

Appendix E: Proxy user testing report

Introduction

To determine the final design our group will develop in response to our design problem, we built three distinct mockups of potential solutions and tested the mockups with proxy users. The mockups our team constructed include a slider bar, a lever add-on, and an attachable string-pull mechanism. Although the mockups we constructed do not emulate the appearance and aesthetics we would strive for in a final prototype, they do mirror the intended functionality of our three primary design ideas. The three mockups are shown in Figures E1, E2, and E3.



Figure E1: A PS4 controller sitting on the slider bar mockup.



Figure E2: A PS4 controller sitting on the lever add-on mockup.



Figure E3: The string-puller mockup attached to a PS4 controller.

Although testing with our direct user, Hector, will provide significant insight into the validity of our designs, conducting tests of the mockups with proxy users is also important to fully understand each design's positive and negative features. In our testing, we sought to uncover the components of each design that proxy users found helpful, comfortable, and natural to use as well as the elements that worsened the user's experience. We also sought to determine whether or not each design idea should be pursued further, and if so, what improvements are necessary for the design to meet our project requirements.

Methodology

In conducting testing of our three mockups with proxy users, we carried out three distinct evaluations with four test subjects from the 6th to the 8th of February, 2023. Each test was conducted with an able-bodied college-age student as the user, and background on our primary user and his physical abilities were given to each test subject. Our test users varied in their amount of prior experience playing FIFA and their handedness, which allowed for multiple perspectives on each design's usability. Questions intended to uncover the user's thoughts on the design were posed during and after each test, and the user's answers were written down. Many questions involved rating an element of the user's experience from one to ten, providing a quantitative element to our tests. Our materials included a PS4 controller and three mockups.

To best evaluate Hector's ability to use each of our designs, we directed the user to interact with the controller and mockup in a way that best resembles how Hector engages with a PS4 controller. These directions included telling the user to directly interact with the controller only using their left hand. We directed the user to place their left palm on the left controller joystick and their left-hand fingers on the right-side functional buttons (see Figure E4).



Figure E4: A user resting their left hand across the PS4 controller as intended.

Specifically for the string-pulling mockup, we told the user to wrap the velcro armband around their right wrist. We also told them not to use their right fingers and to instead pull the string by moving their right arm (see Figure E5).



Figure E5: A user pulling back the right trigger using their right arm.

The three tests we conducted each evaluated a different core requirement of our design. In test #1, we sought to understand whether or not the mockups could activate the right trigger without any other confounding variables, thereby evaluating whether or not the mockups could be used to sprint while not otherwise controlling the player. During the test, we asked the user to set up the controller and mockup and then attempt to press the right trigger using the mockup. Then, we asked a set of feedback questions to understand the user's thoughts about each design's comfortability and responsiveness and what improvements could be made.

In test #2, our goal was to see if the mockups would enable sprinting while the user engaged other abilities of the FIFA player. The test came in two parts. First, we asked the user to activate the right trigger while also pressing and releasing the 'O' functional button on the controller's right side. Second, we asked the user to activate the right trigger while rotating the left joystick using the palm of their left hand. After each part, we asked the user additional questions to gauge the impact of concurrently using other controller inputs on the user's ability to employ the mockup. The results of test #1 were used as a baseline understanding of the user's thoughts on the mockup, and we asked the user to consider their experience in test #2 in the context of their previous experience in test #1.

Finally, in test #3, we strived to understand if each mockup could handle fast-paced gameplay that would involve quickly activating and deactivating FIFA's sprinting function. We asked the user to prepare the controller and mockup for use in pressing the right trigger, and then repeatedly directed them to engage and disengage the trigger at varying intervals. The test concluded by once more prompting the user for their thoughts on the design and a comparison of the user's experience in test #3 versus their experience in test #1. Before ending the session after test #3, we also asked the user to provide any final feedback and to rank the mockups from best to worst after considering their experience in all three tests.

Results

Through the questions posed to each proxy user during the testing process, a set of quantitative and qualitative feedback was collected. The following tables summarize such feedback. Tables E1, E2, and E3 illustrate the quantitative results retrieved from the ranking questions that were asked, most of which asked the users to rank some quality of their experience on a scale of one to ten. Table E4 lists the best-to-worst rankings each user gave the mockups after each test. Finally, tables E5, E6, and E7 list and group the qualitative comments given by each user regarding the three mockups into several categories.

Table E1: The comfortability and responsiveness ratings given to each mockup by each proxy user in test #1.

		TEST #1 RATINGS				
		Subject #1	Subject #2	Subject #3	Subject #4	AVERAGE
SLIDER	Comfortability	10	6	8	9	8.25
	Responsiveness	7	7	9	9	8
LEVER ADD-ON	Comfortability	7	8	10	10	8.75
	Responsiveness	9	8	9	10	9
STRING PULLER	Comfortability	8	9	10	8	8.75
	Responsiveness	7	9	10	7	8.25

Table E2: The comfortability, accuracy, complexity, and difficulty ratings given to each mockup by each proxy user in test #2.

		TEST #2 RATINGS				
		Subject #1	Subject #2	Subject #3	Subject #4	AVERAGE
SLIDER	Comfortability	10	8	7	9	8.5
	Accuracy	9	5	9	10	8.25
	Complexity	1	1	1	1	1
	Difficulty with button press	Same	Same	More	Same	N/A
	Difficulty with joystick rotation	More	More	More	More	N/A
LEVER ADD-ON	Comfortability	7	6	10	9	8
	Accuracy	6	6	10	10	8
	Complexity	1	1	1	1	1
	Difficulty with button press	Same	More	Same	Same	N/A
	Difficulty with joystick rotation	More	More	More	More	N/A
STRING PULLER	Comfortability	9	10	10	10	9.75
	Accuracy	10	9	10	10	9.75
	Complexity	1	1	1	1	1
	Difficulty with button press	Same	Same	Same	Same	N/A
	Difficulty with joystick rotation	Same	Same	Same	Same	N/A

Table E3: The tiring and responsiveness ratings given to each mockup by each proxy user in test #3.

		TEST #3 RATINGS				
		Subject #1	Subject #2	Subject #3	Subject #4	AVERAGE
SLIDER	Tiring	1	1	1	1	1
	Responsiveness	10	8	10	10	9.5
LEVER ADD-ON	Tiring	6	6	4	1	5.75
	Responsiveness	10	8	10	8	9
STRING PULLER	Tiring	1	5	1	2	2.25
	Responsiveness	9	9	10	10	9.5

Table E4: The best-to-worst rankings of each mockup from each proxy user after the three tests.

MOCKUP RANKINGS				
	Subject #1	Subject #2	Subject #3	Subject #4
After Test #1	Slider > Lever > String	Slider > Lever > String	Slider = Lever = String	Slider > Lever > String
After Test #2	String > Lever > Slider	Slider > Lever > String	String > Lever > Slider	String > Lever > Slider
After Test #3	Slider > Lever = String	Slider > Lever > String	Lever > Slider > String	Slider > Lever = String

Table E5: The main comments from each proxy user in regard to the slider mockup.

SLIDER COMMENTS			
Experience	Control	Function	Suggestions
Most natural of all the mockups to use	Difficult to reliably rotate the joystick with base movement	Movement of the base made it harder to slide the controller	Stabilize the base of the slider
Slider was bumpy to move across the bars	Controller wiggles and tilts as it moves across slider	Tape on the slider bars inhibited sliding; the friction of the bar materials stopped sliding	Lower the level of the controller
Holding the hand up for a long time can be tiring	The tilting made the controller annoying to use	With controller tilting, only forward pressing the joystick worked	Prevent falling off the side of the bars
Pressing buttons and sliding at the same time was not natural	Controller slides unevenly; one side is ahead of the other Very reactive to user movements	Harder to slide backward than forward	

Table E6: The main comments from each proxy user in regard to the lever add-on mockup.

LEVER ADD-ON COMMENTS			
Experience	Control	Function	Suggestions
Not natural to use in the given hand position	The large distance of the lever made it difficult to reach	Works better than slider to rotate the joystick and press right trigger	Move the lever closer to the body of the controller
Pinky movement to pull lever is uncomfortable	Pulling lever with too much force moves the setup a lot	Using different fingers for different actions helped with concurrent input use	
Lever could become tiring after repeated use	Controller sometimes lifts up off its base when the lever is pulled		
Spreading the fingers to use the lever was uncomfortable	Very reactive to the user's desired action		

Table E7: The main comments from each proxy user in regard to the string-puller mockup.

STRING PULLER COMMENTS			
Experience	Control	Function	Suggestions
Putting the velcro wristband is time-consuming and annoying to perform	More controllable than the slider and lever when other controls are being used simultaneously	Pulling the trigger is readily performed due to the easiness of pulling the string	Make the setup of the wearable quicker
Comfortable experience apart from the setup	When pulling hard with the right arm, the controller can move out of place	Very accurate use of the trigger by pulling the string	Alter the wearable to be pre-looped instead of having to be looped again each session
Could become tiring to pull the string after a long time	Using a separate arm/hand to activate the right trigger improves usability		Potentially use a “slap-on” wrist band
Would not use the wearable solely due to set up time			

Discussion

The user feedback obtained from our proxy user testing gave us an understanding of numerous positive and negative elements of our design concepts. Each of the three designs showed promise in the tests, and the constructive responses the proxy users gave have given us the foundations to iterate on each design. No design was clearly better than the others, and we will need to pursue testing with Hector to determine the design we should develop further into our final prototype. Table E8 contains our overall analysis of the feedback we received on each design. Tables E9, E10, and E11 list the key takeaways from our proxy user testing for each design and possible improvements we could make to resolve each design’s issues.

Table E8: The core analysis of each mockup's feedback.

SLIDER	The slider was repeatedly ranked the highest in the overall rankings after each test and was rated highly in terms of overall comfort. However, the controller suffered from an inability to move steadily. Such instability caused users to be unable to accurately and readily press the right trigger while using other controller inputs, meaning the mockup would likely be ineffective in real video game-playing scenarios. As a result, it is imperative that we improve the stability of the complete slider design for a functional user experience.
LEVER ADD-ON	The users had mostly mixed opinions of the lever add-on mockup. The proxy users liked its responsiveness but highly criticized the design for its tiring nature. While users stated that they weren't particularly tired during our short examination, they had concerns about the fatigue they might experience pulling the lever repeatedly over a long video gaming session. Lowering the distance between the lever and the controller body will be needed to ensure the design remains usable in real game-playing situations.
STRING PULLER	The string-puller mockup received positive feedback in terms of its overall usability and comfort, especially due to its use of both hands. However, it was disliked by users for its long and tedious setup process. The time it took to get the string-puller mockup ready to use convinced users that they would not use the design before they had even attempted to pull the right trigger. In order to capitalize on the two-handed element of the design, we will need to lower the mockup's barriers to use.

Table E9: The main takeaways, implications, and next steps for the slider.

	Takeaways	Implications	Possible Next Steps
SLIDER	The instability of the base of the slider mockup makes it difficult to slide the controller accurately.	Ensuring that the design is stable and does not move in ways unintended by the user is imperative for usability and function.	We need to determine a way to attach the base to the ground where it is being used. We could also increase the weight of the base so it moves less easily or rework the design such that a base is not necessary.
	The instability of the controller on the slider bars causes the controller to fall over and move unequally on each side when sliding. This effect causes near-impossible use of other controls while sliding the controller.	Keeping the controller steady on the slider bars is core to the design's usability as well, especially when multiple controller inputs must be used at the same time.	We could lower the height of the mockup so that the controller handles sit on the ground to prevent tilting. In addition, we could create a more fine-tuned mold of the controller's underside so that cannot rock as it slides.

Table E10: The main takeaways, implications, and next steps for the lever add-on.

	Takeaways	Implications	Possible Next Steps
LEVER ADD-ON	While the lever is responsive and accurate, the large gap between the lever and the controller body made pulling the lever difficult and tiring, especially since the pinky finger alone had to perform the action.	Repeated use of the pinky finger, particularly when stretched far from the other fingers, reduces the comfort and function of the controller. Tiring movements negatively impact a user's experience with a video game controller.	We could lower the gap between the lever and the body of the controller to reduce the net movement needed to be performed. Also, altering the location of the lever could improve the hand position used when pulling the lever.
	Moving the lever repeatedly can destabilize the base of the mockup. This movement can shift the controller out of position and negatively impact the use of the controller.	User feedback once again indicates that a firm, steady setup is needed for the usability of the controller.	We could stabilize the base by attaching it to the ground where the controller is being used or by increasing its weight. We could also separate the base from the lever to reduce the impact of the lever moving on the base's position.

Table E11: The main takeaways, implications, and next steps for the string puller.

	Takeaways	Implications	Possible Next Steps
STRING PULLER	Use of the right hand to control the right trigger with the string instead of overloading the left hand resulted in increased accuracy and comfort by the users. Using multiple controllers at the same time was much easier.	Adding too many tasks for the left hand results in a worse experience for the user. The two hands components of the string puller mockup significantly improved its ease of use.	If we continue to pursue this design concept, we should retain the two-handed element of the mockup.
	Despite its ease of use, the lengthy process needed to set up the string-puller mockup made it frustrating to use. Users stated they would not use the design for this reason alone.	The barriers to using a design must be sufficiently low for the user to actually engage with the design. The ease of setting up a design is a major factor in its perception by users.	We could alter the wristband portion of the mockup to be quicker to set up. We could use a wristband that is already in a loop and can be tightened or use a wristband that snaps onto the user's wrist.