DECO2300/7230 Digital Prototyping

Interactive Prototype 3

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Practical Session & Tutor's Name: Week 11 Friday 10 am-12 pm - Sanya Ahmad

Statement of Originality

I certify that all images & audio used in the creation of this prototype are my original work.

References for all external sources can be found on page 2 of this document.

1. (How to tween) retrieved from Lens Studio template of the Full body Trigger's script of Tween, Last accessed 12/10/2023.

2. (Inform the user to stand further and debug notes) retrieved from Lens Studio Template of the Full body's script of Tween Manager, Last accessed 12/10/2023.

3. (How to body tracking) retrieved from Lens Studio Template of the Full body Trigger of the FullBodyTriggerController, Last accessed 12/10/2023.

4. (Object tracking to find the user body and hints notes) retrieved from the Lens Studio template of the Full body's script of ObjectTrackingHitController, Last accessed 12/10/2023.

5. (User movement trigger of hinting the crown) retrieved from the Lens Studio template of the Full body's script of MovementsTrigger, Last accessed 12/10/2023.

6. (Touch Event, touch collision when user hints the crown) retrieved from the Lens Studio template of the Full body's script of behaviour, Last accessed 12/10/2023.

Material: Body Mesh retrieved from the Lens Studio library.

Crown material: Crown hat retrieved from the Lens Studio library.

The Concept

This project aims to develop a virtual golf training tool specifically tailored for beginner golfers. The tool integrates XR technology and Circuit Playground Express board as a golf club controller swung in a simulated golf environment built within Unity. As the last assignment

found out, the best efficiency of the circuit playground display style is when the user turns in various directions and will be shown in different colours; this prototype will use this one throughout the whole prototype. Then, via the screen of Lens Studio, users receive real-time feedback on their body behaviour, allowing them to adjust and perfect their golf swing's accuracy and direction.

The purpose of this testing round:

Three primary aspects are up for evaluation:

1. **Determining if the crown hat is positioned centrally can influence users to modify their swing behaviour:**

   One of the core components I've introduced is the crown hat positioned centrally on the user's body. The goal is to evaluate whether this visual cue can positively influence or alter the user's swing behaviour when presented in the XR environment. Introducing this element aims to identify if such a positional cue can provide users with a more tangible point of reference when aligning their swings.

2. **Assessing if the AR component aids users in recognising their body behaviour during a swing:**

   The XR component has been integrated to provide real-time feedback on the user's body behaviour during a swing. This testing phase will gauge how effective this visual feedback mechanism is in assisting users to correct or modify their posture, alignment, and swing technique.

3. **Identifying user preference in terms of XR display types:**

   As XR technology could offer a plethora of display and interaction options, we've designed another XR display type that does not show the user view but with a

background of the golf environment and its body track mesh. Through this testing round, we aspire to discern which display type is most preferred by users and why. Understanding user preferences will guide future design decisions, ensuring the final product aligns closely with user expectations.

The core intention is to gauge the effectiveness of each XR mechanism in relation to user behaviour modification.

Inclusions & Exclusions in Prototype Construction:

Inclusions:

- **Direct Feedback Mechanism:** Given the importance of immediate feedback in sports training, the XR component was deemed essential to include. This real-time feedback mechanism is believed to be vital for users to recognise and correct their body behaviour instantly.

- **Variety in XR Displays:** To understand user preferences effectively, including multiple AR display types was deemed necessary. Without this variety, i couldn't gauge which display resonates most with our target users.

Exclusions:

- **Voice Feedback System:** While voice feedback can be an influential tool in training, it was excluded from this testing round. The purpose is to ensure that users are not overwhelmed with too many feedback types simultaneously. This will be considered for future prototypes.

- **Multiplayer Feature:** Given the primary focus on individual user feedback on the XR mechanisms, I excluded multiplayer features for this testing phase. I intend to test

collaborative learning in future iterations once the foundational XR features have been refined.

Hypotheses for the Testing Round:

1. **Hypothesis for Crown Hat Mechanism:**

   H0a: Users who utilise the crown hat visual cue in the XR environment will demonstrate a more consistent and aligned golf swing than those without.

   H1a (alternative): The crown hat visual cue will not significantly influence the user's swing behaviour.

2. **Hypothesis for XR Feedback on Body Behavior:**

   H0b: Users receiving real-time XR feedback will show a quicker correction in their posture and alignment than those without such feedback.

   H1b (alternative): Real-time XR feedback will not significantly expedite the correction process in user posture and alignment during the golf swing.

3. **Hypothesis for User Preference on XR Display Types:**

   H0c: Users will prefer an XR display with the user's view that provides the most intuitive and least intrusive feedback during their swing.
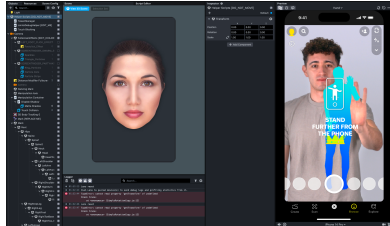
   H1c (alternative): The type of XR display without the user's view that provides the most intuitive and least intrusive feedback during their swing.

4. **Overarching Hypothesis for the Golf Training Tool's Effectiveness:**

   H0d: The combined use of the crown hat mechanism and XR feedback will result in a higher user satisfaction rate and a more substantial improvement in swing technique than not using XR components.

H1d (alternative): The XR-based golf training tool will not yield a significant difference in user satisfaction or swing technique improvement compared to not using XR components.

The Form of the Prototype:

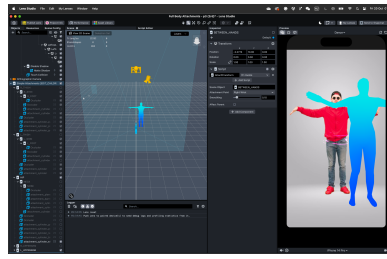| Component	Image Description	Prototype Description
Crown Hat Mechanism Prototype	Figure 1: The screenshot of the Lens Studio with the crown hat with haptic signals in the middle with the user's view and body tracking mesh. Figure 2: The user interaction with the circuit playground board and XR of Lens Studio with the crown hat.	It's designed to capture the orientation of the user's posture during a golf swing and provides real-time feedback via the XR system, and the purpose is to test user whether they could change their swing behaviours or not when swinging in a virtual environment.

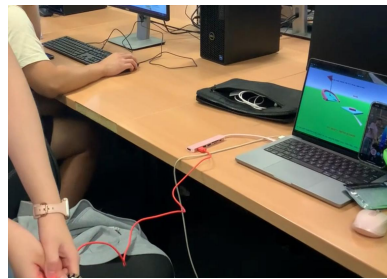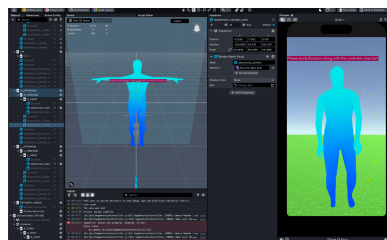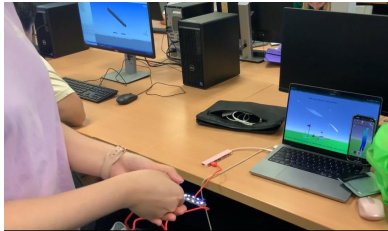| Feedback for Body Behavior Prototype	Figure 3: The screenshot of the Lens Studio shows the user's body tracking mesh and the user's view. Figure 4: The user interaction with the circuit playground board and Lens Studio shows the user's body tracking mesh and the user's view.	The XR system displays the ideal posture onto the user's image, helping to identify and correct misalignments.
Body tracking meshes the background of the Golf environment.		An XR-enhanced file without showing the user's view, but their body tracking meshes the background of the Golf environment to provide

	Figure 5: The screenshot of the Lens Studio shows the user's body tracking mesh and background of the golf environment without the user's view.	real-time feedback on body behaviour.
	Figure 6: The user interaction with the circuit playground board and Lens Studio shows the user's body tracking mesh and body tracking mesh with the background of the Golf environment.	

The Testing Approach:

Agenda:

1. Introduction and explanation of the XR golf training tool.

2. Walkthrough of the three prototype components: Crown Hat Mechanism, XR Feedback, and XR Display Types.

3. Practical demonstration by the tester, with on-the-spot feedback provided by the system.

4. Gathering feedback through a structured questionnaire and open discussion.

Process:

- Orientation: Familiarize users with the XR golf training tool's purpose and functionality.

- Switching XR Display Modes: Instruct users to switch between various XR display types and understand which mode they find most beneficial for their training.

- Feedback Session: After their testing session, users will be given a questionnaire to understand their experience better.

Tasks for Users:

The overall task is to ask them to swing the circuit playground board to hit the golf ball into holes in the unity.

1. Basic Swing Task:

   Task Description: Perform a basic golf swing while hitting the Crown hat in the middle body using the XR body track feedback.

   Purpose: To understand the user's basic golf swing technique and whether the crown hat can help the user change their swing position.

2. XR Feedback Task:

   Task Description: Repeat the golf swing, but this time, use the XR feedback to correct your posture and swing.

   Purpose: To gauge the effectiveness and responsiveness of the XR feedback in real-time.

3. Task Description: Switch between the different XR display modes after each swing.

   Purpose: To understand the ease of switching between modes and to gather which mode they find most intuitive and helpful.

Feedback Collection:

At the end of the testing session, users were provided with:

1. A quantitative online questionnaire where they rated aspects like the intuitiveness of XR body track feedback, assisted their swing direction indication and behaviour changing with body tracking, and overall user experience on a scale of 1 to 5.

2. An open-ended feedback form where they could provide qualitative insight and suggestions or report any issues they encountered.

Method for Evaluation:

Quantitative: Through a structured questionnaire survey with Likert scale ratings, asking about the system's ease of use, clarity of XR feedback, preference for XR display types, and overall satisfaction.

Qualitative: Open-ended questions to gather insights about what users liked, areas of improvement, any discomfort or challenges faced, and any additional features they would like to see.

Evaluation Outcomes & Reflection:

Results:

In this prototype session, there are 6 participants, and shown in appendix:

1. 75% of users found the Crown Hat Mechanism with XR view is effective and easy to control.

2. 70% of users prefer the third view of the prototype, which only shows the golf environment's body track mesh and background.

Outcome: Thus, users who utilise the crown hat visual cue in the XR environment will demonstrate a more consistent and aligned golf swing than those without. Meanwhile, users will prefer XR displays that provide the most intuitive and least intrusive feedback during swings.

Results:

3. 70% stated satisfaction after unity combined with the XR display.

4. 20% felt slight discomfort with the Crown Hat collision effect but not with the XR visuals.

5. 10% felt overwhelmed by the AR feedback during extended use.

Outcome: Combining the crown hat mechanism with XR feedback will increase user satisfaction and substantially improve the swing technique. Most users didn't experience dissatisfaction, but the display of the Crown Hat version could be improved.

- Users appreciated the real-time feedback, with 90% stating it helped correct their posture immediately.

Outcome: Using the crown hat mechanism in conjunction with XR feedback will result in a higher user satisfaction rate and a substantial improvement in swing technique.

Conclusion: Conclusions:

- The Crown Hat Mechanism and the third version of the XR display are well-received, suggesting a promising potential for integration into the final product.

- The XR mode with unity and Circuit playground board is the most preferred display type, indicating that real-time, integrated feedback is more effective than no XR combination views.

However, the system might need a more intuitive way to guide users who find it challenging to interpret feedback.

Changes to be made:

- Enhancements to the XR feedback system to make it more intuitive.

- Possible Including audio feedback in the crown hat is potential for immediate posture correction.

- Consider a tutorial or guided mode to help users familiarise themselves with the feedback system.

Reflection:

As a result of prototyping, we gained a deeper understanding of user preferences and pain points. The immediate feedback mechanism works well. However, the display modes and user guidance could be improved. Future iterations should test the system in more realistic environments, such as a golf course, to assess its effectiveness in the real world.

Sufficiency of the Prototype:

The prototype successfully evaluated the core aspects intended for testing. The feedback provided valuable insights into user preferences, the XR feedback's efficacy, and potential improvement areas. However, particular areas might require more focused testing in the next iteration, like the exact nature of the confusion with the XR feedback and a deeper dive into display modes.

Testing Plan:

Remaining Prototype: Combine the Crown Hat version and a third of version XR display together.

Aspect to Test:

Performance and adaptability of the newly redesigned Crown Hat and background with body track mesh.

Rationale:

Feedback from the initial prototype indicated that 20% of users felt slight dissatisfaction with the Crown Hat. This prototype will focus on enhancing user satisfaction and ensuring users can use it for extended periods without being hard to control and improve their swing behaviour.

Method:

Comparison test between the old and new designs, focusing on prolonged usage and adaptability.

Miro Link:

https://miro.com/app/board/uXjVMywNGPQ=/?share_link_id=549530531319

Video Link:

https://www.canva.com/design/DAFx5XZkQy8/suD2HsPu8OfDMM8sLfUB2Q/view?utm_content=DAFx5XZkQy8&utm_campaign=designshare&utm_medium=link&utm_source=recording_view
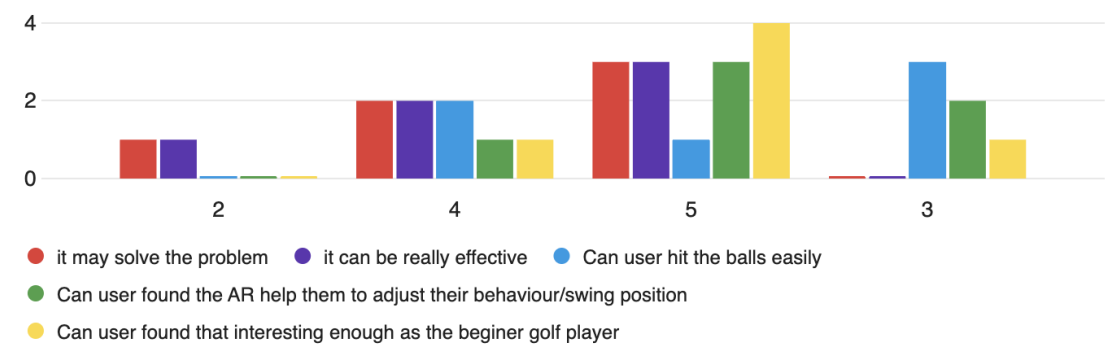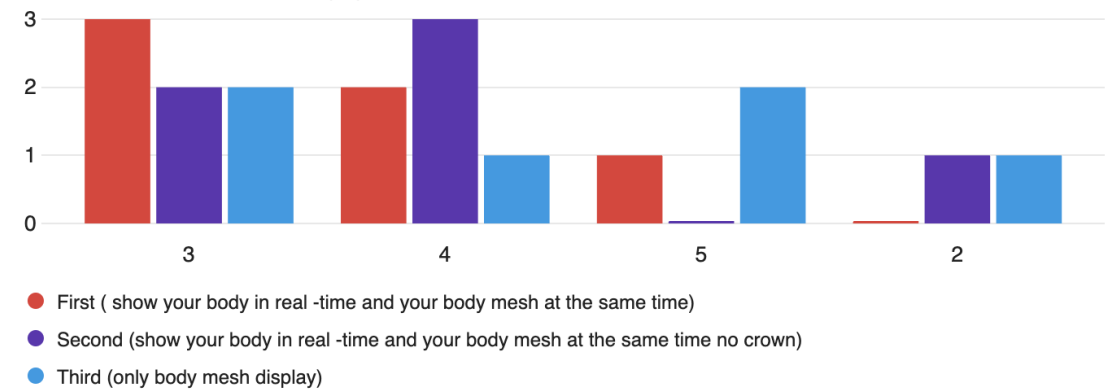
Appendix:

1

Q1_1 - was easy to understand

Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
was easy to understand	1.00	5.00	3.67	1.49	2.22	6	22.00

Q2 - How effective it was for improving user 's golf swing's accuracy and direct...

- ● it may solve the problem
- ● it can be really effective
- ● Can user hit the balls easily
- ● Can user found the AR help them to adjust their behaviour/swing position
- ● Can user found that interesting enough as the beginer golf player

Q3 - Score XR dispaly you prefer?(p1 :)(p2:)(p3:)

- ● First (show your body in real -time and your body mesh at the same time)
- ● Second (show your body in real -time and your body mesh at the same time no crown)
- ● Third (only body mesh display)

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Q4 - Can you please describe why you like it or not?

Can you please describe why you like it or not?

I like the crown which serves as an indicator of whether I hit successful or not

The XR sense shows the real time behavior will improve user practice skills

It is fun and in real to simulate the environment of learning how to play the golf.

I like the third one because there is the same background as it in the Unity.

Q5 - What did you like least about it?

What did you like least about it?

It is really challenging to hit the right target

No, it's great! I like it!

Because it is a bit difficult to control both in XR and physical device.