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Virtual Dressing Room: Smart Approach to Select and Buy Clothes

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Abstract **-** This paper explores the transformative potential of a Virtual Dressing Room as a solution to the challenges associated with online clothing shopping. Because of global exposure and cross-cultural influences, the fashion landscape has evolved significantly, resulting in a diverse and interconnected fashion ecosystem. However, the lack of a physical fitting experience and sizing uncertainties are hindering online clothing sales. Itproposes a new approach that combines augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) to address these issues. Data collection via interviews and surveys, technology integration via modern tools and frameworks, and an agile development process are all part of our methodology. The results of the research show that the app can provide a personalized and immersive fitting experience, accurate recommendations based on body measurements and skin tone analysis, and user engagement via an AI chatbot. User feedback emphasizes the importance of addressing sizing uncertainties when shopping online. In the final analysis, our findings show how technology has the potential to bridge the gap between in-person and online shopping, benefiting both consumers and retailers in the ever-changing fashion landscape**.**

Keywords **-** *virtual_reality, cloths, augmented_reality, ai_chatbot, fitting room, virtualdressing room.*

Introduction

A. Background

Due to the global exposure to various forms of creativity, art, and cross-cultural influences, the fashion landscape has undergone a significant transformation. A dynamic and interconnected global fashion ecosystem has resulted

from this transformation, and it is characterized by the quick globalization of information and communication channels, the development of the internet and social media, and the rise of cultural diversity and inclusivity. As a result, the fashion industry now embraces various aesthetics, styles, and cultural fusions. Fashion trends are no longer restricted to particular geographic areas or demographic groups; they effortlessly cross international boundaries, reflecting how interconnected our world is. Fashion enthusiasts from all over the world are eagerly taking part in the constantly changing fashion conversation as the desire to acquire and adopt these innovative styles has grown into a global phenomenon. The state of the fashion industry today is proof of the influence of global exposure and the profound influence of various viewpoints on the art of dressing and self-expression.

B. Problem Statement

Online clothing shopping has grown in popularity in today's global fashion landscape, owing to cross-cultural influences and easy access to fashion information via the internet and social media. This shift, however, has highlighted a significant challenge: the lack of physical fitting experience for online shoppers. While traditional brick-and-mortar clothing stores allow customers to try on garments to find the perfect fit, online platforms struggle to replicate this important aspect of the shopping experience. This limitation has resulted in a decrease in online clothing sales, which has been exacerbated by customers' diverse body types and dress measurements. Furthermore, due to a lack of fashion knowledge, some shoppers have difficulty selecting clothing that complements their appearance. This issue has far-reaching implications for both customers and online retailers. User satisfaction and adoption of online shopping are hampered, potentially resulting in revenue loss for e-commerce platforms. As a result, closing this critical feature gap is critical for improving the online clothing shopping experience and bridging the gap between physical and digital retail spaces[1].

C. Significance

The importance of addressing the lack of a physical fitting experience in online clothing shopping cannot be overstated. This challenge has far-reaching implications for both consumers and online retailers. It has a direct impact on customer satisfaction and willingness to use online shopping platforms. The wide range of body types and sizes, combined with a lack of fashion guidance, frequently leads to shopper disappointment and dissatisfaction. As a result, this restriction may discourage potential online shoppers and impede the growth of e-commerce in the fashion industry. The impact on online retailers is also significant. A drop in online clothing sales has a direct impact on their profitability and growth prospects. As the global fashion landscape becomes more interconnected, retailers will be at a competitive disadvantage if they do not provide an effective virtual fitting experience. Furthermore, addressing this issue can result in increased customer loyalty, higher sales, and a stronger online presence for retailers. Finding innovative solutions to improve the online shopping experience and reduce sizing uncertainties is therefore critical not only for customer satisfaction but also for the continued success of the fashion e-commerce sector[2].

D. Objectives

By offering creative solutions, this research aims to close the gap between in-person and online shopping experiences[3]. The main goals are as follows:

1. Enhancing Fitting Experience: Create a technologically advanced solution to the fit-related issue in online shopping that allows shoppers to virtually try on clothing items.

2. Guided Selection: Use an AI-powered chatbot to help customers choose clothing through the online platform, simulating the assistance given by in-store sales staff[4].

3. Predictive Insights for Sellers: Construct application that uses machine learning algorithms to forecast upcoming fashion trends, assisting retailers in making smart restocking choices[5].

E. Hypotheses or Research Questions

The study will investigate the following research questions:

1. Can 3D models that simulate physical try-ons improve the online shopping experience and increase customer engagement?

2. To what extent does the incorporation of an AI-powered chatbot assist customers in selecting clothing items, positively influencing their purchasing decisions?

3. How effectively does the predictive analytics component assist clothing store management in making informed restocking decisions, thereby reducing stock-related issues?[6]

Literature Review

The advancement of technology over the past decades has led to shift the customers preferences and behaviors. People are more likely to be on the Internet and entrepreneurs are felt the internet is a big marketplace to sell things as the Customers are connect over the boundaries. This Caused the evolutionary impact on the Business Field and Make an E-Commerce market. Most of the Entrepreneurs ended up with solutions like Websites, Mobile applications that the people in the online can access the products through these. In the apparels industry that the static website that only provides the images if the cloths is a drawback function

The most Common problem faced by the Online Apparel Shopping is the customer won't get an awareness of the Size and the clothing that purchased cannot be exchanged a with another one even if the shopper feels disappointed after purchase. The absence of the tactile experience of trying on clothing has been identified as a key factor in the reluctance of customers to engage in online apparel shopping.

These challenges collectively contribute to a suboptimal online shopping experience, potentially leading to customer attrition and reduced profitability for online retailers. The optimal solution to cope with the problems raised while using websites based on 2D images of the apparels is Virtual Fitton room. A virtual fitting room is a software generated virtual environment that facilitates trying out clothes virtually. Virtual fitting has taken different approaches with different architectures and technologies to propose solutions and each of them have benefits and drawbacks. Some Solutions are 2D real time image-based Systems and 3D mannequins-based systems[7].

F. Maintaining the Integrity of the Specifications

"https://tryndbuy.com" is a one of the web solutions based on 2d real time image of the avatar which can be changed over user input. Shoppers can select the Images of the Cloths and fit to the model. Users are not allowed to customize the model and it uses the same model to all users. Basically, Shopper have to login to the system and have to input the body metrics while creating the account. Web site displays the images generated according to the users' inputs. After the model is created images of the apparel displayed. When a cloth is selected, the cloth fits the model. The drawback of "trynBuy.com" cannot personalize the avatar generating the system as because it is common to all users. So, the shoppers do not feel like they are fitting the apparels in a physical store. It gives similar experiences as traditional static website and user will not get the clear idea about how it fits to body. Addition to that drawback, "TryndBuy" provides only a woman model to try Fitton[8].

G. 3D mannequins-based systems - VR.

As per the survey conducted by our team 3D base dressing room approach is more likely solution that users like to have. "WearFits" is the web solution that provides the 3D renders models that can be customized as per used request and users free to adjust the skin tone color, default outfit of the 3D models which represent the User in virtual environment. Basically, user have to create an account and system generates a 3D renders models that can view over the 360degress then user can able to customize the models with the users preferences, this make the user to feel more interacted towards the model and feels personalized. The user try fit on using the model[9].

H. 3D mannequins-based systems - AR.

Recent many research state that the Dressing up a model which is representing the shopper in Virtual environment is felts awkward by some Shoppers. Shoppers felt less connectivity in buying outfits. Solution to that "WearFits" added an AR feature to their web solution this make the user to try cloths on the users' physique. Solution made with webAR tool to achieve this solution. This website sense the users' position, depth of the user

location by the users' device's camara and with the help of the webAR mount the 3D apparels on certain position. Shopper can view the product by moving the device[9].

Methodology

The goal of our research project is to improve the online clothing shopping experience by combining augmented reality (AR) and hand gesture navigation to enable simple and seamless interaction with virtual clothing. This methodology describes the orderly process one will use to create and assess our creative solution. To accomplish our project goals, one will combine data collection techniques, technology integration, and iterative development procedures.

I. Data Collection

In order to gain an extensive knowledge of user preferences, difficulties, and expectations in the context of virtual dressing rooms, person use a multifaceted data collection approach. Our techniques for gathering data include: -

- Interviews: conducting semi-structured interviews with a chosen number of people who have expertise in the fashion and online retail sectors, such as new consumers, fashion designers, and retail professionals.

- Google Forms Survey: sending a Google Forms online survey to a diverse sample of prospective users asking about their experiences with online clothing shopping, their thoughts on the difficulties they have encountered, and their willingness to use augmented reality (AR) technology.

- Review of Sample Research Papers: With the goal to have a thorough understanding of the best practices, difficulties, and creative solutions,will analyze the existing research papers, articles, and case studies related to AR, VR, and virtual dressing rooms[10].

J. Technology Integration

In the project, it combine various technologies to produce an intuitive AR-based virtual dressing experience. The key technologies and tools include:

1. Three.js - An interactive animation and 3D graphic library for JavaScript that can be used to render virtual clothing and models in web browsers[11].

2. Amazon's Cognitive Services: using Amazon's Cognitive Services' image analysis tools to analyze user photos and precisely identify skin tones[12].

3. React and Node.js - React for front-end development and Node.js for back-end integration will be used to create the web and mobile applications[13].

4. MongoDB -Uutilizing the database management system MongoDB to store user information, clothing, and preference[14].

5. API for AR & VR -Uutilizing Augmented Reality (AR) and Virtual Reality (VR) APIs and frameworks to enhance AR navigation using hand gestures.Avoid combining SI and CGS units, such as current in amperes and magnetic field in oersteds. This often leads to confusion because equations do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity that you use in an equation[15]. The Figure1 & Figure 2 represents the models on how it would be delivered.

6. API for Sales Assistant - The OpenAI API, an advanced NLP tool created by OpenAI, is strategically incorporated into this research project. The API is crucial to the project because it provides the ability to understand and produce text that is similar to what a human would write, improving the project's language understanding. The project's adaptability is ensured by its versatility, which enables it to investigate a variety of applications, including chatbots, and acting as a sales assistant. It addresses issues related to bias and responsible AI usage to comply with ethical standards, which are of the utmost importance. Additionally, model fine-tuning is used in this paper to enhance performance for tasks. The API offers scalability and efficiency, but it also comes with drawbacks like rate caps and cost management. This integration also prepares the project for further growth, guaranteeing that it will stay at the forefront of AI developments and be able to develop as OpenAI releases model updates and enhancements[16].

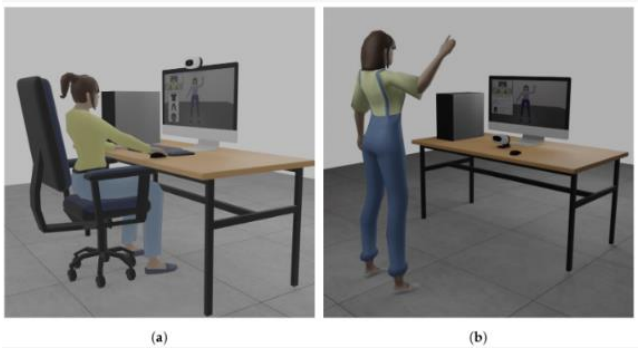

Figure1: Client View *[17]*

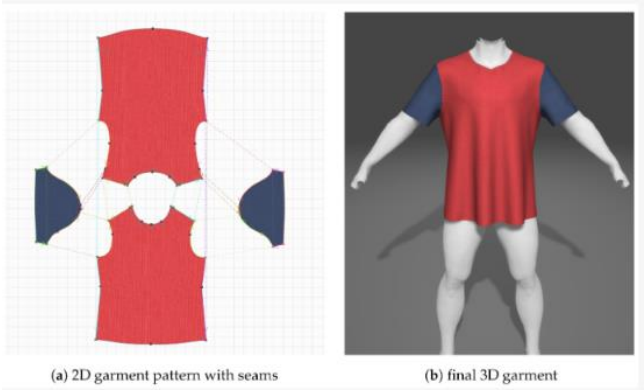

Figure2 : 3D view*[17]*

K. Agile Development Process

For project management and development, one will use the agile methodology to ensure flexibility and iterative development[18]. Our Agile strategy encompasses:

- Sprint Planning
- Daily Stand-ups
- Iterative Development
- User Stories
- Continuous Integration and Testing
- User Testing and Feedback

L. Evaluation and Validation

Both qualitative and quantitative evaluations will be doneto confirm the efficiency of our solution.:

- Usability Testing: requesting feedback from prospective users regarding their use of the AR-based virtual dressing room as they test the application.
- User Surveys: Participants were given post-testing surveys to complete in order to collect quantitative information on their satisfaction, perceived improvements, and ease of use.
- Performance Testing: assessing the application's responsiveness, performance, and compatibility with various devices and browsers.
- Comparison with Existing Solutions: Comparing our solution to other virtual dressing room applications in order to highlight its unique advantages and features.

By using this comprehensive methodology, one hope to create an innovative AR-based virtual dressing room that addresses the challenges of online clothing shopping while leveraging emerging technologies for a better user experience.The overview of the system is shown in Figure 3 below.

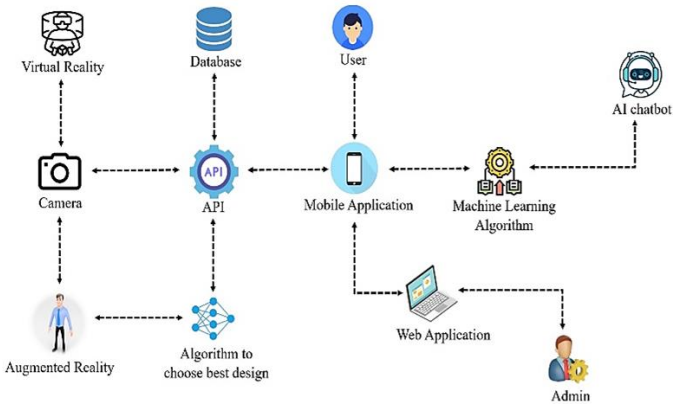

Figure3: System Overview Diagram

II. RESULTS

The design of an innovative virtual fitting room application in the research project that uses advanced technologies to address the challenges of online apparel shopping. The application focuses on gathering important data from users, processing that data, and presenting the results in a user-friendly and interactive format.

Within the profile creation process, the application requests users for some important body measurements. Users are asked to provide their measurements, which may include their height, waist, hips, and chest. These measurements form the basis for building a unique 3D model. With the goal of providing an accurate representation, application makes use of advanced image analysis tools to identify the user's skin tone from a selfie taken with the user's device camera. The recommendation of clothing colors that go well with the user's skin tone depends heavily on this information. The decisions users make are recorded as they use the application and choose various pieces of clothing to virtually try on. These choices help in making suggestions for appropriate outfit combinations and reveal information about user preferences. The customer's device camera data is incorporated into the AR-based system. It records details about the user's surroundings, including the lighting and physical surroundings. This information makes it possible to render and visualize the virtual clothing on the user in a realistic manner.

The application performs several key tasks during the data processing phase to enable a tailored and immersive virtual fitting experience. To begin, it uses the collected body measurements to create personalized 3D models that faithfully replicate the user's body shape, ensuring a lifelike and personalized fitting experience. Furthermore, the application uses image analysis techniques to process the captured skin tone data, allowing it to pinpoint the user's exact complexion. This data is used to recommend clothing colors that complement the user's skin tone, with the analysis based on sophisticated algorithms that take into account subtle skin tone nuances. In addition, as users make choices from the clothing options, our system uses this information to execute the virtual rendering of the chosen garments onto the 3D model. This rendering process incorporates user preferences, such as clothing size and style, to provide a faithful representation of how the chosen attire would appear in the real world. Finally, for AR-based systems, the application expertly manages data from the user's device camera, including position and depth information, to seamlessly overlay virtual clothing onto the user's body in real-time. This integration provides a highly interactive and immersive fitting experience.

The application provides users with a multifaceted experience by presenting the results. To begin, users engage in a real-time virtual fitting experience, viewing a dynamic 3D model dressed in their preferred attire on their device screens, creating a vivid and realistic fitting experience. Furthermore, application provides personalized clothing recommendations, using the user's body measurements and skin tone analysis to recommend fashion options that are harmonious with their individual preferences and physique. The results of AR-based systems are seamlessly projected through the camera of the user's device, immersing virtual garments in their physical surroundings.

Users can explore and interact with these garments from various angles simply by manipulating their device. Furthermore, our application improves user engagement through an AI chatbot that extends recommendations, answers questions, and guides users through the clothing selection process, enhancing the overall userexperience.

In addition to the application's advanced technological features, proactive contact with the user community was facilitated through the implementation of a Google Form to collect useful feedback. Users were asked about the most common problems they encountered while shopping for clothes online. According to the findings, 78% of respondents mentioned the difficulty of accurately determining dress sizes as their primary concern. These findings, which were visually presented in a pie chart graph, highlighted the importance of the virtual fitting room application's focus on mitigating sizing uncertainties. Furthermore, the insights gained from this user feedback are being used to inform ongoing efforts aimed at improving the online shopping experience and delivering solutions that are in line with users' preferences and needs. The report of the collected feedback is provided in the figure 4and figure 5below.

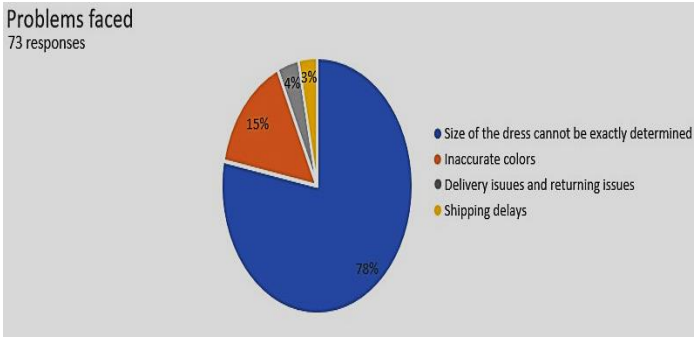

Figure4 : Response from Users regarding problem faced.

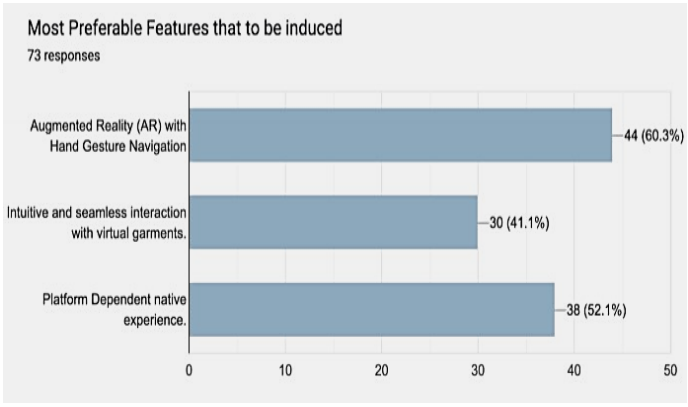

Figure5 : Features preferred by customers.

In result, the virtual fitting room application excels at data collection, processing, and presentation, ensuring users have a unique and engaging online clothing shopping experience. Application can offer users precise, aesthetically pleasing results and individualized assistance throughout their shopping journey thanks to the integration of modern technologies like 3D modeling, skin tone analysis, AR, and an AI chatbot. This all-encompassing strategy successfully addresses the problems associated with online clothing shopping, transforming it into a fluid and user-focused experience.

Conclusion

The transformative potential of a Virtual Dressing Room as a smart approach to selecting and purchasing clothes online is explored in this research paper. The fashion landscape is rapidly changing as a result of global exposure to diverse creative influences and cross-cultural trends. Online clothing sales have decreased as a result of the lack of a physical fitting experience, which has hampered customer satisfaction.With augmented reality (AR) and virtual reality (VR) capabilities, this research set out to develop a creative solution that combines modern

technology in order to improve the online shopping experience. Three main goals established: enhancing the fitting experience with 3D models and VR environments, assisting customers through chatbots that are powered by AI, and giving customers predictive insights. The researchers examined existing solutions in the virtual fitting room space using a comprehensive literature review, distinguishing between 2D image-based and 3D mannequin-based systems. According to the findings, 3D mannequin-based systems, particularly those with customization options, received more positive user feedback.

This paper described a methodology that includes information gathering, technology integration, and an agile development process to accomplish the research objectives. paper highlightes the significance of gathering user preferences and feedback through discussions with users, surveys, and analysis of prior research. A user-friendly AR-based virtual dressing room was made possible by the modern technology stack, which also included Three.js, Amazon's Cognitive Services, React, React Native, Node.js, and MongoDB.

The study's findings revealed that the application excels at data collection, processing, and presentation. The researchers were able to create personalised 3D models and provide clothing recommendations tailored to each individual by capturing user body measurements, skin tone, and preferences. The AR-based system seamlessly overlays virtual garments onto the user's body, providing an immersive fitting experience. An AI chatbot increases user engagement by assisting with clothing selection.The main issue of accurately determining dress sizes was brought up by user feedback gathered through a Google Form, which underlines the significance of the virtual fitting room's focus on diminishing sizing uncertainties.

Finally, by leveraging modern technology to create a Virtual Dressing Room, the research project successfully addressed the challenges of online clothing shopping. This smart approach provides users with a one-of-a-kind and engaging online shopping experience, reducing sizing uncertainties and providing personalised assistance. This solution has the potential to revolutionise the way people select and purchase clothes online by bridging the gap between in-person and online shopping, benefiting both customers and retailers. As fashion trends evolve, the Virtual Dressing Room demonstrates the power of technology in improving the global fashion landscape.

REFERENCES

[1] RONALD E. GOLDSMITH, LEISA R. FLYNN, "PSYCHOLOGICAL AND BEHAVIORAL," JOURNAL OF FASHION MARKETING AND, VOL. 8, PP. 84-95, 2004.

[2] AHSAN ILYAS, SYED SHEHRYAR AKBAR, "MACHINE LEARNING AND VIRTUAL TRY ON FOR IMPROVING SALES AND PURCHASE," INTERNATIONAL JOURNAL OF SECURE AND INTELLIGENT COMPUTING (IJSIC), VOL. 1, NO. 1, PP. 1-15, 2022.

[3] F.CORDIER, HYEWON SEO, N. MAGNENAT-THALMANN, "MADE-TO-MEASURE TECHNOLOGIES FOR AN ONLINE CLOTHING STORE," MADE-TO-MEASURE, VOL. 23, NO. 1, PP. 38-48, 2003.

[4] AKSHAT GAURAV, BRIJ B. GUPTA, PRABIN KUMAR PANIGRAHI, "TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE," INVESTIGATING THE IMPACT OF AI-POWERED TECHNOLOGIES ON INSTAGRAMMERS' PURCHASE DECISIONS IN DIGITALIZATION ERA–A STUDY OF THE FASHION AND APPAREL INDUSTRY, VOL. 177, PP. 1-11, 2022.

[5] M. KRISHNAKUMAR, AKANKSHA DAYMA, SHIVKUMAR M. BELLI, "ONLINE CLOTHING RENTAL WEBSITE QUALITY: MEDIATING EFFECT OF ATTITUDE ON BEHAVIOURAL INTENTION," MEDIATING EFFECT OF ATTITUDE ON BEHAVIOURAL INTENTION, VOL. 1, NO. 2023, PP. 530-547, 2023.

[6] MAKHLOUFI, A. EL, AI APPLICATION IN TRANSPORT AND LOGISTICS: OPPORTUNITIES AND CHALLENGES, VOL. 2023 EDITION, AMSTERDAM: COE CITY NET ZERO, FACULTY OF TECHNOLOGY, AMSTERDAM UNIVERSITY OF APPLIED SCIENCES, 2023, P. 99.

[7] BHARAT LAL BHATNAGAR, GARVITA TIWARI, CHRISTIAN THEOBALT, GERARD PONS-MOLL, "MULTI-GARMENT NET: LEARNING TO DRESS 3D PEOPLE FROM IMAGES," PROCEEDINGS OF THE IEEE/CVF INTERNATIONAL CONFERENCE ON COMPUTER VISION (ICCV), PP. 5420-5430, 2019.

[8] INDIA, "TRYNDBUY," 2018. [ONLINE]. AVAILABLE: HTTPS://TRYNDBUY.COM/. [ACCESSED 18 08 2018].

[9] WEARFITS, "WEARFITS," POLAND, KRAKÓW, 2019. [ONLINE]. AVAILABLE: HTTPS://WEARFITS.COM/VIEWAR.HTML. [ACCESSED 25 08 2023].

[10] WEERASINGHE S.W.P.N.M, RAJAPAKSHA R.M.D.D., SATHSARA L.G.I., GUNASEKARA H.S.D.N, DINUKA R. WIJENDRA, DILSHAN I. DE SILVA, "VIRTUAL DRESSING ROOM: SMART APPROACH TO SELECT AND BUY CLOTHES," UTC FROM IEEE XPLORE, NO. JULY 26,2023 AT 13:16:08, PP. 193-198, 26 JULY 2023.

[11] DIRKSEN, JOS, THREE.JS ESSENTIALS, A. E. R. P. ,. D. E. A. N. ,. E. T. K. P. N. C. E. S. C. G. M. COMMISSIONING EDITOR ASHWIN NAIR, ED., BIRMINGHAM - MUMBAI: PACKT PUBLISHING LTD. LIVERY PLACE 35 LIVERY STREET BIRMINGHAM B3 2PB, UK. ISBN 978-1-78398-086-4 WWW.PACKTPUB.COM COVER IMAGE BY SUYOG GHARAT (YOGIEE@ME.COM), JULY 2014, P. 198.

[12] VAIBHAV SHARMA, VANDANA NIGAM, ARVIND K. SHARMA, "COGNITIVE ANALYSIS OF DEPLOYING WEB APPLICATIONS ON MICROSOFT WINDOWS AZURE AND AMAZON WEB SERVICES IN A GLOBAL SCENARIO," MATERIALS TODAY: PROCEEDINGS, 26 SEPTEMBER 2020.

[13] AGGARWAL, SANCHIT, "MODERN WEB-DEVELOPMENT USING REACTJS," INTERNATIONAL JOURNAL OF RECENT RESEARCH ASPECTS, VOL. VOL. 5, NO. 1, MARCH 2018, PP. 133-137, 2018,.

[14] LIANA STANESCU, MARIUS BREZOVAN, DUMITRU DAN BURDESCU, "AUTOMATIC MAPPING OF MYSQL DATABASES TO NOSQL MONGODB," 2016 FEDERATED CONFERENCE ON COMPUTER SCIENCE AND INFORMATION SYSTEMS (FEDCSIS), NO. 11-14 SEPTEMBER 2016, IEEE.

[15] BARUAH, RAKESH, AR AND VR USING THE WEBXR API, VOL. 1, BERKELEY, CA: APRESS, 2020, PP. XXIII, 328.

[16] SKOLO, "MEDIUM," 9 12 2021. [ONLINE]. AVAILABLE: HTTPS://MEDIUM.COM/NERD-FOR-TECH/CREATE-AI-APPLICATION-IN-MINUTES-WITH-OPENAI-API-5E84BD3EC5D0. [ACCESSED 12 05 2023].

[17] GILDA MANFREDI, GABRIELE GILIO, VINCENZO BALDI,HIBA YOUSSEF AND UGO ERRA, "MDPI," JOURNAL OF IMAGING, 26 03 2023. [ONLINE]. AVAILABLE: HTTPS://WWW.MDPI.COM/2313-433X/9/4/76. [ACCESSED 20 08 2023].

[18] LOTFI BEN OTHMANE, PELIN ANGIN, HAROLD WEFFERS, BHARAT BHARGAVA, "EXTENDING THE AGILE DEVELOPMENT PROCESS TO DEVELOP ACCEPTABLY SECURE SOFTWARE," IEEE TRANSACTIONS ON DEPENDABLE AND SECURE COMPUTING, VOL. 11, NO. 6, PP. 497 - 509, NOVEMBER-DECEMBER 2014 2014.

[19] J. DIRKSEN, THREE.JS ESSENTIALS, A. E. R. P. ,. D. E. A. N. ,. E. T. K. P. N. C. E. S. C. G. M. COMMISSIONING EDITOR ASHWIN NAIR, ED., BIRMINGHAM - MUMBAI: PACKT PUBLISHING LTD. LIVERY PLACE 35 LIVERY STREET BIRMINGHAM B3 2PB, UK. ISBN 978-1-78398-086-4 WWW.PACKTPUB.COM COVER IMAGE BY SUYOG GHARAT (YOGIEE@ME.COM), JULY 2014, P. 198.