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Accessible and Engaging Web Application for Increasing Customer Base and Purchasing Rate of Goods within the Retail Industry

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ABSTRACT

People generally prefer to shop online as it is more convenient and time-saving. Therefore, it makes sense for any type of business owner to use the internet to sell their goods. In order to increase the overall customer base as well as increase the purchasing rate of an average customer, there are many elements that need to be factored into an online clothing store application that will help improve customer satisfaction and aid in making the online store application successful. However, the process can be improved much further by implementing more advanced features which are not so common in competitive applications such as smart recommendations and providing more ways to visualize the items such as Augmented Reality and 3D models to visualize how the clothes would look on someone. The goal of this research is to discover how to incorporate such technologies and build a clothing store application that will improve the rate of customer purchasing and increase the overall customer satisfaction.

***Keywords*—** Retail Industry, Increasing Customers, Purchase Rate, 3D Model, Augmented Reality

I. INTRODUCTION

Using online platforms to sell clothing items is not a new concept. However, it can be beneficial to both the customer and the business owner. When it comes to an online web store, visual design and useability as well as the content play a huge role [1]. Aside from having a good application, there are many other ways to motivate customers into purchasing more items. Selling more products is the ultimate goal of any online store as it is the main income source.

A study investigating the contributing factors of online customer experience has identified the following elements [2].

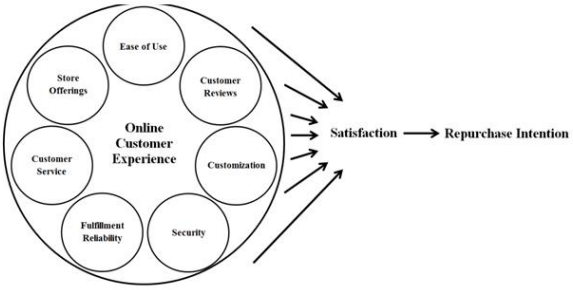

Figure 1: Factors of customer satisfaction

Figure 1 illustrates what needs to be on the web application store to give the customer a good online customer experience. This is important as customers are the key part of any business. Therefore, having good customer satisfaction means they are more likely to repurchase from the same store. The current study has aimed to develop a web application that fulfills the aforementioned factors.

Customers prefer simple user interfaces which allow them to do tasks more easily. Ease of use should be considered as a complex system would be hard to navigate even though it may have good features. Everything from the colors to the font and the layout of the content will affect how the user would feel. Other factors such as customer reviews and ways to communicate with the store are also key elements as they compel customers to buy goods without hesitation.

This study will focus on improving an online retail store to address all the necessary factors which will help the store become more user-friendly and engaging which will improve the customer experience and therefore increase the market share and purchase rate of the average customer. Furthermore, in the future, the system can be potentially integrated with other technologies which will add more advanced features such as Augmented Reality (AR) which will allow the user to see the clothing items on themselves, and 3D avatars which can be used to see how the clothing items would look on a virtual body, and smart

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clothing recommendation options. Implementing such features will enable the online store to distinguish itself from the rest of the competition.

II. RELATED WORK

A study has been done about Augmented Reality technology being used in online cloth fittings [3]. The study shows that 60% of returns are because of improper fit and how Augmented Reality technology has promising results in addressing issues such as the fit of the clothing. However, the process of using the technology requires additional hardware equipment such as precision cameras, and motion sensors to function. Excluding the hardware requirement, the study shows positive outcomes with using Augmented Reality with E-commerce applications such as the retail industry.

During the COVID-19 pandemic, the amount of people who started using online shopping methods has increased five times between 2019 and 2020 according to a study done by Young et al. [4] about the growth of e-shoppers during the pandemic. Before the pandemic situation, their studies have shown a slow but steady growth of e-shoppers each year.

To develop the web application, MongoDB, Express JS, React, and Node (MERN) was used. Naidu et al. [5] have made a similar web application for e-commerce purposes. MERN was used for its many advantages such as better performance, code reusability and so on. However, its interface seems outdated and not user-friendly enough for a shopping web application. The user interface (UI) is the part the customer interacts with. The UI should be self-explanatory as well as visually pleasing to the customer. When designing any interface, it is mandatory to consider the UI as well as the user experience (UX).

Vegiayan et al.'s [6] study conducted in Malaysia on customer satisfaction in online shopping shows how customer satisfaction contributes to purchase rates. Having a good variety of items as well as offering promotions and discounts also contribute to increasing customer satisfaction.

This is why the home page is a crucial place where the content on the page has a huge impact.

Using AR technology for E-Shopping applications was studied by Saikia et al. [7] in 2021. Their research shows how advantageous this technology can be for the retail industry. The study has recommended that for this technology to be used effectively, the client side should have a powerful computer- especially the graphics card should be substantially powerful to have a good framerate. This could be an issue as not all customers will own powerful computers. Therefore, such customers can use the 3D avatar model which was proposed which is less taxing on resources as it does not have to work in real-time. However, the study shows promising data that suggests that AR technology will be an excellent feature in the future in the retail industry [5] as technology will get better with time and more and more customers will switch to more powerful hardware.

III. METHODOLOGY

In order to develop the web application, several technologies were selected. MongoDB, Express JS, React, and Node (MERN stack) were proposed as they make the building process of the application easier and smoother. Using React and Tailwind for building the user interfaces allows the application to be responsive which means the user interface will be able to adapt to different screen types. This was taken into consideration when selecting the technology as this enables the customer to access the online clothing store from many devices ranging from computers, and tablets to mobile phones.

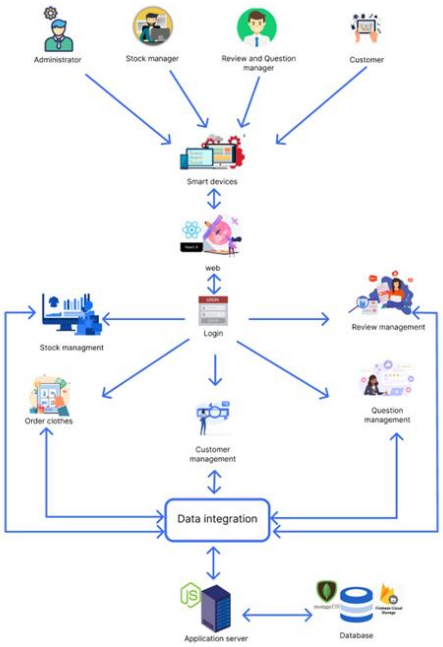

Figure 2

Before implementing the web application, the user types were identified. From that point onwards the features were divided so that it would be easier to give access control to the user types. Mainly two types of users were identified- customers and administrators. Administrators can be further divided as shown in figure 2. Features of the web application are divided into four quadrants: Stock Management, Customer Management, Review and Question Management, and Order Management. Covering these aspects of the web store is crucial as they comprise the main aspect of the store.

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The proposed system allows several user types to use the system. The administrator will have all the privileges to the full system. Stock Managers and Review and Question Managers will get limited privileges only enough to perform their relevant tasks. The customer user type will have another set of privileges that only allows them to perform tasks that are related to purchasing an item. *Figure 2* shows how a registered user will be able to log in to the system through the login portal from a device of their choice. Once the system identifies the user and authenticates them, the system will grant permission accordingly to each user. Using a single login interface for multiple user types was suggested as it simplifies the task and reduces the overall clicks required. As an added benefit it will negate the chance of a user entering details into the wrong login portal if separate login portals were implemented.

The admin side will be able to use the application to display the goods to the customer and manage other aspects of the online store. Multiple statistical reports are provided to the administrator by the system using the data from the database. This will help with deciding which products are most sold or which products are least sold. Furthermore, the administrator will be able to view statistical review reports per item which gives them the ability to filter out products based on positive or negative reviews. These features will ensure that the goods which are being sold are up to the customers' expectations. Knowing what the customer wants and does not want will reduce overstocking or understocking of products. Therefore, this is a great way to aid in reducing unnecessary costs or losses.

The customer side can use the system to browse for goods based on many factors such as name, type, color, and even occasion, and so on. This will ensure that the customer would find what they need instantly. As with the admin side, the customer will also be provided with statistical data which can aid in making a purchase decision. Since this is an online store, the customer might have questions regarding the goods, or the store or other aspects. Using phone calls to address customer issues will require too much resources and hours. Implementing a question handling section was suggested to resolve this issue as customers can simply ask any question and the admin side will be able to view the questions and answer or delete them if required. It is common for customers to have doubts or questions regarding a certain product. Having a clear product description will help to give the customer an idea about the product. Customer reviews are an added way to clear customer doubts which will encourage the customer into purchasing the item.

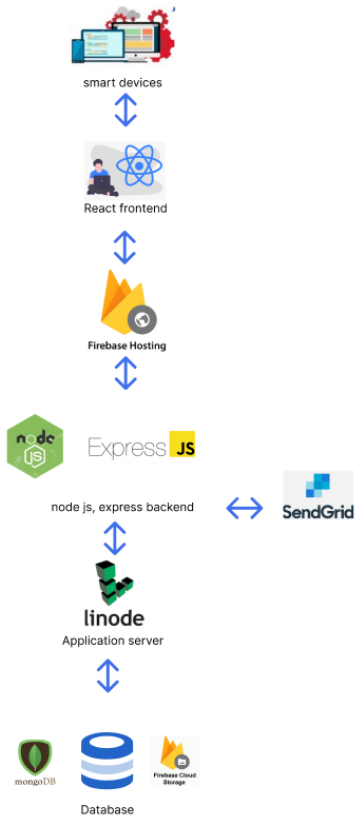

Figure 3

Figure 3 illustrates the technologies used to develop the web application. On the top level, there are devices that the customers use to interact with the online application. React is used to develop the user interfaces using the declarative approach instead of the imperative approach which requires all the steps for the Document Object Model (DOM) to be implemented. In addition to that, React is component-based which means it can be used repeatedly or can be mixed with other components to make new interfaces. As for the styling which plays a significant role in making the whole application look customer-friendly and attractive, Tailwind CSS was used which is a free and open-source Cascading Style Sheets (CSS) framework. This framework is different from other frameworks such as Bootstraps as Tailwind makes a series of utility classes that are easy to use.

Firebase hosting was proposed to host the frontend of the web application as it is much more convenient to use firebase hosting instead of traditional methods such as hosting on a personal virtual private server (VPS). Firebase hosting also provides analytics and a dedicated domain. If there is a traffic increase then the service will be scalable.

Node.js is a JavaScript runtime environment that is used to run JavaScript outside of a web browser. Express is a Node.js framework for developing a web server. This is

much more convenient to implement than using statically timed object-oriented programming languages. JavaScript is a dynamically typed programming language.

Linode is a cloud hosting provider. It is used to host the backend part of the application. It provides virtual private servers and database capabilities as a service. Comparatively Linode is inexpensive as well.

For the data storage aspects of the web application, MongoDB was suggested. MongoDB is a NoSQL document database that provides rich query capabilities and advanced data processing features which are also known as aggregation pipelines. This is another advantage when creating analytics for both the customers as well as the administrators. Aggregation pipelines will make the process fast as all the data processing will be handled by the database section. MongoDB Atlas provides free instances of MongoDB which helps with initial development and deployment in later stages. Scalability is available and comparatively easier to scale up.

Firebase storage is binary large object (BLOB) storage that is used to publicly store large files such as product images and user profile pictures and review pictures and so on. This storage system is used as it provides the ability to store large files such as images. Just as with MongoDB, Firebase storage is also scalable if needed.

Application tests were conducted to ensure that the web application performs as expected. Several test plans were executed using the Selenium IDE tool. Major functions were tested several times using multiple test plans for both success scenarios as well as failure scenarios.

IV. PROPOSED SYSTEM

As mentioned above, the web application can be divided into several sections by identifying the user types. From the admin section of the web application, several types of permission levels are in place to give access control to the relevant person. The web application will provide a dedicated feature set to add new stock items to the online store. This section is designed with a dynamic interface that will change according to the data inserted. This ensures that the correct details about the project are being inserted and no information is missed out from the product details. Giving the customer all the information about the item is important, hence, the usage of a dynamic interface with various validation methods.

Additionally, the administrator section has features to manage orders as well as manage customers. Managing order feature set is designed in a way that the employee does not have to enter or update details regularly. Most of the data is generated using the data which is taken from the customer when making a purchase. Authorized employees will have full access to manipulate any part of the orders. However, if they change major details, they are required to provide a valid reason. This is done so that if there is a necessity to check the order details in the future, they will see all the details along with modified data with validation for the modifications. The Customer Review section is mostly used by customers. However, in instances where there is misleading information provided, the administrator can remove customer reviews with proper reasoning. However, the application is designed in a way which does not remove the review completely. Only the text and images will be replaced by another text explaining the reasons for removing the review. The rating count will be kept. This is done as customer reviews can be both negative and positive. Giving the option to fully remove reviews will give the impression to the customers that the store owners will remove negative reviews and keep only the positive reviews. This could cause customers to lose confidence in reviews.

The Customer Reviews and Questions sections are made as a single component that contains two elements. This was determined as it made the interface look cleaner while providing clear content. Furthermore, the option to receive email notifications when the administrator answers a customer's question was added for the customer's ease.

As mentioned previously, customers have the ability to easily search for what they need with a complex filtering system provided. A typical set of filtering methods are implemented and additionally, occasion-based filtering methods are also introduced to quickly filter clothing items based on the occasion. Other methods include tags and price ranges which they can pick. A stacking multiple filter option is available which will further aid in finding more specific items.

When the customer registers for the first time they will receive an email with a validation code that is required to complete the registration process. When a user logs in to the application, a session with their details will be created in the backend. When the user performs an action, the application will first validate if the user is a logged-in person by using middleware. This middleware will check the details of the user with the session details and authorize the action. If the action is performed by some other person, then the middleware will not authorize the action. This method of performing actions will help with the security of the web application as customers value their privacy and security when using web services online. Once the user clicks the logout button the session will be destroyed.

Reports of review details are given to the customer. Whenever they view an item, the system will give a chart that shows a summary of overall user reviews. Using this information, the customer can get a quick idea about the product. By selecting the chart, customers can filter the reviews. The search feature is implemented to

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search for reviews by keywords as it will also aid in finding specific aspects of the product that the customer might want to find through customer reviews. This same searching feature is available for the Customer Questions section for the same aforementioned reasons.

Administrators will get a variety of reports as well. Knowing your customer profile is a good way to give them what they want. Therefore, offering reports which give data such as age group, gender, purchase rates and more will be useful. Other types of reports such as stock details or sales reports are also offered.

Furthermore, this online web application can be further improved with features that would distinguish it from the rest of the competition. Using smart clothing recommendations when a customer picks a clothing item, the system will recommend other matching clothing items. For instance, if the customer selects a T-Shirt, then the system will recommend matching pants, hats, shoes, and other items which go well with the selected item. This will recommend a full outfit rather than showing similar results. In this case, the customer will more likely buy several clothing items if they liked the recommendation that the system provided. Furthermore, by using machine learning technology, the system can provide more than one outfit combination for the customer to go through. From the customer's point of view, they will get the satisfaction of purchasing a good combination of clothes while the business owner will get more revenue.

One of the biggest drawbacks of online clothing stores is that the customer cannot interact with the item. This will lead to hesitation in purchasing the product. A suggested solution is to use 3D avatar models and/or Augmented Reality technology to let the user visualize the item on an avatar or themselves. Providing the option to place multiple items on the avatar will grant the ability to the customer to make their own outfits and purchase the whole outfit at once. A more functional use of this technology would be to see if an item fits the customer well or not. Customizable avatars can be provided where the customer will be able to make their own avatars with accurate body measurements. This allows the system to represent how the fit of the clothing will look on their bodies. Letting the customer have multiple avatars stored on their account will eliminate the need of guessing the size of the item when purchasing clothes for other people.

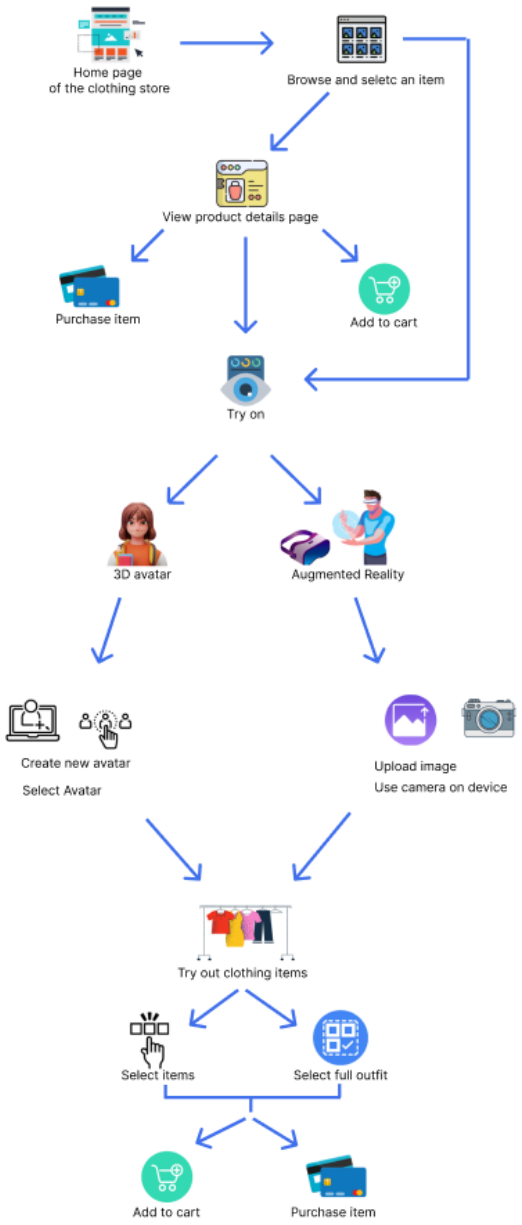

Figure 2: Flow diagram of customer using the advanced features

To further illustrate how the proposed technologies can be used by the customer, figure 4 was created. First, the customer will visit the website. Then they can browse for any product and navigate to the 'view product details' page. Here the customer will have regular options such as purchasing the item or adding it to the cart. A new option called "Try on" will be available where the customer will be presented with two more options. The first option will be the 3D avatar visualizer mode and the second option will be the AR option. Once the customer selects a preferred option, more options will be presented

such as creating a new avatar or using the device camera to initiate AR. Next, the customer will have access to the item they have chosen or use the shopping cart items. The customer can directly select specific items or the full outfit and continue to purchase or add the outfit to the cart. Furthermore, the customer will be able to access the "Try on" visualizer section directly from the browse page.

V. DISCUSSION

Having a user-friendly and attractive store with a good selection of clothing items is an excellent way to motivate customers into purchasing goods. Just like in physical stores, online stores will use many strategies to increase customer purchase rates. Clothing sites will generally advertise about discounts and other offers on the homepage where the customer's eye would be caught. Another common but subtle way is to recommend clothing items to the customer. A study conducted on text labels and text-image labels using eye tracking shows that people gravitate towards the images rather than text-only labels [8]. Showing them more visuals will increase the rate of customer retention.

Studies show that customers tend to trust other customers rather than what the seller is advertising as the seller can be biased [9]. Therefore, customer reviews are just as essential as the product description itself. Customer questions will also aid in this.

During the development process of the web application, using MERN stack technology proved to be a good decision as the process of making the application was relatively straightforward. The combination of React with Tailwind styling made it more convenient as giving a progressive web application is much easier, not to mention less expensive than developing a separate native application for mobile devices. Responsive pages will allow the content to fit perfectly on the screen regardless of the screen size or the resolution. This is essential as the eye of the customer processes images much faster than reading textual content [10].

When developing the web application several issues were encountered. MongoDB does not support storing binary large object (BLOB) file types which include videos, MP3 files, PDF files and images, and so on. Since the online web application handles a lot of image files, it is crucial to find a suitable solution. One method to store image files in MongoDB is to convert the image file into text-based data, then store it directly on the database as long text. While this method will work, it is not the ideal way to store image files as converting the image file to text and re-converting the text data back to a usable image file will take a considerable amount of time. Especially since there will be multiple images on a particular web page at a given moment. Moreover, if the image size is large, then the conversion process will take longer to complete. To overcome this limitation, as suggested previously, Firebase storage was used. Firebase storage supports BLOB-type data; therefore, it does not need any conversion of the image file type to be stored. When the user uploads an image from the frontend, the image file will get uploaded to the Firebase storage. Then a reference link to the image on Firebase storage will be returned which will be stored in MongoDB as regular text data. When data is being retrieved, the reference link will be used to locate the image file inside Firebase storage.

The home page is the first page the customer sees when they visit the store. Showing more content to the customer is essential. However, doing so could make the page look more cluttered. Studies show that people tend to prefer minimalistic designs [10]. Therefore, making the page look minimalistic while providing ample content is challenging. To overcome this, animations and carousel sliders are used. The page is divided into multiple sections which help with making the page look more organized and pleasing. Colors were carefully picked and used in a minimal way to make the page cleaner than it actually is. The goal is to show the customer as many things as possible without overwhelming the customer. Sectioning the page allows the customer to clearly see and do what they intend to do.

In order to test the web application further, additional tests can be performed. For instance, the scalability of the application is yet to be tested. Performing tests will ensure that the application will always work as expected. The proposed advanced features should be thoroughly tested using both software-based tools as well as humans. Whenever new features are to be implemented, it is vital to make sure that it does not affect the current functionality of the web application.

VI. CONCLUSION

In the modern day, it is essential for any business to provide its services via the internet. When it comes to a clothing store there are key factors to consider which make the store more customer-friendly and engaging. Using modern technology to develop an online store application that would fulfill all the factors that are required to maintain a certain level of customer satisfaction has been the goal in devising the present system. The proposed system would be a cross-platform application that allows customers to perform all the actions required to purchase goods online in a convenient and efficient manner. Furthermore, the application can be improved by introducing technologies such as Augmented Reality, 3D modeling, and smart recommendation methods, ultimately increasing the customer base and purchasing rate of goods within the retail industry.

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REFERENCES

[1] Y.-C. C. M.-J. W. Chao-Hung Wang. (2015). Evaluation of an augmented reality embedded on-line shopping system. *Procedia Manufacturing, 3*.

[2] Online customer experience, satisfaction and repurchase ... - core (2022).

[3] I. Pachoulakis. (2012). Augmented reality platforms for virtual fitting rooms. *The International journal of Multimedia & Its Applications, 4*(4).

[4] J. S. G. C. Mischa Young. (2022). The increase in online shopping during COVID-19: Who is responsible, will it last, and what does it mean for cities?. *Regional Science Policy & Practice*.

[5] E-commerce web application by using Mern Technology. (2021). *International Journal for Modern Trends in Science and Technology, 7*(05).

[6] C. M. M. L. H. Kala Vegiayan. (2013). *Online shopping and customer satisfaction in Malaysia*.

[7] ResearchGate. (2021). *Augmented reality based online application for E-SHOPPING*.

[8] W. Schipperheijn. (2022). How can discount labels reduce food waste in grocery stores? an eye-tracking experiment analysing the effect of text-only and text-and-image discount labels on the information processing of a customer and the impact on the purchase intention. *How can discount labels reduce food waste in grocery stores? An eye-tracking experiment Analysing the effect of text-only and text-and-image discount labels on the information processing of a customer and the impact on the purchase intention*.

[9] D. I. Fatema Kawaf. (2019). Online fashion shopping paradox: The role of customer reviews and facebook marketing. *Journal of Retailing and Consumer Services, 48*.

[10] AegisDemoAdmin. (2022). The power of Data Visualization - Aegis – articles. *AEGIS*.

[11] S. Z. Z. N. M. N. Zuriana Abu Bakar. (2017). A study of minimalist principles for designing entrepreneurs' website. *Proceedings of the 2017 International Conference on Information System and Data Mining - ICISDM '17*.