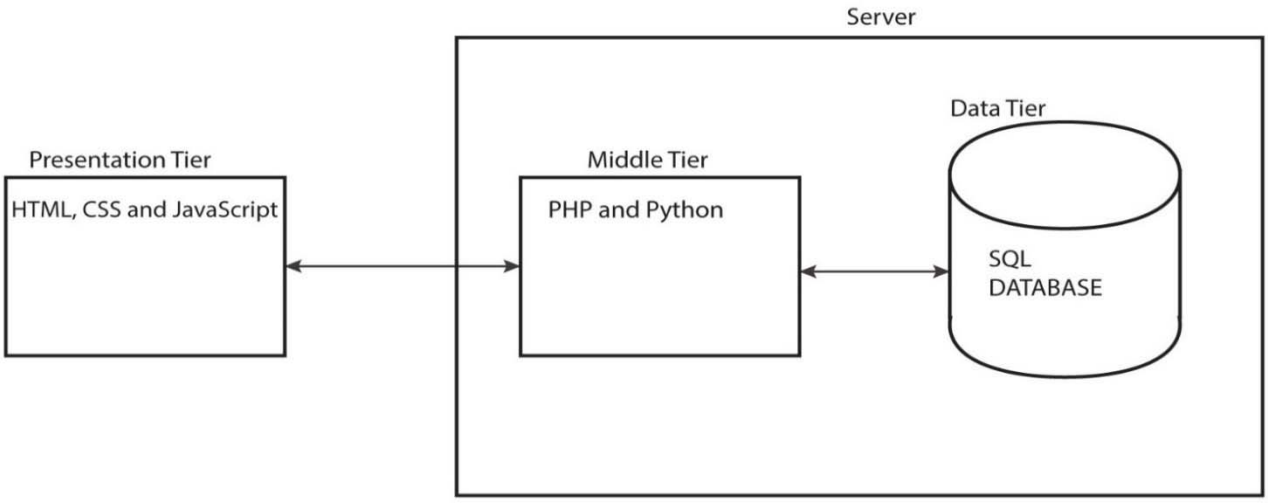

Figure 3.3: System architecture of the web application

IV. Result And Documentation

This paper involves building a recommendation system where users can easily get recommendation of products they will like and the prices of those products. The entire aim of the project is to build a system that suggests items to its users. From the conception of this research, the focus had been to implement the objectives of the system effectively and efficiently. On the completion of this research, users can now easily get recommendation items/products just buy rating a few items. Also, a major objective was to tackle the cold-start problem being faced by having a new user in the system, in such cases, neither the taste of the new users can be predicted nor can the new items be rated or purchased by the users leading to less accurate recommendations. This was tackled by randomly recommending products to the user based of existing user preferences in the system.

A brief explanation of how the user can use the application is given below.

- Turn on the device e.g. desktop, laptop, mobile phone etc.
- Open a browser e.g. chrome, internet explorer etc.
- Enter the URL: http://clocksell.com
- At the right topmost part of home page login if an old user or signup if a new user
- Give ratings to items to start getting personalized recommendations.

Below are screen shots of the recommendation system:

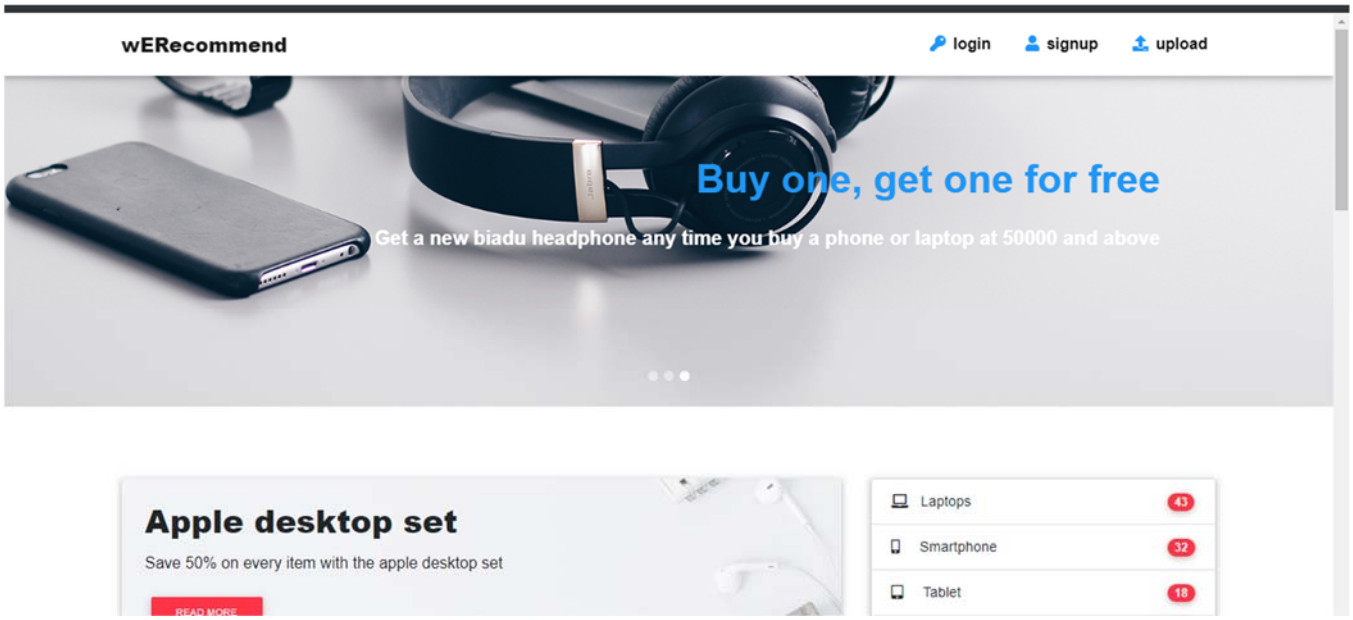

Figure 4.1: Home page

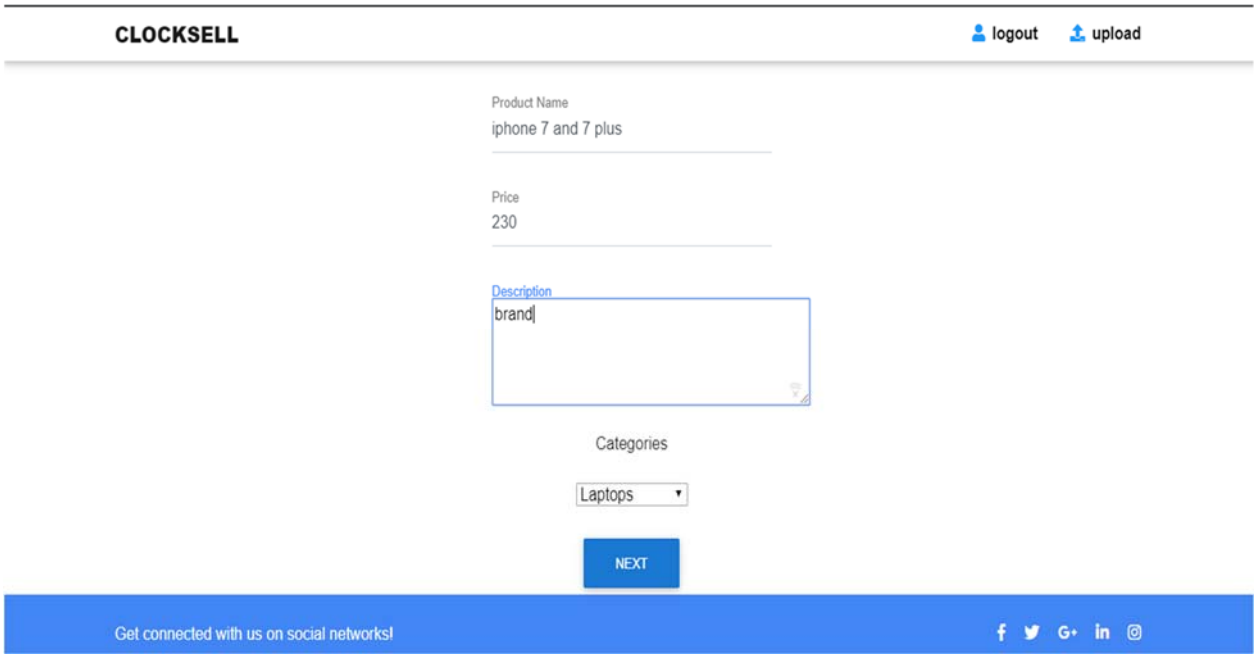

Figure 4.2: Product upload page

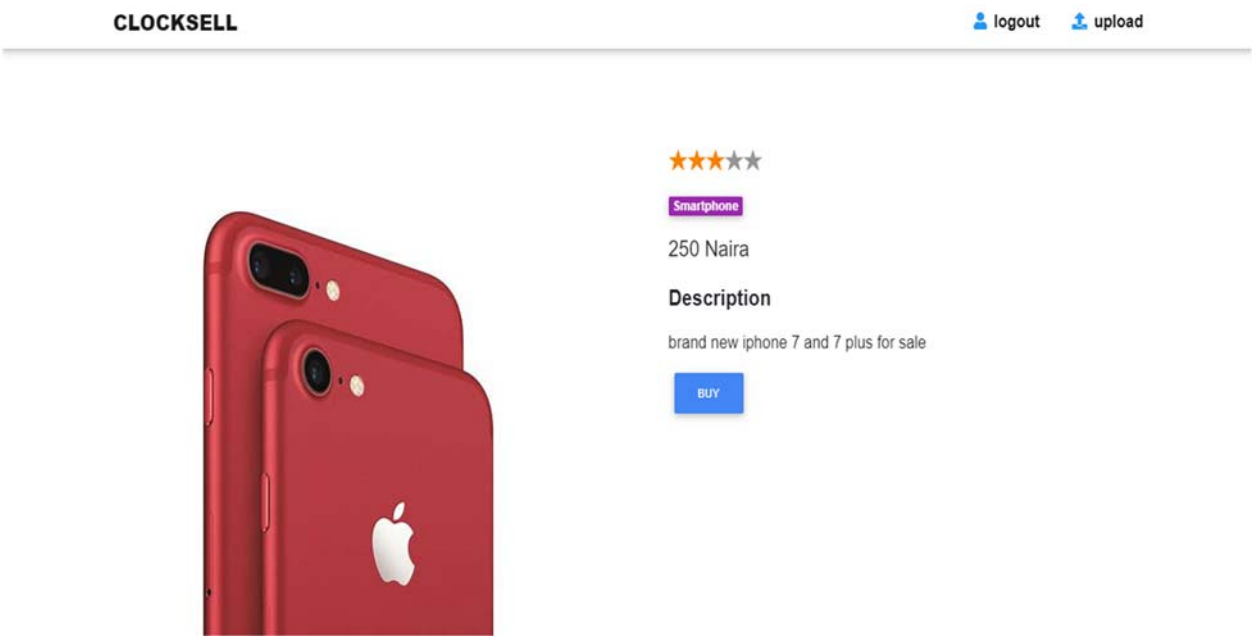

Figure 4.2: Product rating page

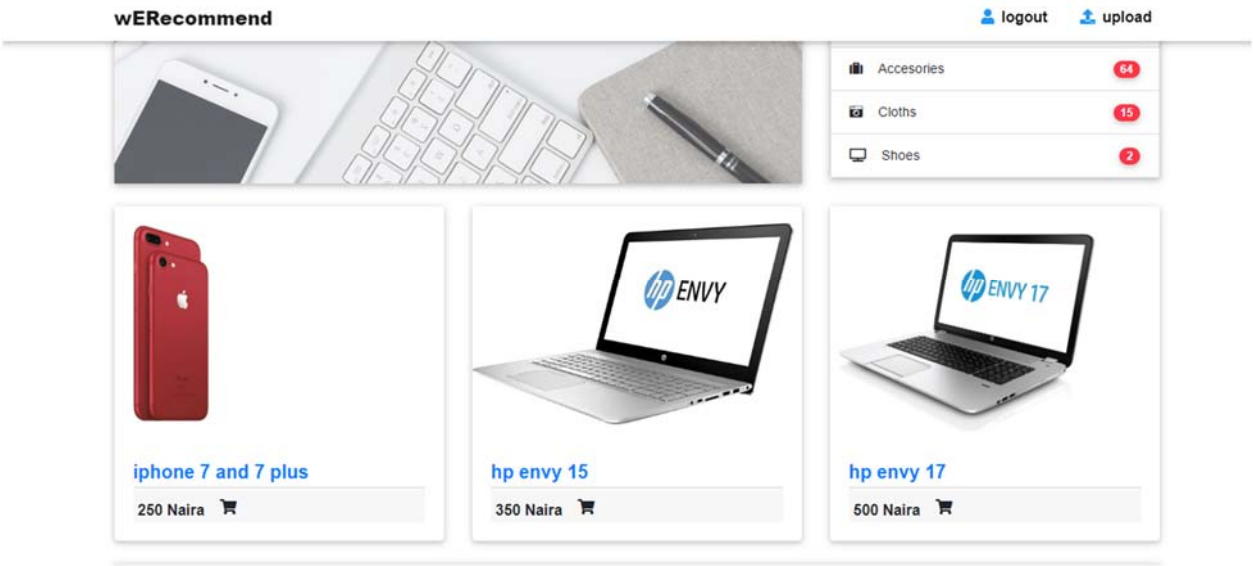

Figure 4.3: User page where products is being recommended

V. CONCLUSION

In the last few decades, recommender systems have been used, among the many available solutions, in order to mitigate information and cognitive overload problem by suggesting related and relevant items to the users. In this regards, numerous advances have been made to get a high-quality and fine-tuned recommender system. Nevertheless, designers face several prominent issues and challenges. Although, researchers have been working to cope with these issues and have devised solutions that somehow and up to some extent try to resolve these issues, however we need much to do in order to get to the desired goal.

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