Virtual Fitting Room and AI based Online Clothing Store

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ABSTRACT

E-commerce is one of the new trends in the modern business world today, and significantly purchasing products over the internet can be observed as an intended behavior of the new generation. The main reason people prefer buying goods or services via the internet is owing to the wide variety of choices and the convenience to the customers. In recent years with the pandemic (COVID-19), E-commerce markets have had a boom all over the globe. Even though E-commerce has made purchasing goods and services easier, the existing literature review depicts that most of the customers are not satisfied with the product they receive, especially when customers purchasing clothing industry chain, the main problem is the sizes of the cloths when ordering and users do not have a chance to wear and buy it. As a solution to this problem, a virtual dressing room will be introduced, where the user is allowed to create a 3D dummy as per the body dimensions of the user, and afterwards the user can select a cloth design which fits to the 3D dummy. Moreover, the user is also allowed to customize the cloth designs, and because of this the user will be ultimately satisfied. A descriptive analysis is to be done on cloth size, categories, and measurements which are to be included in the dummy models.

Keywords
Virtual Fitting, E – Commerce, Fashion

1. INTRODUCTION
It has been noted that the use of web apps has increased in recent years. Since the previous few years, there has been no decrease in growth. Many individuals use the internet for a variety of reasons. One of them is for online shopping, which is becoming more popular by the day [1]. With the advancement of virtual technology, consumers may now meet a variety of creative contact points during their shopping experience. Virtual fitting rooms a simulation technology that gives a virtual product trial experience, allow consumers to browse expanded selections and try on stock even through online platforms. Given that the majority of consumers reported a lack of touch and feel as the most significant issue with internet buying [2].

2. BACKGROUND & LITERATURE SURVEY
An increasingly popular form of human-computer interaction is virtual dressing. In essence, virtual dressing tries to produce a situation where a user appears to be wearing "visual" attire. The visual dressing system should produce a picture of the user wearing a 3D coat made by a computer while they are in front of the camera [3]. In order to make the computer-generated clothing model match the user body, it is first necessary to obtain accurate skeleton extraction and skeleton motion estimate.

The concept of garment modelling was developed, which is based on the creation of virtual bodies using conventional dimensions. construct the 2D clothing design, which is then appeared around a virtual human body to produce the basic form. There are used here are the height, weight, waist, shoulders, and features of the average human body. As a result, a 2D design is always constructed using dimensions that are representative of the normal person's body [4].

Also, most of the users are happy to customize the 3D model. Joint structure avatars are created and allows to select skin color and the details of the user are displayed in a virtual mirror system, mainly saving time of the consumer is focus on this research. An open-source software is used to create lightweight realistic 3D models for human form [5].

Research done by a team in University of Würzburg in Germany on the topic of Product recommendation system for fashion stores in 2018 have discovered an algorithm for recommendation system. In that algorithm they have built this algorithm with the use of Content-based filtering method. But in this the product recommendation system suggested by this research is suitable for physical stores which can transfer traditional fashion store into a smart fashion store [6].

3. METHODOLOGY
3.1 Creation of 3D User Model
This component serves as the project's backbone. Since this is an online web application, the user must first provide their personally identifiable information such as height, weight, waist, and shoulders. It provides users some drop down list with parameters. When user select those individual parameters. The data entered here is processed into a 3D user dummy, which is built and displayed [7]. It shows 3D user dummy according to the user inputs. The 3D model of the user will be built using "Blender" software and used three.js to connect the website. Another feature of this component is the ability to pick gender and skin colors. There will be a selection of skin colors available with standard complexions. This is also done on the backend with the help of some standard coding. As a result, the website displays the 3D user model related to the data entered by the customer.

Figure 3.1 Create 3D User Dummy

3.1.1 Tools and Techniques

MySQL

There are both free and paid versions of MySQL. As of now, Oracle is in charge of the commercial release. It's a relational database management system (RDBMS) database, so it's straightforward to set up and use, but it may not work well with programs that need strict adherence to the SQL standard. MySQL is best suited for simple web applications that deal with lower volumes of data on a fault-tolerant database due to its severe restrictions on SQL standards. MySQL's restricted integration features also make it challenging for it to function in heterogeneous database settings. MySQL is a relational database management system (RDBMS) that complies only partially with the Structured Query Language (SQL). It is best suited for simple online applications or those that can get by with a straightforward schema design and straightforward SQL queries to manipulate data. When dealing with sophisticated applications and massive amounts of data, MySQL is not the best option.

JSON

There is a lot more information being stored and moved between computers, many of which are completely unaware of each other, as the web's popularity and power increase. The ideal way to transfer this information has always been through open standards that anybody can use and improve, just like the web. XML's early success can be attributed to the fact that it closely resembles HTML, the language that laid the groundwork for the World Wide Web. However, it was difficult to understand and use. JavaScript Object Notation (JSON) is perfect for this purpose. It's likely that you've encountered JSON data if you've used an API during the previous few years. While the format wasn't finalized until 2006, it was first designed in the early 2000s. Knowledge of JSON and how it operates is essential for any web developer. The data storage and transfer format JSON is easily understood by humans. While it was designed with JavaScript in mind, any language can benefit from this library's widespread use in online applications. One or more keys and values form the basis of the structure

3.2 Creation of 3D Garment Model

The 3D model of clothing items will be created in this component. There will be a front view of the available clothing on the web application. When the user selects their preferred clothing, the user will see a 3D model of the garment. The "Blender" and "Three.js" are also used to create this 3D clothing. The pre-built 3D garment will be linked to the front view garment picture, and when the user clicks on the front view of the garment, the most suitable size of 3D garment will be displayed in 3D user dummy [8]. Here the most suitable size is taken from the parameters which user entered to create user 3D dummy [9].
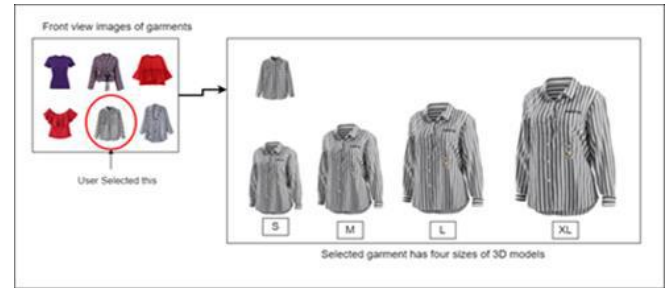

Figure 3.2 Create 3D Garment Model

3.2.1 Tools & Techniques

Three.js

You may directly handle 3D objects in the browser by using Mr. Doob's Three.JS library, which was written in JavaScript. ThreeJS was built by Mr. Doob. You need to have an understanding that ThreeJS, with the usage of JavaScript, gives you the ability to employ WebGL in an HTML5 canvas. You are able to drive WebGL and hence 3D with the help of ThreeJS and JavaScript. The craziest part is that there is no requirement for any further installation or plugins whatsoever! Import the library, and, hey presto, the door to the 3D universe has just opened. The camera will display a point of view of your scene, just like it would in real life. To be more specific, discuss about field of view, or for short. You'll be able to bring objects into or take them out of this area of view simply by moving the camera. The information that the rendering engine receives will be comprised of everything that can be seen in this camera's field of view. The scene and the camera are used as parameters by the rendering engine. Having done so, it will now display everything on the HTML5 canvas that I had been describing to you earlier. Each time you refresh your screen, the image that is being rendered will be produced by the rendering engine. In most cases, sixty frames per second will be used. Your animation wouldn't be the same without this vital component!

MySQL

Structured Query Language (SQL) is the most common language used to access and manipulate database entries, and MySQL is a relational database management system built on top of SQL. MySQL is released as open-source software with no restrictions and is freely available to the public. Oracle Corporation offers support for this. Insert, update, remove, select, create tables, drop tables, etc., are all examples of such queries.

Before diving into MySQL, it's crucial to get a firm grasp on what a database is. A database is a program that saves data in an ordered manner. It's really simple for the user to get into and control. Tables, rows, columns, and indexes help us structure data so that can quickly locate the information needed. Database actions such as creating, administering, accessing, and finding the data it stores have their own unique APIs that must be used with each database. There are numerous databases to choose from these days, such as MySQL, Sybase, Oracle, MongoDB, PostgreSQL, SQL Server, etc. When it comes to relational database administration, MySQL is currently the most widely used software. It's database software that anyone can use, and Oracle backs it. In comparison to Oracle Database and Microsoft SQL Server, it is a more efficient, scalable, and user-friendly database management system. When used with PHP scripts, it allows developers to create robust and dynamic server-side or web-based enterprise systems

3.3 Garment Customization Feature

In this function, when the user selects a 3D clothing model the user can customize the selected cloth, to create the clothing model the blender software is used. Which allows creating 3D models. This function creates 3D models customizable using the Three.js technology [10]. Then the user is allowed to customize the 3D clothing according to the available templates in the web application. In the web applications for specific clothing models, there are predefined templates are designed, the user can select the templates from the provided collection, when the user selects the template it is applied to the 3d model and displayed to the user in 3D view, apart from that, when a user customizes a cloth the price may change depending on the template or design, then the store is notified that a user has ordered a customized clothing. The store will contact the customer with results.

3.3.1 Tools and Techniques

SVG

You can create vector graphics like the one seen below by using a language called SVG, which is an XML language and is very similar to XHTML. It is possible to make an image with it by either manually entering in all of the required lines and shapes, making changes to raster images that already exist, or doing a combination of the two methods. Altering the appearance of the image and all of its constituents can also be accomplished by filtering, transforming, or combining different parts of the image.

Three.js + HTML

JavaScript Application Programming Interface (API) known as WebGL is used to render three-dimensional objects, two-dimensional objects, and graphics on a web browser. WebGL stands for "Web graphics Library." Users are able to experience interactive content on webpages with GPU acceleration thanks to the WebGL Application Programming Interface (API), which eliminates the need for users to first download and install any plug-ins. WebGL gives developers low-level access to hardware while maintaining the familiar code structure of OpenGL ES. The Mozilla Organization is responsible for the development of WebGL. In spite of all the advantages that WebGL offers, it does have a few shortcomings, which is where Three.js comes in to play. WebGL is an extremely low-level system that is only capable of drawing the most fundamental of objects, such as points, squares, and lines. In order to accomplish anything substantial with WebGL, a significant amount of code is typically required, and this is where Three.js comes in.

3.4 Product Recommendation System

Within this component, the user will be given recommendations for the ideal outfits that are appropriate for him or her. The platform will gather information about each customer from their search history on the internet and preserve it in their profile, such as age, gender, and other preferences. The system will propose matching outfits to the consumer based on the data provided by the customer. Even if a consumer searches for a garment that is not currently available in the online store, the customer will be notified when the garment becomes available. The following figure 3.1 shows how the system will recommend garments to the customers.
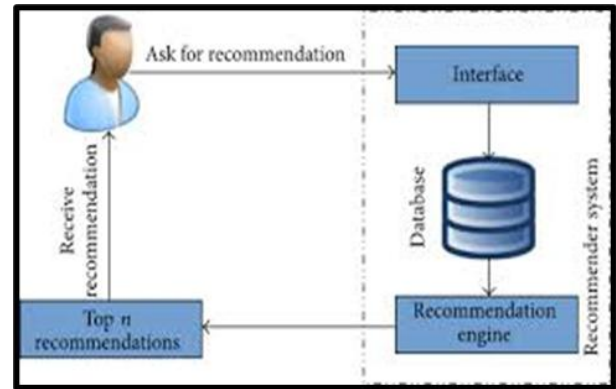

Figure 3.3 Product Recommendation System

The product recommendation system will work with both content-based filtering method and collaborative filtering method. In the content-based approach the system will only recommend products with same attributes. It means if a customer search for a white t shirt with black strips the system will only recommending products with that name. In collaborative filtering approach. In this approach the system tracks the different details related to one component. As an example, shown in the figure 3.2, if Customer A selects item1, item2 and item3 and another customer called customer B selects item1, item3, item4 and if a customer called customer C select item1 as his 1st item then the system will automatically recommend item3 to customer C. This happens because both customer A and B have selected item1 as their 1st products and Customer C have selected item1 as his 1st item. Because of both the customer A and B have selected item3 the system will recommend item3 automatically to customer C. This component will be built since it is mostly focused on machine learning and artificial intelligence utilizing "python" and other languages.
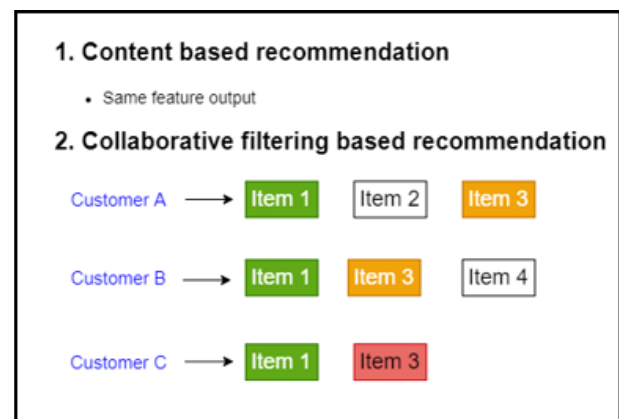

Figure 3.4 Recommendation Filtering Methods

Once a customer creates a user profile the system automatically sorts that user into a user category out of 72 user categories which are categorized according to the body size, gender, and skin color tone. And after that the system will recommend products which have been purchased by the same category of customers. Following tables shows how the customer categories are created.

Table 3.4.1 Men's Categories

Men's Categories					
Sizes	Skin Colors				
	W1	W2	D1	D2	B1	B2
XS	XSMW1	XSMW2	XSMD1	XSMD2	XSMB1	XSMB2
S	SMW1	SMW2	SMD1	SMD2	SMB1	SMB2
M	MMW1	MMW2	MMD1	MMD2	MMB1	MMB2
L	LMW1	LMW2	LMD1	LMD2	LMB1	LMB2
XL	XLMW1	XLMW2	XLMD1	XLMD2	XLMB1	XLMB2
XXL	XXLMW1	XXLMW2	XXLMD1	XXLMD2	XXLMB1	XXLMB2

Table 3.4.2 Women's Categories

Women's Categories					
Sizes	Skin Colors				
	W1	W2	D1	D2	B1	B2
XS	XSWW1	XSWW2	XSWD1	XSWD2	XSWB1	XSWB2
S	SWW1	SWW2	SWD1	SWD2	SWB1	SWB2
M	MWW1	MWW2	MWD1	MWD2	MWB1	MWB2
L	LWW1	LWW2	LWD1	LWD2	LWB1	LWB2
XL	XLWW1	XLWW2	XLWD1	XLWD2	XLWB1	XLWB2
XXL	XXLWW1	XXLWW2	XXLWD1	XXLWD2	XXLWB1	XXLWB2

3.4.1 Tools & Techniques

Logistic Regression

In situations where there are only two possible outcomes, the statistical modeling technique known as logistic regression is employed. Logistic regression, which falls under the umbrella of the Supervised Learning methodology, is one of the most common and widely used machine learning algorithms. The categorical dependent variable can be predicted by using it in conjunction with a predetermined group of independent factors. The outcome of a dependent variable that is categorical can be predicted using logistic regression. As a result, the output need to be a value that is either categorical or discrete. It can either be yes or no, zero or one, the truth or a lie, etc., but rather than reporting the exact value as 0 or 1, it presents the probability values that lie between the two numbers. The Logistic Regression is quite similar to the Linear Regression, with the primary difference being how each method is used. When trying to solve regression difficulties, linear regression is the method of choice, but logistic regression is utilized when attempting to solve classification issues. Logistic regression is a type of algorithm for supervised learning classification that is used to make predictions on the likelihood of an outcome variable. The target or dependent variable has a dichotomous nature, which indicates that there are only two distinct categories that are viable options

Python

Python's high-level, built-in data structures, dynamic typing, and dynamic binding make it a popular choice for Rapid Application Development and as a scripting or glue language to tie existing components. Python's simple syntax and focus on readability make it ideal for reducing the time and effort needed to maintain software. Python's support for modules and packages also makes it easy to write reusable code and create modular applications. As Python is developed by a large community of independent developers, new features and libraries are constantly being added.

Experts in artificial intelligence often use and recommend the programming language Python. Google TensorFlow and similar frameworks (scikit-learn, Keras) for Python lay the groundwork for AI development thanks to their accessibility and versatility. The existence of these libraries is essential because they free up developers to concentrate on improvement and creation. Python's slow speed is another one of its flaws. The dynamic typing that gives it such versatility, however, makes it quite slow because it necessitates so much looking up of definitions. Fortunately, there is a solution: switching to a different Python framework.

4. CONCLUSION & FUTURE WORK

The purpose of the research was to provide better solutions to E-commerce shoppers, out the shoppers this research was mainly focused on clothing purchases. The probability of a clothing shopper getting unsatisfied is very higher comparing the other purchases i.e., Electronics. The main reasons were the size issues, in order to address this problem, the users are provided with wearing and purchasing the cloths virtually, which will save time and other additional costs. This system allows the users to select the preferred cloth from the web application and wear it virtually, the user can give the body measurements of the user and wear it. In addition to that, the user is also possible to customize the cloths according to the user's preferences, which will be available for purchase once the item is ready after customization. The user is also suggested with other cloths depending on the size and selection of the cloth. Therefore, this research addresses many problems faced by the customers around the world, when implemented globally. This research can be considered as a major contributor to the E-commerce globally as well as locally.

Problem Faced	Traditional E-commerce	Modern Virtual E-commerce
Size may vary	65%	28%
Clothing is not suitable for appearance	40%	10%
Color differentiation	51%	40%

5. RESULTS & DISCUSSION

Looking at the user 3D model component, a key factor in this project comes to output. According to the data entered into the system by the user, the system will display a corresponding 3D user dummy for user. Here the 3D user dummy can be adjusted according to the parameters related to the data selected by the user and complexion of the 3D user dummy can also be changed.

In the 3D garment model component, the system will display the corresponding 3D garment model which is corresponding to the parameters of the garment. User can try the 3D garments with the 3D user model created.

In the garment customizing feature a survey was conducted to implement this system, and abled to see the willingness of many people to this new system. Depending on the user's selection of templates the user will be displayed the selected template.

In the product recommendation system, according to the data of the users of this system and the products the system will automatically recommend the best suiting garments to the customers. These four components together are novel to the fashion industry, and initiative, "Virtual Fitting Room," has the potential to significantly alter it by using cutting-edge technology.
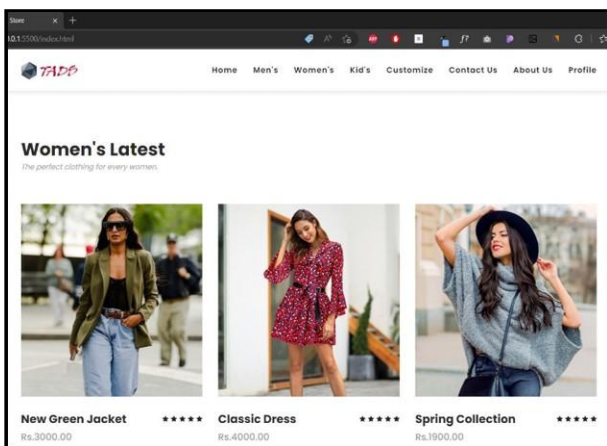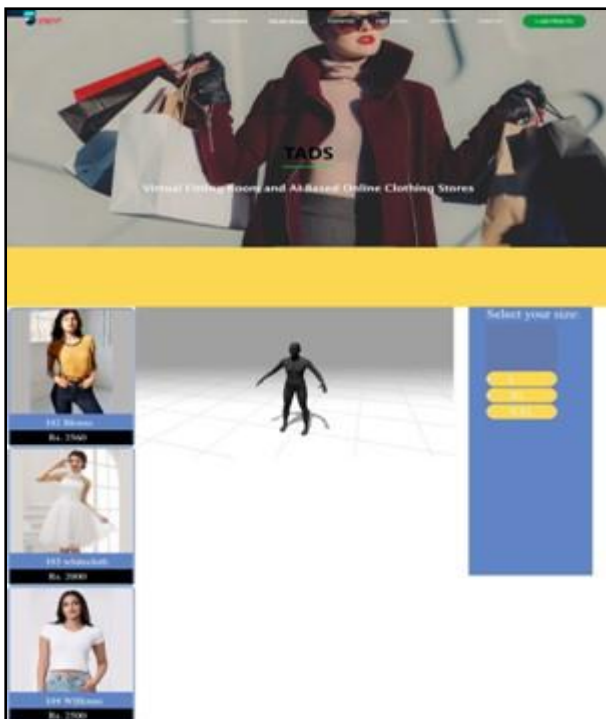

Figure 5.1 Home Page

Figure 5.2 3D Fit-on Room

6. ACKNOWLEDGMENTS

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