# 3D Garment and Jewelry Visualization Using Augmented Reality (AR)

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***Abstract*—Integrating virtual reality (VR) and augmented reality (AR) technologies has revolutionized the retail industry, offering immersive experiences to customers. This paper presents the development of a virtual dressing and jewel try-on room using Unity, a popular game development platform. The proposed system aims to enhance the online shopping experience by allowing users to virtually try on clothes and jewelry in real time. The virtual dressing roomutilizes Unity's powerful rendering capabilities to provide userswith a realistic representation of how clothing items look and fit on their digital avatars. By leveraging AR technology, users canoverlay virtual garments onto their physical selves using their smartphones or other AR-enabled devices. The system also incorporates advanced physics simulations to ensure accurate cloth draping and movement, enhancing the realism of the virtual try-on experience. Additionally, users can explore a variety of virtual jewelry collections and try them on with the jewel try-on option. To let customers visualize various combinations and styles, interactive elements like resizing, rotating, and layering jewelry pieces are included using Unity's scripting capabilities. Customers and retailers alike can profit from the suggested virtual dressing and gem try-on room in several ways. It eliminates the need for in-person store visitsby giving customers an easy and entertaining opportunity to browse and try on jewelry and clothes from the comfort of their homes. In conclusion, the Unity-created virtual dressing and gem try-on room shows how immersive technologies may revolutionize the online purchasing experience.**

***Index Terms*—Augmented Reality (AR), virtual,3D**

## I. INTRODUCTION

A 3D model is crucial in helping customers perceive virtualapparel more favorably. For instance, a model's topology can be used for physically based cloth simulation [4] and also thejewelry, a model's normal vectors can help deliver a realistic rendering of fine details of clothing when used with the right BRDF model [8], and a model's deformable garment model can be trained for draping on various body shapes and the neck sizes. What's more, the latest advancements in VR technology enable us to create brand-new user interfaces for fully immersive clothing browsing. As a result, it is anticipated that demand for useful garment and accessories digitalization solutions will rise.

Other possibilities include the image-based rendering proposed in [7], which is a different approach since it can synthesize a new view at each viewing angle. However, the lack of depth information makes it challenging to integrate interactions with additional clothing for VR applications in the future. A fine model might be produced by close-range scanning using a hand-held active sensor; however, this method was disregarded because it typically takes longer to scan and the quality can vary depending on the operator.

The robustness of the reconstruction method is another factor we took into consideration for this project. Our goal is to create a robust algorithm that can function well in situations where the camera moves quickly, which will speed up the digitization process. In addition, since it can drastically lower the amount of memory needed and because 2D garment and jewel segmentations can be used for 3D garment and jewel digitization, compatibility with a 2D garment digitization process based on static photographs has also been taken intoconsideration [7].

Large, complicated 3D digital models can now be viewed online and remotely, and they may even be connected to external databases for research and teaching. Despite the existence of certain standards and the growing development of plug-in applications (OSG4Web, Java3D, etc.), game engines (Unity3D, 3DVia, etc.), libraries (C3DL, Open Scene Graph, X3DOM, etc.), APIs (WebGL, O3D, etc.), and

languages and technologies (VRML, X3D, PDF3D, etc.), the prevalence of 3D models on the web is still relatively low [2].
However, there is a growing need from the scientific community and end users to utilize 3D models using a client-server architecture. However, robust commercial solutions are lacking when it comes to the online visualization and interaction of large polygonal datasets. Google Earth offers what is perhaps the most popular and effective web-based rendering method for 3-D models (terrain and man-made structures), even though it is unable to display and interact with huge 3D polygonal models. The study of using Unity 3D for virtual reality scene modeling.

## II. LITERATURE SURVEY

To facilitate remote access and enhance accessibility for a broader user base, unstructured 3D data acquired via photogrammetry or laser scanning undergoes a conversion process into polygonal textured 3D models. This conversion employs a blend of automated algorithms and manual interventions to effectively organize and refine the data. Subsequently, these models are visualized using web-based tools, thereby enabling widespread access and enriching educational opportunities. Recent developments in 3D modeling, surveying methodologies, segmentation techniques, and web-based accessibility for historical sites and artifacts are detailed in the referenced paper [1]
Utilizing extensive computational resources over thousands of CPU hours, researchers delve deep into the intricacies of secondary clothing effects on animated characters through a comprehensive exploration conducted with a large motion graph, challenging existing assumptions [3]. Many textile materials exhibit limited flexibility when unsupported, yet this aspect is often overlooked in cloth simulation algorithms aimed at optimizing performance. However, a novel approach combining quick projection techniques with constrained Lagrangian mechanics, as detailed in [4], offers a solution by minimizing strain along the warp and weft direction. This innovative technique seamlessly integrates into simulation code, effectively serving as a velocity filter.
A groundbreaking method outlined in [5] eliminates the need for manual intervention in animating realistic clothing on synthetic bodies of varying shapes and poses. Central to this technique is the DRAPE (DRessing Any PErson) clothing model, derived from physics-based simulations of clothing dynamics on diverse body forms.
The rise of "virtual try-on" applications has garnered significant attention, allowing users to digitally visualize themselves adorned in different attire without the need for physical changes. This technology not only enhances the shopping experience but also streamlines decision-making processes, thereby boosting retail efficiency and reducing product return rates [6]. Moreover, the integration of virtual try-on features in digital entertainment applications and games adds another dimension to user engagement and creative expression.
In recent times, there has been a notable surge in interest surrounding the concept of virtual try-on networks. However, constructing an image-based virtual try-on network poses significant computational challenges due to the diverse characteristics of apparel. Current approaches often fall short of accurately preserving the identity of the individual or the attributes of the clothing, thereby impacting the perceived quality of the generated images [7]. Further research is imperative to address these shortcomings and enhance the effectiveness of virtual try-on systems.
There is a growing curiosity about the potential consumer-brand interactions facilitated by augmented reality (AR). Understanding how consumers engage with mobile AR shopping applications, such as the one offered by Sephora for in-home use. As highlighted in [8], expanding the scope of AR research beyond the immediate physical environment to encompass the broader spatial-symbolic context of consumer interaction is essential.
Exploring the latest advancements in Blender 3D sculpting tools reveals a suite of essential techniques tailored to artists' needs. These include Voxel Remesher, Dynotopo, QuadriFlow, and Multiresolution functionalities [10]. Essential Components: Mastering the core sculpting operations provided by Blender, such as Dynotopo, Voxel Remesher, QuadriFlow, and Multiresolution, empowers artists to craft intricate and lifelike creations. The versatility of Blender's sculpting brushes allows artists to customize and optimize their workflow, resulting in stunning artwork with efficiency. Typical approaches within Blender 3.0 for

sculpting attire, accessories, and facial characteristics offer artists a comprehensive toolkit for realizing their creative vision.

The integration of 3D registration and monitoring is facilitated by the mobile terminal's display, seamlessly merging real video with virtual objects. A comprehensive framework for developing applications utilizing augmented reality technology with Unity 3D provides developers with a step-by-step guide [9]. This framework outlines the nuances between virtual reality and augmented reality, shedding light on how augmented reality impacts human existence.

With the proliferation of personal mobile devices capable of generating captivating augmented reality environments [12], researchers are delving into the vast potential of AR across various domains. Descriptions of work conducted in diverse application domains highlight the ergonomic and technical challenges associated with building AR applications for mobile devices. Marketing scholars and practitioners are increasingly intrigued by Extended Reality (XR) technologies, recognizing their potential to deliver immersive consumer experiences that rival real-world encounters.

In the realm of jewelry, automation emerges as a crucial necessity. Leveraging augmented reality, jewelry vendors can virtually showcase their designs, eliminating the need for physical patterns.[15] By reconstructing 3D objects using techniques like the ICP algorithm, virtual objects can seamlessly integrate with real-world environments in real time, overcoming occlusion challenges. Blender stands as a powerful open-source 3D graphics avail software, offering a myriad of features for infrastructure modeling, texturing of cloth, physics simulation, rendering, animation, shading colors, compositing, and real-time game development. Additionally, Blender provides extensive educational resources, including tutorials and documentation, empowering users to unleash their creative potential.ICP and HAAR.

Blender is renowned as a robust open-source 3D graphics software, celebrated for its diverse toolkit encompassing infrastructure modeling, texturing, physics simulation, rendering, animation, shading, compositing, and real-time game development capabilities. Moreover, Blender distinguishes itself by providing a wealth of educational materials, comprising tutorials and documentation, which serve to streamline the learning journey for users.

## III. PROPOSED METHOD

This chapter deals with various software utilized inthis project. The workflow and file formats used in this project are also explained here briefly. The block diagram of 3D Garment Visualization is shown in Fig.1.

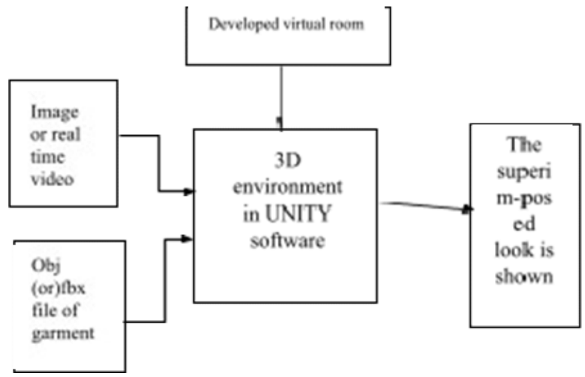


Fig.1Block Diagram of 3D Garment Visualization

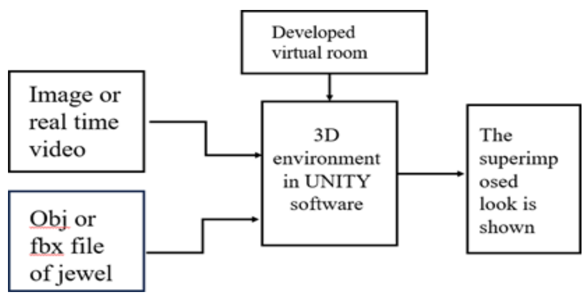


Fig.2Block Diagram of jewelry Visualization

### *A. Working Flow*

The first stage is to determine the project's scope and needs. This entails developing a 3D clothing concept and decidingon the design, color, texture, and fabrics. The 3D clothing model is built in this stage using 3D modeling software that includes Blender or Autodesk Maya. The model should be optimized for rendering in real-time and include all elements like stitching, seams, and texturing. When the design is finished, it is saved in an appropriate format such as.obj or.fbx. The 3D clothing model will then be integrated into an AR scene using Unity Software. This entails importing the 3D model and configuring the AR monitoring and camera settings. The AR application's user interface has been created to allow customers to communicate with the 3D clothing model. This involves picking different garment sizes, colors, and styles. The user interface (UI) should be simple and easy to use, allowing users to effortlessly move around the program. This is also added with a 3D jewelry model that is also imported from Blender. Mostly we prefer the obj and fbx fileformats of Jewel. We add jewels as an asset in Unity and they are superimposed on personal retail time video. Jewelry has different types and shapes which helps to preview whether it suits us. Once the AR application is developed, it is tested on different mobile devices to ensure compatibility and functionality. Any issues or bugs are addressed and the application is optimized for performance.

*B. Algorithm*

The various steps involved in 3D Garment Visualizationare listed below. Here we use the unity platform to build the prototype. The webcam in Unity can be accessed by using C# script it also has some inbuilt features like ‘WebcamTexture’ that helps to capture frames from the webcam.

- New Unity 3D project creation.
- If necessary, import a 3D model or make straightforward 3D scenario.
- For the texture application and webcam access, write a new C# script.
- Attach the script to the scene's primary camera or an empty GameObject.
- Wherever you want to display the camera stream, create a plane (or any other GameObject with a Renderer) in the scene.
- Select the required dress and jewel models that haveto be displayed on the plane.

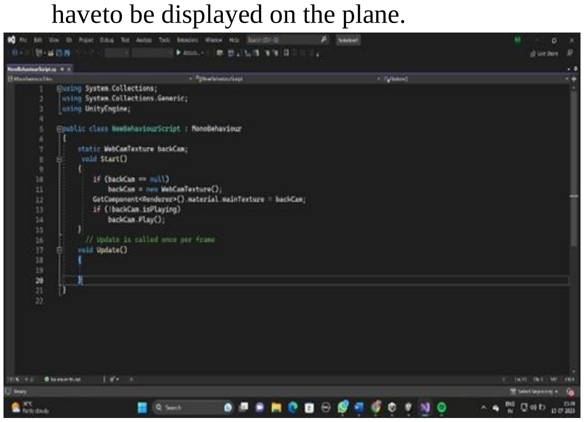

Fig.3 C Script for accessing the camera in UNITY

*C. Coding*

```
Using System.Collections;
using System.Collections.Generic;using UnityEngine;
public classNewBehaviourScript: MonoBehaviour
{
static WebCamTexture backCam;void Start()
{
if (backCam == null)
backCam = new WebCamTexture();

GetComponent<Renderer>().material.mainTexture = backCam;
if (!backCam.isPlaying)backCam.Play();
}
```

The above code is used to capture the live video and display it on the plane. The script is imported as one of the assets to the unity platform and the selected garment is placed on the plane and the real-time virtual experience is provided.

## IV. DESIGN OF WEB APPLICATION TRY-ON:

Use Blender to make a dress model: In this phase, A 3D model of the dress is made. This entails designing the clothing, modeling it in 3D, and adding materials and textures to it. Adding the dress model to Unity: Unity is a 3Dgame development engine where the dress model is added after it has been built. When not in use, the dress model is then kept in Unity's asset library. Create a 2D image of a person: A person's 2D image is created using a camera or other image-capturing equipment. Later on in the procedure, the person in this image will be fitted with the dress model.

Fig.3 The dress developed in a blender.

In Unity, make a 3D model of a person: A 3D model of a human is made using Unity's built-in tools or unique C# or Python code. Later on in the procedure, the person will be dressed using this model. In Unity, combine the person model and the clothing model: In this step, Unity is used to combine the person model and dress model to produce a single 3D model of the dressed person. To achievethis, the models must be properly positioned and scaled. Apply the dress model to the person model: After the person and dress models are combined, a procedure knownas skinning is used to add the dress model to the person model. The 3D model is rendered in Unity using a camera and lighting configuration once the dress model has been putinto the person model. This creates a stunning 3D representation of the dressed individual. Map the 3D model to the 2D image: In this stage, the previously acquired 2D image of the subject is overlaid with the produced 3D model. The position, scale, and orientation of the 3D model are mapped onto the 2D image using custom C# or Python code.

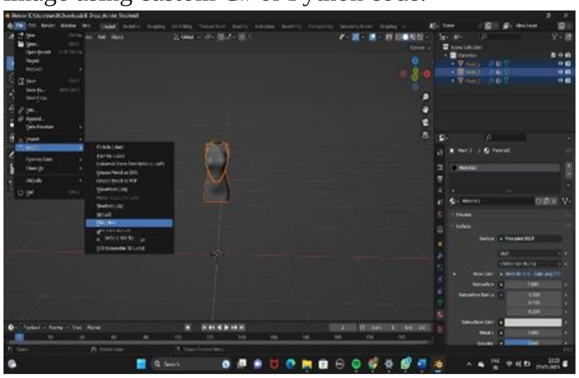

Fig.4 The dress developed in blender is imported to unity

JEWEL TRY ON:

Begin by crafting intricate 3D models of your jewelry in Blender. Focus on realistic materials, gemstones, and details to enhance visual appeal. To integrate your Blendermodels into Unity, export them in a format that works well, like FBX. Open an already-opened Unity project or start a newone. To continue developing, import your exported 3D modelsinto Unity. Provide a user-friendly user interface that enables users to peruse and choose various jewelry pieces for virtual try-ons. Set up a camera so you can see the virtual scene as clearly as possible. To best highlight the jewelry's features, adjust the lighting. Users can choose and virtually wear various jewelry pieces by interacting with the user interface (UI) with the use of C# programming in Unity. Then the plane is used to display the real-time video and the preview is provided to the user.

## V. RESULT ANALYSIS

This paper proposes the software Prototype. This is different from the similar existing apps with combination of jewel and dress. This can help to maintain salutariness in stores mainly during pandemic.

### *A. Cost Effectiveness*

We have used open-source software hence it's really less in cost. The laptop should be a higher-end with better webcam. We can also connect external webcam with higher pixels to get better clarity.

### *B. Output Analysis*

We took problem statements like we can't maintain hygiene during the pandemic and online shopping people cannot check their color tone matches. In jewelry shops precious collections cannot be given to all hence this virtual try-on can help customers get realistic experiences in addition to safety to the retailers. This can help to make decisions and it also helps designer with idea implementation and view on their customers in real time. We also need to analyze its performance in terms of frame rates and smoothness it's working better. User experience is easier and presentable because importing and exporting are easier. This increases both jewel and garment marketing online as

It provides a virtual experience.

Fig.5.The view of the selected outfit for both 3D model and real-time video

This 3D model is created using a Python script that can help in checking size approximately. It's an open source hence platform supports are flexible. And it's a customizable event.

Every element can be fixed based on customers' preferences. The overall impression it’s helpful to the fashion industry. Without the use of real prototypes, designers can swiftly create, change, and test their designs by visualizing clothing in 3D. As a result, prototyping and testing take less time and money, which can shorten the time it takes for new clothing to hit the market. Reduced environmental impact: Designers can eliminate the need for real samples by utilizing 3D garment visualization to generate and test designs, which can assist in lowering waste and the fashion industry's environmental impact.

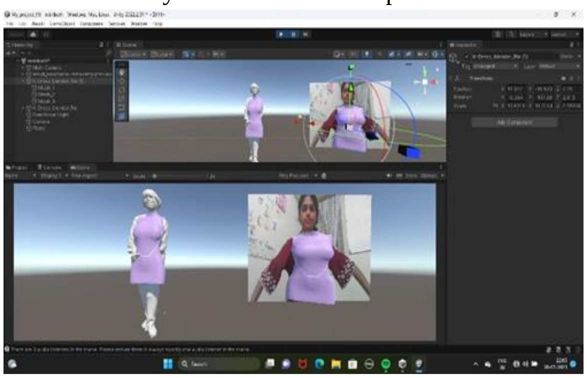

Fig.6 Output of the prototype

## VI. CONCLUSION

The 3D garment and jewelry visualization project has shown to be a useful tool for the fashion industry, In conclusion. The creation of dynamic fashion clothes with adjustable styles, hues, and textile patterns has also been made possible by the use of 3D garment simulation and visualization. Designers can raise the caliber of their designsby having the opportunity to rapidly assess changes and simulate revisions to patterns, colors, textures, and finishing touches. With different gems and stones and patterns on jewels based on customer experience

Additionally, the software has made it possible to visualize a clear relationship between 2D patterns, 3D shapes, and waste generated throughout the garment design process, supporting zero-waste initiatives. This 3D garment visualisation preserves the healthfulness of the clothing prevents a pandemic from affecting the fashion sector and helps retailers to protect precious jewelry in shops. Overall, the initiative has shown how digital 3D design has the power to revolutionize the fashion business.

## VII. ACKNOWLEDGMENT

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## REFERENCES

[1] A.M. Manferdini, F. Remondino, “A review of reality-based 3D model generation, segmentation, and web-based visualization methods”, in Int. Journal of Heritage in the Digital Era, Vol.1(1), pp. 103-124, 2012.

[2] Yi Liao. The 3 DS MAX modeling technology in the application of virtual reality [J]. Chinese scienceand education innovation Tribune, 2011 (18): 113. [2]

[3] NURBS.http://baik

[4] de Aguiar, L. Sigal, A. Treuille and J. K. Hodgins, "Stable spaces for real-time clothing", *ACM Trans. Graph.*, vol. 29, no. 4, pp. 106:1-106:9, July 2010

[5] R. Goldenthal D. Harmon R. Fattal M. Bercovier and E. Grinspun "Efficient simulation of inextensible cloth" ACM Trans. Graph. vol. 26 no. 3 July 2007.

[6] P. Guan L. Reiss D. A. Hirshberg A. Weiss and M. J. Black "Drape: Dressing any person" ACM Trans. Graph. vol. 31 no. 4 pp. 35-1 2012.

[7] S. Hauswiesner M. Straka and G. Reitmayr "Virtual try-on through image-based rendering" IEEE Transactions on visualization and computer graphics vol. 19 no. 9 pp. 1552-1565,2013.

[8] Jun Xu; Yuanyuan Pu; Rencan Nie; Dan Xu; ZhengpengZhao; Wenhua Qian, “Virtual Try-on Network with Attribute Transformation and Local Rendering”, IEEE Transactions on Multimedia, vol. 23, pp. 2222 - 2234, April2021

[9] J. Scholz and K. Duffy, "We are at home: How augmented reality reshapes mobile marketing and consumer-brand relationships", Journal of Retailing and Consumer Services, vol. 44, pp. 11-23, Sep 2018.

[10] Meenu ChaudharyGurinder SinghLoveleen GaurNidhi MathurShikha Kapoor, “Leveraging Unity 3D and Vuforia Engine for Augmented Reality Application Development”, 3rd International Conference on Technological Advancements in Computational Sciences (ICTACS), November 2023.

[11] Xury Greer, “Sculpting the Blender Way: Explore

Blender's 3D sculpting workflows and latest features, including Face Sets, Mesh Filters, and the Cloth brush",2022

[12] Mehdi Mekni and Andre Lemieux, "Augmented reality: Applications challenges and future trends", Applied Computational Science—Proceedings of the 13th International Conference on Applied Computer and AppliedComputational Science (ACACOS '14), pp. 205-209, 2014.

[13] M. Alcañiz, E. Bigné, and J. Guixeres, "Virtual reality in marketing: A framework review and research agenda", Frontiers in Psychology, vol. 10, pp. 1530, Jul. 2019.

[14] Jai Prajapat, Manish Sathe, Simran Shah, Chinmay Raut, "Jewellery Tryon using AR", vol. 9, Edition 4,2022

[15] Radhika Gnaneswaran, T. Senthil Kumar, P. Privin Dolleth Reyner, G. Leela, "3D Modelling of a Jewellery andIts Virtual Try-on", pp.157-165, January 2016.

[16] Himanshu More, Gaurav Salunkhe, Rigved Shete, Prakash Kawade, "Virtual Jewellery Shopping using Augmented Reality", Vol.9, Issue 07 (July 2020).

[17] Lav Soni; Amanpreet Kaur; Avinash Sharma, "A Review on Different Versions and Interfaces of Blender Software", 7th International Conference on Trends in Electronics and Informatics (ICOEI), April 2023