Epsilon Futuristic Virtual User Environment

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***Abstract*—Virtual Reality (VR) is an essential technology in today's internet world. VR has the capability to provide great insight into a particular subject, display features of a device, or even convey an idea through its exceptionally realistic atmosphere. Epsilon represents an advanced skin measurement device. It was initially built as part of a research project by a team at London South Bank University. Currently, Epsilon has been introduced and applied in several global corporations. The futuristic concept of Epsilon was an essential part of upgrading this medical research tool. However, comprehensive training that involves being physically present on campus is essential for Epsilon and requires significant time and money. Consequently, utilising the Virtual User Environment (VUE) to showcase all features of the futuristic Epsilon device is an essential step to demonstrating its qualities by providing users with the necessary training. This paper outlines the process of creating a web-based, interactive 3D virtual user environment for the futuristic Epsilon device. The VUE is an interactive 3D guide that will display to all learners all the futuristic features of Epsilon. Furthermore, enhancing the functionality of this device is a crucial element of effectively marketing this research instrument globally.**

Keywords—3D modelling, Web3D, Virtual Reality (VR), VLE (Virtual Learning Environment), 3DLearning, Virtual Labs, Epsilon, 3ds Max, Virtual User Environment (VUE), Mixed Reality (MR), Smart Cities

I. INTRODUCTION

This paper illustrates the process of designing and building the futuristic hardware of the research instrument Epsilon and how upgrading this device will improve its functionality immensely, especially when presented in a Virtual User Environment VUE. As we know in the current era the significance of virtual reality lies in its ability to convey a clear and explicit idea or concept to users by creating an immersive and lifelike environment. The need for showing accurately all functions of any equipment or device is another crucial element in utilising all its capabilities and features and there is no other way better than introducing them in a VUE where all experiences are immersive and engaging. Thus, it is perfectly appropriate to enhance and upgrade the usage of Epsilon by adding a new hardware (futuristic) version of it to the life-like environment of the VUE [1]. The increased use of 3D web resources has increased the necessity for further development of this research device. Additionally, with the existence of several ambiances like Virtual Learning Environments (VLE), 3D learning, Virtual User Manuals (VUM), Second Life, Mixed Reality (MR), Virtual Laboratories (V-labs), and many more have made it more demanding to enhance the Epsilon tool into something more effective and efficient, especially after experiencing the COVID-19 era and the importance of remote training/learning [2].

Incorporating these interactive 3D tools and environments into today's several sectors such as e-commerce, e-government, e-health, smart cities, etc. has enhanced and significantly elevated the user experience. Three-dimensional VR replicates actual features and qualities, allowing online users to engage with them through the internet as a platform [3]. Initially, the idea was to create and build a new accessory (holder) for the original Epsilon device to enhance its capabilities. The latest inclusion will expedite the skin measurement procedure, enhance efficiency, and enable simultaneous measurements for more than one individual at a time. The BIOX lab at LSBU has given its approval for the holder design. The new holder for the research instrument is a wearable part that can be secured to the individual's limbs as shown in Figure 1. In our modern technological time, it has been noticed the increased prominence of remote clinics and the rise of virtual treatments, it is imperative to engage in the development of novel wearable components utilised for medical services. Additionally, the ease of deploying wearable components or devices stems from their cost-effectiveness and dependable nature [4]. This novel device is explained by BIOX (2016) Biox Science of Measurement

"*When contrasting Epsilon with alternative skin medical technologies, it exhibits great sensitivity, enhanced repeatability, and produces skin measurement outcomes unaffected by external conditions. This novel tool is identified as the new scanning device for imaging dielectric permittivity (Ɛ) utilised for sensitive objects, comprising plant and animal skins, solutions, body fat, balms, polishes, and powder. Epsilon's primary electronic and signal processing function transforms the initial non-linear signals from the sensor into a finely calibrated permittivity scale for applications such as assessing hydration levels or monitoring dynamic processes, such as liquid penetration through membranes or textile wetting.*" [5].

Moreover, the existing user manual for Epsilon is exclusively provided in physical printed formats. The device's booklet expresses that "Epsilon's case contains a handheld probe, a parking base, and an in-vitro stand, firmly kept in a special box" [6]. The design of the new Epsilon holder was thoughtfully and intricately crafted to consort with the Epsilon's form while prioritising the well-being of the individual. The color and material incorporated into the device's holder consisted of a fabric that resembled stretchy material, chosen to create a visual resemblance to an actual item in the recently invented holder.

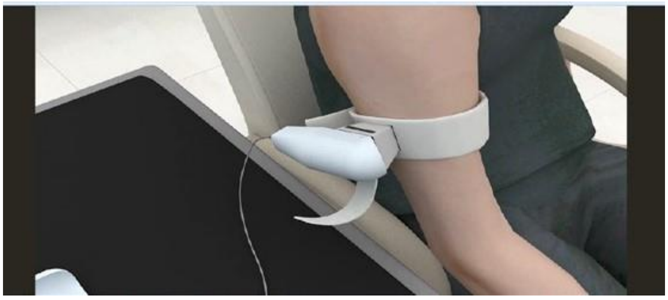

Fig. 1. Epsilon futuristic holder

The research investigates the implementation of a three-dimensional presentation, and the methodology employed to create the futuristic Epsilon and its new holder. Additionally, it follows the utilisation of the VUE.

II. The Implementaion of 3D Contents and Associated Design

Following the transition to the second generation of WWW, web applications have shown significant enhancements. The new browsers' versions expand to a range of events, like group cooperation, interaction, social platforms, also, the massive interaction linking online clients with computers. 3DVW is a crucial application of the new browsers' versions, these virtual worlds represent simulated, visuals, multimedia, and 3D atmospheres [7]. The use of three-dimensional content in technology dates back to the necessity for displaying animated content on computer systems. The fundamental concept behind creating objects in 3D is to provide users with a realistic representation. Designing three-dimensional content is a critical act within virtual reality [8]. Developing three-dimensional content is based on the following phases:

a) Modeling: developing a computer model in a three-dimensional manner.
b) Outline and simulation: combining animation with constructing a view for our 3D item.
c) Executing: the addition of elements to the scene, like lights, surface type, positioning of the camera, and other qualities.

The notion of illustrating web pages in a 3D setting is widely debated and strongly advocated for in several fields such as engineering, science, and technology. Furthermore, remote learning has gained popularity, particularly through the pandemic's impact and its continuing, and the heavy dependence of users on the internet as a medium for a multitude of activities such as remote learning and virtual classes. Recently, several new viewpoints have surfaced in the literature concerning the prospect of learning. It was mentioned by Potkonjak, Gardner, Callaghan, Mattila, Guetl, Petrović, Jovanović (2016), "Technical models that related to remote education, V-Labs, VR and VLE, and virtual system. Furthermore, the overarching innovative notion of immersive education consolidates several of these concepts" [9]. Utilising virtual reality technology in the health sector and remote treatment clinics fields provides benefits such as educating trainee doctors, nurses, and clients on using the equipment properly and performing various medical tasks. Medical training tools that utilise three-dimensional content over the Internet have been shown to enhance the learning process. An example of this is a VR health clinic designed for cardiac diagnostic and observing tasks, which can support the training of hospital staff, trainee doctors, nurses, and non-medical staff on how to perform an Electrocardiogram (ECG), operate an Automatic External Defibrillator (AED), also the use of blood pressure device.

The mentioned applications ensure an engaging and collaborative remote virtual practice within the health sector and private clinics. These applications aim to simulate actual patients, anatomical regions, and clinical procedures, to provide a realistic learning experience. Virtual environments enable users to interact with the system and manipulate objects with lifelike sensitivity, thus promoting practical learning and making the overall experience both straightforward and enjoyable [10]. The utilization of VR technology in such projects will facilitate the ability to provide all learners with exceptionally immersed knowledge [11].

III. The Development of Epsilon Futuristic VUE

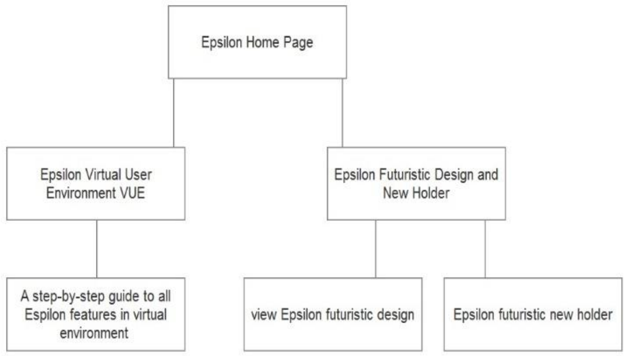

Fig. 2. Flowchart of Epsilon Futuristic 3D interactive VUE

As seen in Figure 2 (above) the process of designing Epsilon was not simple, and one of the initial obstacles was deciding on the most comprehensive, user-friendly, and appropriate 3D modeling software. Eventually, the modeling package chosen for the Epsilon interactive user environment was 3D Studio Max. Additionally, Adobe Flash CS6 software was utilised to incorporate interactivity between all clients (trainees) and Epsilon. Besides the previously mentioned packages, other 3D designing programs were considered in the early phases of the design like Google Sketchup, Blender, and Unity. 3ds Max was selected due to its professionalism and the availability of all options and functionalities required to build, design, and model all three-dimensional contents in every scene. According to the sitemap of the VUE, users can select between two options once they visit the Epsilon home page. Firstly, is to go through the guided step-by-step virtual user environment that will explain all of Epsilon's features (futuristic) comprehensively, demonstrating how the new probe of the futuristic Epsilon operates and conducting skin measurements in comparison to the existing device. Secondly, users can select two more options on the site which are, viewing Epsilon's futuristic design in detail. Illustrating all technicalities of the upgraded tool and how it differs in terms of design from the original Epsilon. Additionally, users can view the newly added hardware (Epsilon holder), and how this new addition to the research device will make the process of examining several patients smoother and more efficient. Figure 3 below shows the options available on the Epsilon site. Further information about the technical design and all the development stages will be explained in the sections to come.

As previously stated, Epsilon is a medical device employed in the scope of skin treatment and cosmetic operations, and it falls within the domain of healthcare and medicine.

Fig. 3. A screenshot of the Epsilon options from the Epsilon's site

The medical industry is prominently associated with the exploitation of the most sophisticated types of equipment like 3D and VR for purposes such as demonstrations, training, testing, and performing numerous medical practices. Ghanbarzadeh, Ghapanchi, and Blumenstein (2014) highlighted that

"Three-dimensional Virtual Worlds (3DVW) have found applications in diverse health-related contexts, and we have classified them into five primary categories: education, therapy, simulation, assessment, and lifestyle." [7].

A. Creating and building Epsilon futuristic model with 3D Studio Max software:

3D Studio Max is a 3D software that can effectively and promptly produce three-dimensional content (scenes and objects) [12]. In 3D modeling, producing 3D content quickly is a critical aspect of the design process, just as in any other process. Original Epsilon consists of a base and a probe, futuristic Epsilon consists of a probe with a rotating head and there are a few modeling challenges on the head, such as input buttons for powering the device on or off and starting the scanning process. To ensure the object is as realistic as possible, the probe was measured using a physical ruler. Additionally, accurate pictures of the device were taken to capture its precise proportions. Figure 4 below shows some of the early modelling stages of futuristic Epsilon.

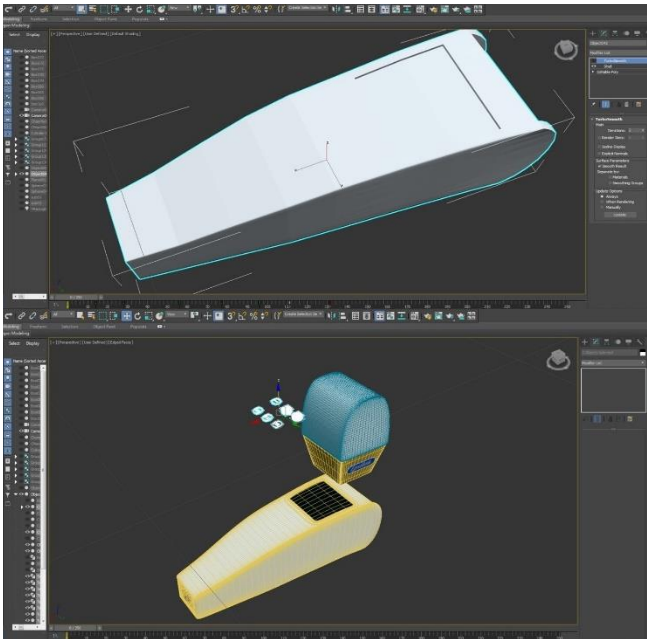

Fig. 4. Early rudimentary designs of futuristic Epsilon tool

It is crucial to keep in mind a significant aspect when incorporating new components into the existing design. The newly developed addition is a dynamic component capable of rotating both upwards and downwards. Hence, adjoining a pivotal end to the new part as shown in Figure 6, the new component must be disconnected from the existing elements of the Epsilon probe. Consequently, when the new component is in motion, it should proceed in the planned route and not detach from the probe's original body.

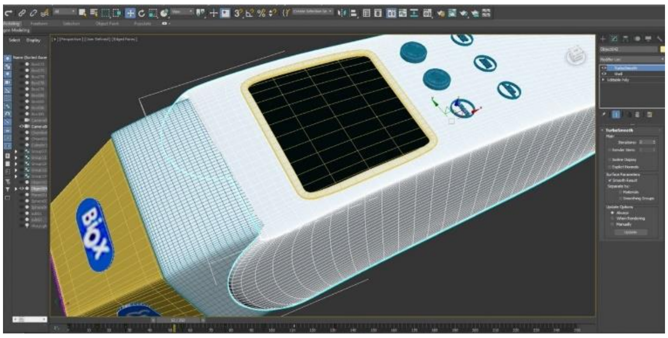

Fig. 5. Placing all pivotal points while considering other moving parts

B. Adding material to the futuristic model:

It is important to consider materials at an early stage when creating a model to ensure that they are realistic and meet the client's requirements. Once a suitable material has been chosen, it should be studied carefully to ensure that it does not cause slow rendering or unrealistic results, particularly if it has a high level of glossiness or reflection. However, if the best material is not used, the final product may look unrealistic to viewers in comparison to the real object. Our third-party renderer is Vray materials throughout the entire work, this renderer is widely used in manufacturing to generate images with a professional appearance and is considered a standard among professionals. To achieve a futuristic appearance for Epsilon and similar components, a semi-glossy finish is applied, featuring a whitish material. Using a glossiness level of 0.6 and a subdivision value of 20, this object will have minimal impact on rendering time. High-Definition Range Imaging (HDRI) utilised for the background of the scene. It benefits significantly in generating accurate influences of light and shades. HDRI is a useful tool for creating realistic shadows and lighting in virtual objects, simulating real-world conditions. While it may add extra time to the rendering process, it can help to reduce the glossiness and reflectivity of the objects, which can ultimately improve overall performance. As seen in the Figure below the process of applying V-ray materials to the futuristic Epsilon

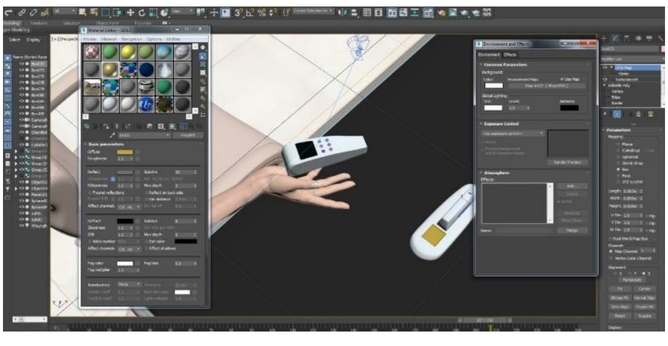

Fig. 6. Adding V-ray materials to Epsilon futuristic model in 3ds Max

Once the materials have been chosen and incorporated, taking into account project timelines and quality standards, we make the necessary preparations to animate the objects. This entails grouping and linking all objects that can be combined, as failure to link any object with the others may result in the keyframes associated with that object being lost, rendering it unanimated

C. *Animating Epsilon futuristic version:*

Animation is a crucial aspect of any 3D project and typically takes up around one-third of the project's total time. It involves planning how objects will interact with one another, as well as determining their motion and direction within the user's virtual world. This planning stage can be quite time-consuming, but it is simpler than character animation as it does not require the use of complex rigging tools like bones. Planning is essential before the animation process; it is worthy to orgnise the pivotal points for each object's motion. For this specific project, the timeline has been set to 1000 frames and 15 frames per second to ensure that the animation rate is reduced to keep file size suitable for online use via using the curve editor as seen in Figure 7.

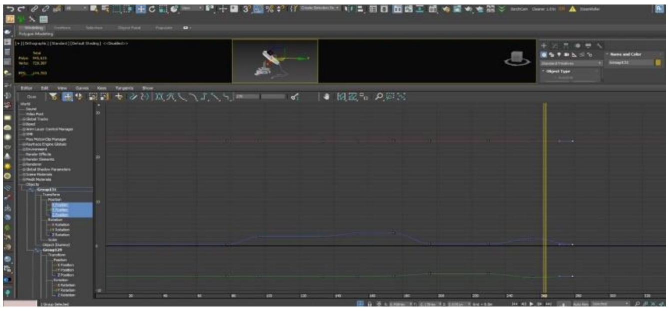

Fig. 7. Using curve editor in 3ds Max to animate futuristic Epsilon

D. *Rendering the futuristic Epsilon:*

After the animation procedure has been completed and keyframes are set to determine where each object should stop, the last phase of the modelling process, known as rendering, can commence. It is important to monitor the speed and duration of every item being rendered. Each frame should be carefully reviewed to ensure that it is in the correct position and that all items have the appropriate shadows and lighting. It is not uncommon to discover issues at this stage that were not noticed during the modelling and animation phases, such as floating objects. Throughout the rendering process, a little screen will be displayed, rendering each square pixel, and assessing all items material, shadows, light, reflections, etc. Figure 8 shows each square pixel being rendered for the Epsilon futuristic protective case.

Fig. 8. Rendering window for the futuristic Epsilon protective case

The V-Ray plugin in 3D Studio Max includes a comprehensive set of V-Ray components, encompassing V-Ray lighting, materials, cameras, and the renderer. Nevertheless, the choice of light for the three-dimensional scenes is entirely at the discretion of the developer. V-Ray lighting imparts a heightened sense of realism when paired with V-Ray rendering, resulting in a more authentic and lifelike outcome. Also, The V-Ray lighting is specifically engineered for seamless compatibility with V-Ray material and the V-Ray renderer. Furthermore, V-Ray offers more complex and scene-specific shadow control options, whereas conventional lighting provides only two shadow choices. Figure 9 below, shows the process of applying V-Ray lights to the settings of Epsilon futuristic virtual user environment VUE.

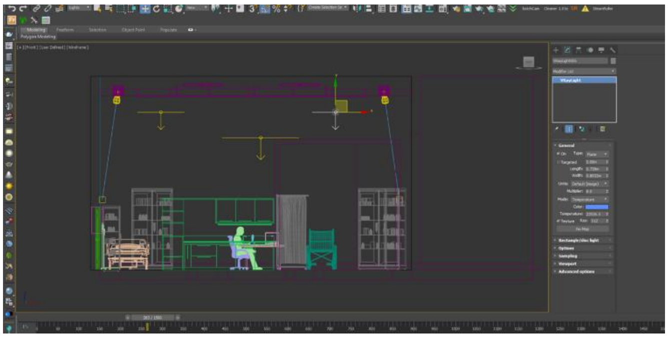

Fig. 9. Applying the V-Ray light to the Epsilon futuristic VUE

E. *Adding links and Interaction to Epsilon Futuristic:*

To make the new tool interactive, we had to transfer all the image sequences we had created with 3ds max software into a Flash file:

Step	Description
1	Firstly, access the Flash file that has a size of 1920x1080HD in its first scene. Every set of movements can be grouped to one scene, where they can relate with each other to accomplish their objective
2	Add the entire image sequence animation to the file library
3	Build another figure then begin the process of dragging pictures into that symbol's frame one at a time
4	The image sequence, that was transferred from 3D studio to Flash, was positioned on specific frames to construct a flipbook-like structure (cartoon technique)
5	To make a button that ends or stops a particular action, use ActionScript with the term "stop();" and attach it to the button that we've made
6	Flash CS6 offers a range of built-in ActionScript functions in its global function's submenu. They cover various aspects such as controlling movie clips, timelines, browsing, and printing. Common functions like play, stop, and goto
7	If you want to use a button you have created with an attached script in a different location, you can achieve this by creating a new layer in a new scene and copying/ pasting the button to the new layer. The new layer will replicate the exact functionality of the original button

Fig. 10. Table showing adding links and interactivity to Epsilon futuristic

In addition to incorporating interactive features and buttons into the device, audio clips are integrated. These audio clips will play alongside the displayed explanatory text when the user clicks on them. Previously outlined steps can be replicated for all items that need to be linked.

The Epsilon futuristic virtual environment is an online platform that is entirely interactive and can demonstrate and explain all its features, functions, and even an example of a skin measurement taken on a person in a three-dimensional setting. Figure 11 provides a visual of the instrument in action.

Fig. 11. The instrument in operation

The futuristic design of the Epsilon device showcases new capabilities that were not present in the primary Epsilon probe, like the device's movable head, screen, and operational keys as shown in Figure 12.

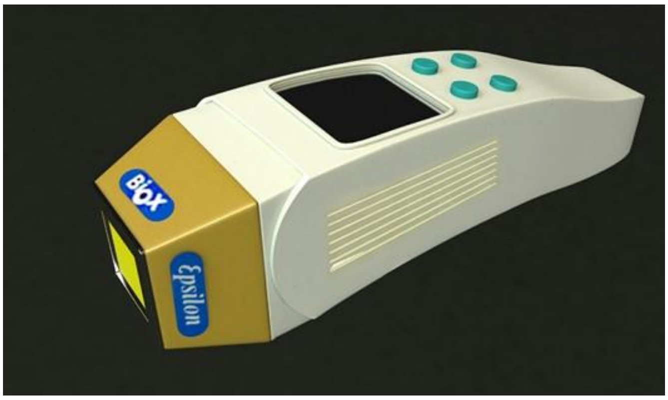

Fig. 12. The Epsilon futuristic concept with moving head, screen, and functional buttons

The figure above showcases the Epsilon device's moving head, which allows for skin measurements to be taken in both vertical and horizontal positions by moving forward and backward. To offer accessibility and showcase measurement outcomes and skin images, a new screen has been added to the original Epsilon probe design providing the capability of reading scan results directly from the device and making the measurement process practical and convenient. Additionally, there are plans to convert the Epsilon device to function wirelessly soon. As in the original Epsilon device, The Epsilon futuristic device offers three distinct modes for skin measurement: snapshots, bursts, and videos. Image or video taken from these scans are stored in a designated folder on the device's hard drive. The interactive 3D environment of the device is designed so that all buttons and tabs can be clicked on by the user. To enable on-probe operations, functional buttons have been incorporated into the futuristic design of the Epsilon probe as seen in Figure 13. This feature will enhance the device’s usability, making it independent of any other device and fully portable, as it can now operate directly from the probe rather than being connected to a laptop or a PC. All keys are going to offer essential operations like On/Off, Scan, and Reset. The introduction of these design concepts will play a significant role in improving the operation of Epsilon devices in the future. As a VR creator/developer, it is essential to observe adding other features or elements to enhance the overall experience instead of focusing solely on developing and improving the virtual reality content and any three-dimensional object in it. This could include new and upgraded designs, as well as audio features, which can help to immerse clients even further into the VR experience [13].

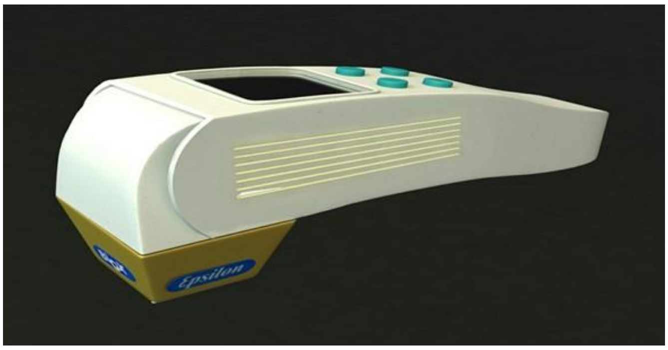

Fig. 13. Functional buttons, screen, and rotatable Epsilon head

IV. NEW HOLDER DESIGN OF EPSILON RESEARCH TOOL

After the completion of the primary steps of this study, a new designing emerged, which had a positive impact on the entire measuring process. The concept was to construct an extra addition or holder for the skin instrument, which would significantly benefit the measuring process by making it quicker, and more efficient, and allowing multiple patients to be measured simultaneously. The novel component was created using a cloth-like material to simulate an actual item. It is made of gel or silicone materials, and it is sufficient to accommodate a square-shaped holder that will function as a base for Epsilon. A buckle is also included to secure the Epsilon tool securely in place during measurements as seen in Figure 14.

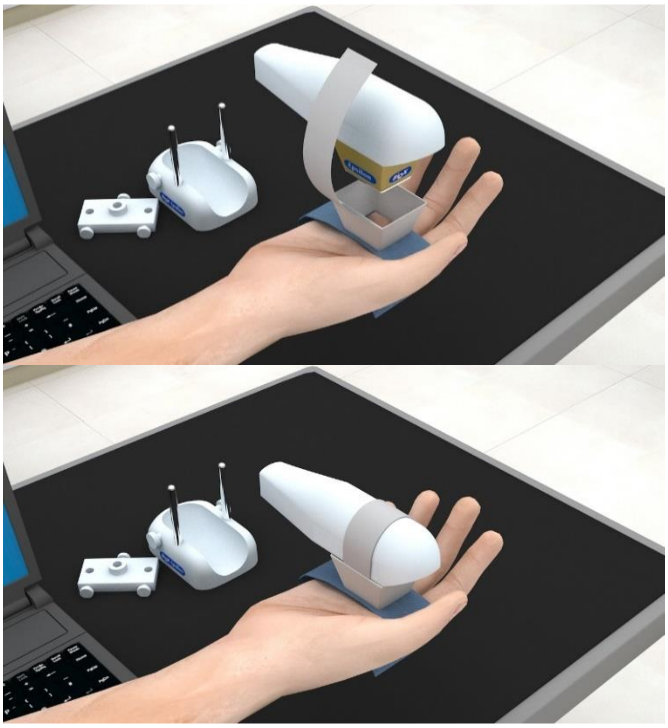

Fig. 14. Epsilon new holder strap in operation

V. EVALUATING EPSILON FUTURISTIC DESIGN

The Epsilon medical device can now be experienced through a 3D virtual user environment system called VUE. In the past, clients had to attend face-to-face sessions to learn about Epsilon's characteristics and operations. The Epsilon VUE platform is enjoyable, accessible, and engaging, but it also showcases all of Epsilon's futuristic functions and features in a virtual setting.

The results presented below were obtained from a usability study conducted on Epsilon among 23 participants, comprising both IT and non-IT background users.

Out of the participants in the usability study conducted for Epsilon, 83% reported a smooth and error-free online service while 17% were neutral. 58% of users enjoyed the Epsilon futuristic virtual user environment and 42% were neutral. 64% of users were successful in using the VUE while 36% were neutral. Among the contestants, 59% were able to control the futuristic VUE while 33% were neutral and 8% faced difficulties. 92% of users found the newly enhanced Epsilon probe features clear and useful while only 8% disagreed. As for the comprehensiveness of the VUE, 36% thought it was sufficient and comprehensive, 46% were neutral, and 18% disagreed.

The results suggest that the VUE of Epsilon's futuristic design is effective, and error-free, and users were able to use it successfully. The new features in the futuristic probe, as presented in the VUE, were found to be user-friendly and more beneficial compared to the original Epsilon probe. Nonetheless, there is still room for improvement in the VUE system's capability to comprehensively educate users about Epsilon's enhanced features.

VI. CONCLUSION

The objective of the academic research is to provide a summary of Epsilon's futuristic VUE (Virtual User Environment), that includes three-dimensional content. The focal part of this research is the use of a VR setting to show how to use a research medical device for human skin measurement purposes, aided by a voice attribute. The new Epsilon VUE will replace the previous method of demonstrating the medical device's features and functions to clients by providing them with an available URL after acquiring the device. The online VR platform is easy to use and self-explanatory, with audio support guiding users step-by-step via the procedure. The use of virtual technology in presenting online 3D content of the skin measuring tool has enhanced the learning process of how the device works, making all 3D objects and scenes dynamic in response to trainees' actions. This allows for the integration of interactivity, dynamic animations, and visual design to challenge and stimulate users. The Epsilon VUE system has the potential to change remote learning by providing a working and connecting practice. Users can remotely try and investigate the research tool employing the Net as a program and find all its characteristics and utilities. The presentation of new hardware demonstrates the impact of advertising and the need to convey new ideas realistically to the world, particularly in the current era of social media and the widespread use of the Internet especially during the pandemic, which made remote learning, working, and training so popular and in some cases mandatory. The finalised design of an interactive virtual environment for Epsilon can be developed easily to align with the modern developments in the technologies of extended realities.

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