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3D AVATAR PLATFORM — A UNIQUE CONFIGURATOR FOR 3D FIGURINE CUSTOMIZATION

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Abstract: *A 3D avatar platform is a software product that provides monitoring and management of automated production of 3D models, static and animated avatars. Alongside the features for automatic avatar generation, preview, manipulation, download, and editing, the platform provides all digital products on one place, customized for the company business vision. In this paper we present a proof of concept for the new platform feature that supports 3D figurine configuration for fast figurine ordering. The unique configurator provides customers a possibility to choose the pose and the size of their figurine, and the shape, size and color of the figurine stand. The figurine pose can be specified from the set of the predefined poses, or even fully customized by the customer. Research on existing 3D platforms in the area of 3D figurines customization is described in the paper, alongside their capabilities, and tools they offer. The paper conceptualizes the possibilities and features of 3D platform in the domain of 3D figurines customization.*

Key Words: ***Human 3D scanning, Web platforms, 3D content, Product customization***

1. INTRODUCTION

3D avatar is a graphical representation of a person in three dimensional space. Apart from three-dimensional, avatars can also be two-dimensional. We can further divide avatars into categories by the degree of reality in which they portray the person. These categories are:

1. Realistic avatars, that provide a fateful representation of the person in question.
2. Cartoonish avatars, that somewhat resemble the person, but have a couple or more features accented in order to achieve a cartoony look.
3. Completely imaginative avatars, that look nothing like the person they are supposed to represent [1].

The main focus of this paper will be on realistic avatars set in three-dimensional space that are made through usage of 3D scanners. These avatars can be used, in combination with 3D printers, to create a miniature replica of a real life person, allowing people to commemorate some of their most cherished moments, or to keep a figurine of their loved ones close by.

Customization is one of the most important aspects of commercial success, as it gives a feel of luxury to the items being sold. The research previews that product customization may lead to increase in customer satisfaction and loyalty [2]. In order to provide the best customer experience and increase in heir satisfaction, the product being sold should be tailored to customers needs and aesthetic preferences. A 3D avatar platform presents one possible solutions of the figurine customization problem. The importance of 3D avatar platform in providing customers with all parts of 3D avatar life cycle has been covered in previous papers, as this work presents continuation of work on describing avatar platforms, technologies involved in human scanning and avatar production [1,3,4].

Structure of this document is as follows. Section 2 presents the results of the research conducted on existing 3D avatar platforms and customization options they provide. Section 3 provides description of 3D avatar platform that offers figurine customization as a proof of concept, while section 4 concludes the paper.

2. BACKGROUND

As the industry of 3D printing continues to grow, there are more and more companies offering the production of 3D customer scans [5]. Even though the branch of printing 3D scans grows, there is very few systems that provide user with the ability to fully customize their figurines. For example, Sculpteo offers the possibility of online 3D printing of user provided 3D models [6]. Since it heavily relies on users uploaded models, it also provides the service of analyzing and automatically repairing the model for 3D printing. Although it provides users with the possibility of choosing material and orientation of the figurine, it doesn't provide the means of creating these scans and further customizing of the figurine to be printed. Shapify represents 3D avatar platform that offers the possibility of scaling the scanned figurine before printing [7]. This means that the two figurines printed in the same ratio will maintain proportionate height difference. However, Shapify doesn't provide a way of customizing figurine position once the 3D model has been acquired. On the other hand, there are platforms that offer customization of cartoonish user created avatars. One of them is

Thailand based Minockio that provides the user with service of choosing facial features, clothes and figurine pose in order to create a custom cartoonish miniature [8]. Apart from not dealing with realistic 3D models, Minockio does not provide the user with the possibility of choosing a figurine stand, material or the size of the printed figurine. One other platform that allows users to create a custom fantasy avatar is HeroForge [9]. It provides customer with the possibility creating their own fantasy avatar and then choosing things like facial features and outfit, as well as the material and figurine stand. It also gives possibility of placing the created avatar in one of the predefined poses, in which the figurine will be printed. Although it does provide a lot in the way of customization, HeroForge does not work with realistic 3D scans and provides user only with the limited choice of fantasy avatars.

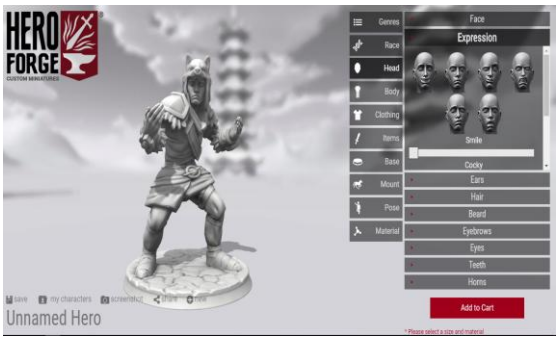

Fig. 1. *HeroForge customization platform*

3. FIGURINE CONFIGURATOR

As one of the main features of our proof of concept 3D avatar platform, we have implemented a figurine configurator that enables customers to customize figurines to be 3D printed from their realistic 3D avatars. The main idea of the configurator is to enable customers to make their own figurines, take as much time as they need to customize them exactly to their liking, without interruptions, and then proceed to order the figurine for 3D printing. As such, we encourage our customers to take part in the 3D avatar life cycle as early as production phase. This proof of concept 3D figurine configurator is designed to be extendable, and will serve as a base for future work.

The configurator makes it possible to customize the pose and the size of the figurine, as well as size, colour and shape of the figurine stand. This is implemented as a regular part of the ordering process on the 3D avatar platform and is streamlined so that both the configuration and ordering is as fast and user-friendly as possible. The integration of the customization and ordering process on top of both the production and distribution phases is especially important, as it completes the 3D avatar life-cycle, as referenced in previous work. This makes the 3D avatar platform unique in a sense that customers can get their avatars created, customized, distributed and consumed in various ways, with possibilities to share and download, as well as 3D print, all on a single platform.

As a part of the 3D avatar platform, the configurator is implemented as a web application, providing all users of the platform with the ability to customize their own figurines. Upon finishing the creation and customization of the figurine, users can order them for 3D printing, or proceed to create and configure other figurines, made from same or different 3D avatars.

To reach more customers, we have implemented the user interface both in 2D and 3D [10]. At any point in the process of configuration, customers can switch between 2D and 3D interface without losing their progress. Since customers can access our 3D avatar platform from different devices, namely PCs, smartphones and tablets, all of which have different technical specifications [11], we have decided to implement 2D version of the configurator to make it possible for customers with older devices to easily configure their figurines. Proof of concept 2D user interface for the configurator is shown on Fig. 2, on which all mentioned basic options of customization can be seen. This user interface is implemented following the best practices of responsive web design [12], so customers can use the configurator on devices with screens of different sizes.

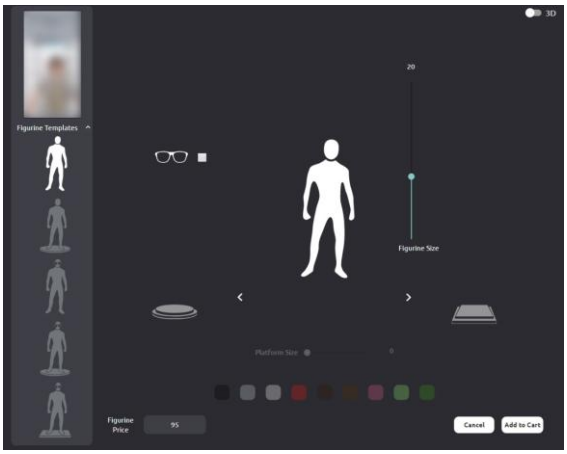

Fig. 2. *Proof of concept 2D user interface*

This interface was implemented using standard web technologies, and is portable to every browser and device. However, best user experience can be achieved using the 3D user interface, as the customer can be immersed into the 3D virtual world, as well as view and customize the figurine more realistically. We proposed and implemented the 3D user interface, implemented using advanced web technologies. Proof of concept 3D user interface is shown on Fig. 3.

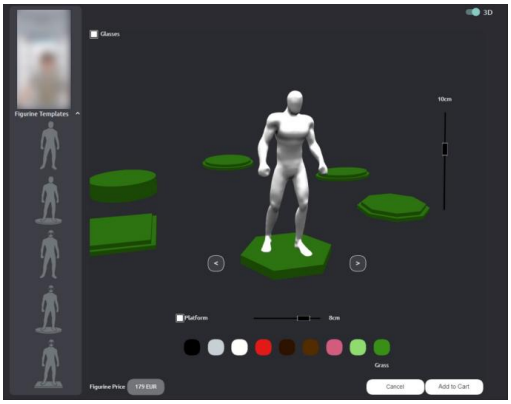

Fig. 3. *Proof of concept 3D user interface*

The realistic 3D avatar is replaced with a generic one, but in reality, customers using the configurator will be shown their own 3D avatars. From a user perspective, 3D user interface for the configurator makes it possible to truly visualize the end product - a realistic 3D-printed figurine based on a realistic 3D avatar of the customer [13]. The customer can select a figurine configuration from a set of pre-existing default templates, or create a unique configuration through combinations of basic options. In addition to basic customizations, we provide the customer with the ability to add accessories to their figurine, such as glasses, hats, etc. When showcasing both 2D and 3D interfaces internally and in parallel, subjects have shown greater interest in favor of 3D user interfaces. Every customization action as part of the configuration process feels more realistic, and adds a certain sense of satisfaction to the user. By seeing the 3D avatar in 3D space, rotating and customizing it, changing the parameters and creating their own unique 3D figurine, customers can really feel like a part of the process. Having a preview of the real end-product makes the customers customize more, as they have a feeling that every customization matters [14] [15].

The configurator is powered by WebGL [16], computer graphics technology optimized for web performance. WebGL allows us to create a 3D scene, in which different 3D models and objects can be placed, manipulated and displayed. As a proof of concept, we have created a basic scene with a number of predefined figurine stands, a loaded 3D avatar of the customer that is performing the configuration process, and a scene-embedded user interface. We provide sliders for figurine and figurine stand size manipulation, a colour palette for choosing figurine stand colours, buttons for switching the figurine stand and a panel of buttons for accessories. Changing any of the figurine settings through the user interface, both the 3D model of the figurine and labels that indicate values will change. For example, moving the figurine size slider will resize the figurine in real-time, as well as change the number above the slider to show updated values. As this user interface is just a proof of concept, options are still limited. Figurine and figurine stand sizes are limited to predefined values, as well as figurine stand colours and additional accessories. However, it would be very easy to upgrade the 3D user interface to support continuous figurine and figurine stand sizes, figurine stand colours and more options to choose from for additional accessories.

One nice feature of WebGL is the ability to run animations and effects on user input [17], which makes for a great user experience. For example, when selecting the figurine stand, switching from one stand to another causes the 3D avatar to jump as the figurine stands switch places, making it a really satisfying effect. An example of such animation is shown on Fig 4. We believe that these effects are the future of 3D figurine and avatar configurators and editors, as they greatly enrich the interactivity of the configurator, as well as user experience.

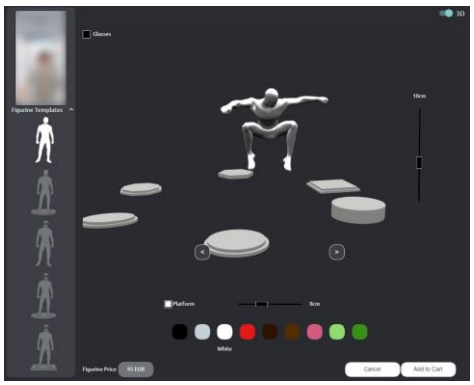

Fig. 4. *Jumping animation triggered upon changing the figurine stand*

As part of the 3D avatar platform, the configurator is connected to the backend servers and database, so all actions on the user interface and updates from the server are happening in real-time. Every change to the figurine configuration triggers certain functions on the platform and update the price of the figurine instantly. This way, the customer can track the price and how it changes based on different configurations, and does not have to worry about any surprises concerning the pricing. Using the *Add to cart* button, as shown in the lower right corner of Fig 4, the customer can add the configured figurine to their order, and proceed to checkout.

WebGL provides many possible extension points to existing proof of concept user interface. These include, but are not limited to, customizing character pose (instead of selecting from a list of existing poses), multiple 3D avatar loading and configuring, additional accessories and objects support, as well as interfacing with different 3D modelling tools such as Blender, 3D Studio Max, Maya, and others. It is also possible to rotate the scene and look at the figurine from all angles. It is possible to create a user interface that will allow the customer to play with the lighting [18] inside the configurator and simulate the effects of sun or different times of day on the outlook of the figurine. It is even possible to link the user interface to Virtual Reality (VR) headsets and devices. All of these extensions are very possible and can be implemented in a reasonable amount of time. Some of them, such as interfacing with 3D modeling tools and scene rotation are already implemented in the proof of concept 3D user interface that we present in this paper.

Since every our avatar comes with a rigged skeleton, having the option to manipulate the skeleton can allow the customer to make custom figurine poses. WebGL supports these manipulations in two ways. First, it is possible to move bones and joints inside the skeleton and set the avatar in the desired pose, whatever that pose may be. This option is requires the implementation of the user interface that allows the customer to move individual bones and joints. It is also advanced from the user perspective, as it may require knowledge of how 3D skeletons work. However, the second option is more user-friendly, albeit more limited in which poses can be created. The 3D avatars used in this research are animated, and come with several different animations, such as walking, running, jumping, dancing, etc. It is

possible to select and run animations within the configurator and stop them in a specific moment, thus stopping the avatar in its movement and creating a unique figurine pose. By using commands for animations such as *start, stop, rewind*, customers can play around with the animation until they are satisfied with the figurine pose. Using any of these two techniques allows customers to create their own unique figurine pose, which adds more depth to the customization process. Since there are a lot of ways to create a figurine pose, monetization strategy could go like this: basic users could select a pose from a predefined set of poses, paying customers could run animations and select a pose by stopping them in a desired moment, and extra paying customers could manually configure the figurine pose by means of manipulating the 3D skeleton itself [19]. Since the 3D avatar platform offers both user dashboards and administrator panels, manual manipulation of the 3D skeleton could be reserved for administrators, who would have the experience necessary to perform custom configurations successfully.

It is possible to extend the existing proof of concept 3D figurine configurator to support multiple figurines at the same time. In case of family or other group 3D avatars, using the facilities provided by WebGL, it is possible to arrange different avatars and manage their own poses, before combining them into one composition, ready to be ordered and 3D printed. Along those lines, adding accessories or other 3D objects into the scene is possible simply by importing 3D objects into the scene, moving them, resizing or recolouring [20]. A simple user interface would be provided, with controls for selecting desired 3D models and manipulating their size, shape and position. Customizing figurine poses would also be available for each 3D model or avatar. Even though these functionalities are not yet supported in the existing 3D figurine configurator, it would be very easy to implement them and enable them for production settings.

One possible specific aesthetic feature of the 3D figurine configurator is the ability to import 3D scenes in which the figurine configuration will take place. This can be done by importing 3D scenes, created in 3D modelling tools, into the WebGL environment of the 3D figurine configurator. For example, it is possible to create a specific scene for a business partner that will promote their company and services, or simply reflect their company themes. These scenes would provide excellent marketing capabilities for business partners and a great opportunity to customize 3D configurators for specific events, seasons of the year or times of day. It would be equally easy to create and import scenes which would serve purely for aesthetic purposes. These scenes would be created to reflect a certain theme, city or natural environment, to make the configurator environment more pleasant and welcoming. They wouldn't need to be realistic either. Fantasy settings are common today, especially in the 3D world and the world of video games.

At last, specific WebGL technologies allow linking user interfaces with VR devices and technologies [21]. This means that the 3D figurine configurator's user interface could be implemented in such a way that using VR devices, customers could configure their figurines almost like real sculptors. VR technologies provide complete immersion for users [22] [23], enabling them to directly manipulate 3D objects, avatars and figurines using their own hands, through user interface of course. We feel like this could the real future of 3D avatars and figurine configurators, and could provide a glimpse into what a 3D world really could be. We will present an example scenario that could happen when a customer starts the customization process in a virtual reality powered 3D figurine configurator. First, the customer is presented with their own realistic real-size 3D avatar, in a default pose. The customer can then rotate it, resize it, change the pose, add, remove, resize and recolour the figurine stand, etc. The customer would have direct contact with the figurine, as well as a realistic depiction of the future 3D printed figurine. All of these actions would be performed inside VR space, with realistic size of the figurine and complete immersion. The best thing about it is that, from the technological standpoint, the switch from 3D created scenes and environment used in the proof of concept 3D figurine configurator could easily be tweaked and made VR-ready.

Although the 3D figurine configurator described in this paper is still in the proof of concept phase, all of the basic options of 3D figurine configuration the 3D avatar platform are provided, making it possible to choose a figurine for 3D printing in a fast and easy way. We strongly emphasize the extensibility of the configurator, which makes it a great foundation for further research and improvements. With small adjustments, this proof of concept 3D figurine configurator could greatly increase in functionality and customer appeal.

4. CONCLUSION

3D avatar platforms present an online system that provides customers with means of customizing and tailoring their figurines to their liking before production. This paper provides description and example of a service for 3D figurine customization that has potential to further develop and expand, and to possibly be able to provide more customization options in the future.

The conclusion of the paper is that, even though interest in 3D printing grows, there is very few systems, if any at all, that provide users with the ability to tailor their figurines to their liking. With the evolution of personal computers and graphical processing units, the technology for implementing such configurator already exists, with the first steps towards it already being taken. While the described configurator offers the means of customizing things like size and pose, things like custom clothes and expression might not be that far from reality.

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