Accessible Avatar Customizer for Social VR:

INFR 4460U: Special Topics in Game Dev: Emerging Technologies

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***Abstract*—Accessibility is an essential topic in Social VR avatar design, as it relates to avatar diversity for disability and minority representation. In the modern gaming era, the freedom to express oneself allows a player to develop a strong sense of embodiment and personal identity. While its effects on online VR social platforms are researched, little is known about potential solutions to the problem. Structured interviews were conducted with 13 participants who showed their preference towards being able to customize their character to represent them and shed light on how existing systems of customization felt too limiting, often leaving them unsatisfied as the result often ends up far from a true representation of the user. Through methods such as bodystorming and playtesting throughout key stages of the development process, we gained insight into potential issues with our product and corrected them for the final iteration. This project focuses on the customization of VR avatars to address the issue of limited avatar diversity. It will address the issue of inaccessible design through features such as assistive device representation, body customization, and diverse skin tone settings.**

***Index Terms*—Accessibility, VR, Avatar, Customization**

I. Introduction

The advancement of VR technology has resulted in the need for more accessible social VR avatars that cater to a broader range of users, particularly marginalized communities. The proper representation of these users is critical to promote inclusion and participation in VR spaces. However, designing for VR comes with unique challenges and limitations. As a team with no prior experience in this area, we conducted a survey to gain preliminary insight on the topic as well as a bodystorm test to gather feedback on our prototype that was created through the application of the design thinking framework. We performed a playtest on our prototype and had participants fill out a series of questionnaires that we can use to evaluate our product by organizing the data from the feedback into a System Usability Survey, NASA Task Load Index, and a Presence Questionnaire, the results of which would allow us to highlight problems with our product and gain insight on how to rectify these issues for our final iteration. This would ensure that we accurately catered to the needs of our target users, those with physical disabilities and persons of color. In this document, we will be outlining the evolution of the prototype and methods leading to its final iteration.

II. Methods

Identifying the overlying problem and task so we could come up with a problem statement and justification was the next step on the list. Under design thinking, we must first empathize with and understand the desires of users before we can address the problem at hand. We created a survey on Google Forms to gain insight into how users of VR technology are affected by the limited personalization of their virtual avatar regarding accessibility due to disability. Our survey asked users about their thoughts and opinions on topics such as the level of customization in video games and their satisfaction with existing systems allowing for representation with virtual avatars. We then used design thinking to come up with our solution based on our survey results and designed an initial prototype that would fulfill the identified needs of the user.

When conducting our bodystorm, we employed a two-fold approach: A physical paper prototype and a digital prototype within Mozilla Hubs. To ensure that the products met the needs and values of our primary target audience, we developed a persona and designed a use case diagram to map out interactions within the system. For the physical bodystorm, we printed out each frame of the prototyped design within Figma and simulated the systems using Wizard of Oz Interactions, taking notes of the tester's thoughts and behaviors. We then conducted digital testing in Mozilla Hubs, where we created a simple VR environment to simulate interactions within our product.

A playtest was performed using our prototype which combined our Figma-based UI as well as a build of UMA DCS to compensate for the basic component of a character customizer and to better showcase the functionality of our product. Participants were then asked to fill out a survey to gain feedback on the usability and functionality of our prototype. This data was then used to calculate scores for a SUS, a NASA TXL, and a Presence Questionnaire to find where our prototype sits on the scale. This feedback was then incorporated into the next iterations of our product.

III. RESULTS

From our surveys, we discovered a variety of different responses and opinions on the matter of personalizing their virtual avatar. A majority of users showed their preference towards being able to customize their character to represent them and stated how existing systems of customization are to limiting and often leave them unsatisfied as the result often ends up far from a true representation of the user. These preliminary results show how important this matter is to users and how it impacts their experience even outside of VR. Users noted how there are no options for accessories such as hijabs, and existing accessory options tend to be very limiting (only one design for a pair of glasses or wristwatch). Furthermore, there would often be no way of representing users with disabilities None of this would reflect their real-life selves which causes a disconnect in how the avatar can embody and immerse them.

The results of our bodystorm testing revealed some key areas where our paper prototype fell short in providing a satisfactory user experience. One issue we encountered was the lack of a UI area to view the user's avatar and see real-time changes. User feedback highlighted the negative impact of this omitted feature on the overall experience. Our digital testing in Mozilla hubs incorporated a mirror to address this issue. Feedback also indicated a lack of clarity and depth in some of our customization options and menus, such as the difference between the ”body measurement” and ”weight and height” nodes. Due to our limited scope, we cannot include advanced accessibility features like text-to-speech or color-blind features, which may exclude certain target users from using our software.

We then gathered participants to test our controller, where we organized our data into a System Usability Scale (SUS) and a Quality Function Deployment (QFD) Template. Looking at the data from our SUS [Fig. 3], the overall feedback was very positive as users found our system easy to use, not unnecessarily complex, and designed well. Our average score from 5 participants was 77% (an above-average score) [Fig. 4]. This helped us identify potential players' preferences about our controller, allowing us to take the necessary corrective steps forward. Additionally, after compiling data onto a TXL, we gathered further insight into the perceived usability of our product. The overall mean score was a low 2 indicating that the product was not very taxing to use but the average score on performance shows that users aren't completely satisfied with the performance for the effort they put into it which is reasonable as we were in the prototyping phase. The feedback we received on the presence questionnaire scored the product with a high total of 103.8 with a low standard deviation. An area of note is the lower average score for the realism category is lower than other parts which conflict with the core issue the product is trying to address. This was rather concerning but further investigation of this shows that the issues weren't with the realism of the customizer itself but rather with our integration of VR.

IV. DISCUSSION AND CONCLUSION

Our experience working on the product has highlighted numerous considerations that we could have benefited from had we taken them into account earlier in the design process. Due to our limited scope, we cannot include advanced accessibility features like text-to-speech or color-blind features, which may exclude certain target users from using our software. Furthermore, we had not fully grasped the scope of the project and the difficulty we would encounter with the limb editor as well as the complexity of a fully actualized avatar customization tool that would account for features and elements that were underrepresented on top of the standardized features found in most modern-day avatar creators. This lack of understanding caused us to overestimate the amount of work we could accomplish and this negatively affected our final product as a result. Additionally, because our playtest involved using our decoupled UI in Figma and the UMA DSC scene rather than our integrated product, we weren't able to get fully accurate feedback on the state of our product's usability in the finalized layout for the scene which has since changed from what we presented to playtest participants. Overall, we have learned a lot from the experience of working on this project and will apply the lessons from this to further our growth in

V. APPENDIX

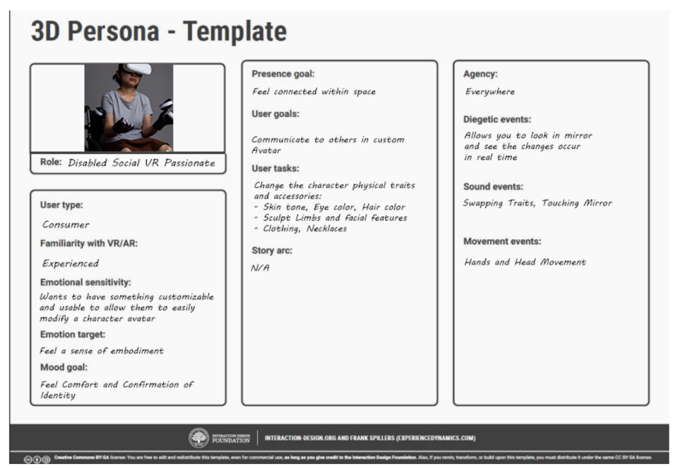

Fig. 1. Persona

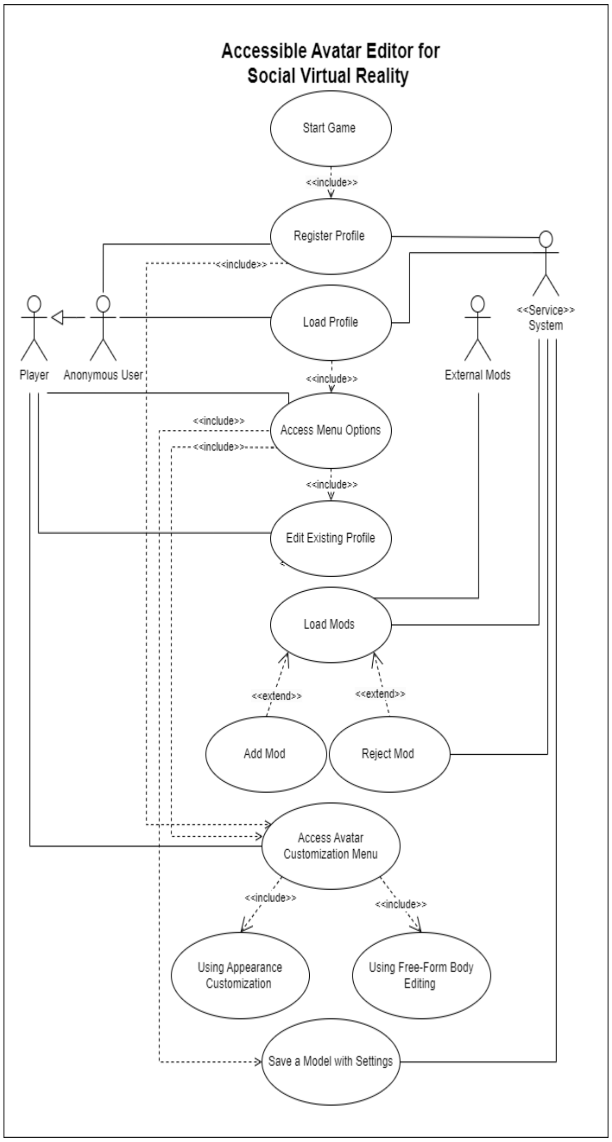

Fig. 2. Revised Use case

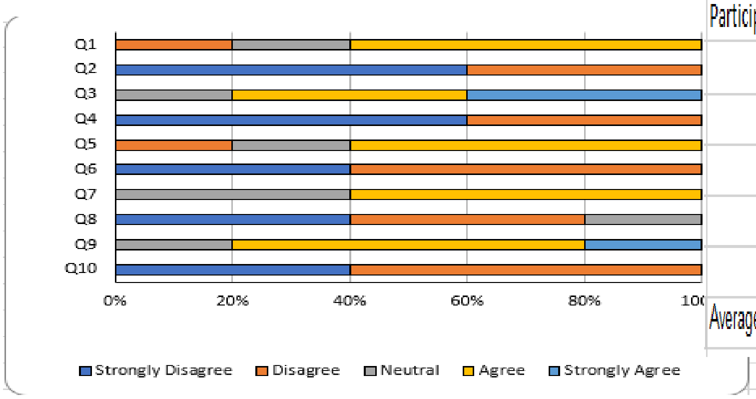

Fig. 3. SUS Graph

Paticipant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10		
	I think tha	I found the	I thought t	I think tha	I found the	I thought t	I would im	I found the	I felt very c	I needed t	Score	Average
1	4	1	4	1	4	1	4	1	4	1	87.5	77
2	4	2	5	1	4	2	4	2	5	1	85	
3	2	2	3	2	2	2	3	2	4	2	60	
4	4	1	5	1	4	1	4	1	4	2	87.5	
5	3	1	4	2	3	2	3	3	3	2	65	

Fig. 4. SUS Score

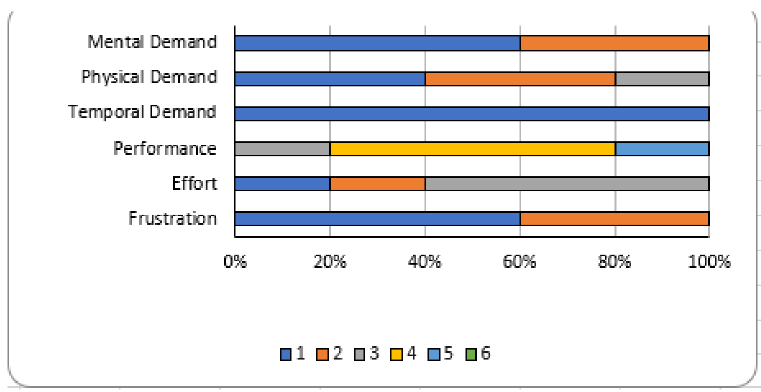

Fig. 5. TLX Graph

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Individual Mean	Total Mean
1	1	1	1	4	2	1	1.666666667	2
2	2	3	1	3	3	2	2.333333333	
3	1	1	1	5	3	1	2	
4	1	2	1	4	1	1	1.666666667	
5	2	2	1	4	3	2	2.333333333	
Average Score	1.4	1.8	1	4	2.4	1.4		

Fig. 6. TLX Score

Realism	Average	Possibility to act	Average	Quality of interface		Possibility to examine	Average	Self-evaluation of performance	Average
Q3	5.4	Q1	5.8	Q14	1.2	Q11	6.2	Q15	5
Q4	5.4	Q2	6.2	Q17	2	Q12	6.2	Q16	5
Q5	4.6	Q8	6.4	Q18	1.6	Q19	5.8		
Q6	4.8	Q9	6.4	Total	4.8			Total	10
Q7	5.2			Inverse	16.2	Total	18.2	Standard Deviation	0
Q10	3.8	Total	24.8	Standard Deviation	0.4	Standard Deviation	0.230940108		
Q13	5.4	Standard Deviation	0.282842712						
Total	34.6								
Standard Deviation	0.596816954								
Total	103.8								

Fig. 7. Presence Questionnaire Score

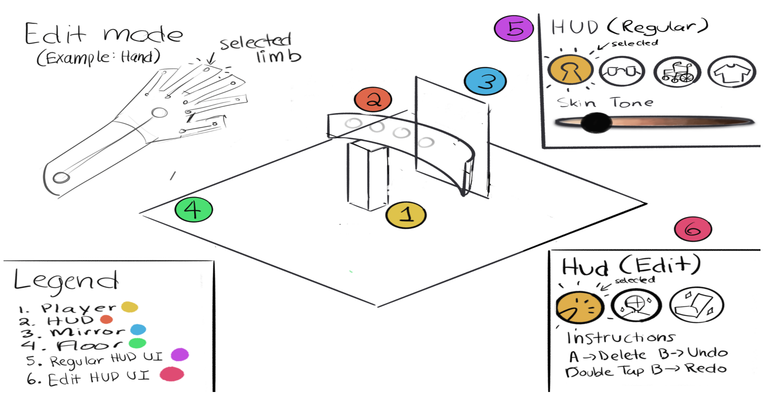

Fig. 8. Prototype Design