

Supplementary materials of Game mechanics and interaction for mixed reality and gamification

SUBMISSION ID 3987

1. Links

The demo builds for each mechanic can be tried at the following links (mobile platforms *not* supported):

- [AR drawing](#)
- [Coin tossing](#)
- [Object searching](#)
- [Navigation and view matching](#)

2. User study

Introduction. We held a short user study about the game mechanics described in the main paper. Questions asked participants about the effectiveness of the game mechanics, whatever they had fun, the validity of their mixed reality aspects, and their educational aspect (in the context of gamification).

Participants were given a short survey comprised of the following questions:

• User demographics:

1. Age
2. How familiar are you with technology as a whole?
3. How familiar are you with video games?
4. How familiar are you with the world of augmented reality?

• AR drawing:

5. Did you struggle with the execution of the interaction?
6. Did you feel like you were really drawing on the real-life monument?
7. Which of the two versions did you prefer?
8. Did you like the game mechanic?
9. Does this gameplay mechanic feel natural to you in the context of mixed reality?

• Coin tossing:

10. Which of the two available input modes did you prefer?
11. In the swipe version, did you find the coin tossing intuitive?
12. In the slider version, did you find the on-screen controls intuitive?
13. Did you like the game mechanic?
14. Does this gameplay mechanic feel natural to you in the context of mixed reality?

• Object searching:

15. Did you struggle understanding how the game mechanics worked?
16. Did you struggle with finding the requested items?
17. Did you find it interesting that the path always develops along the physical scene?
18. Did you like the game mechanic?
19. Does this gameplay mechanic feel natural to you in the context of mixed reality?

• Navigation and view matching:

20. Was navigating around the monument intuitive?
21. Did the text boxes placed on the monument increase your sense of immersion?
22. Did you struggle with finding the correct view?
23. Did you like the game mechanic?
24. Does this gameplay mechanic feel natural to you in the context of mixed reality?

• Final questions:

25. How would you rate this mixed reality experience compared to a more regular video game?
26. Would you be interested in playing a more complete application that implements a similar set of mechanics?
27. Which was your favourite game mechanic?
28. Did these ways of interacting increase your interest towards the monuments depicted?

Each section referring to a single mechanic contained a web link to its corresponding demo build.

The survey received 16 responses in total. Questions were given in both English and Italian. Certain questions are repeated for each game mechanic, or for each of their variants, so that they can be compared with each other. Most questions were multiple choice questions, with the answers available being: "Yes", "No" and "A little bit". Questions about user demographics used a 1 to 5 scoring system.

User demographics. The first section concerns user demographics, and asked about participants' familiarity with technology, video games and augmented reality as well as questions about gender and age bracket as it is common. As seen from questions 1, 2, 3, and 4, the survey received answers from a reasonably varied assortment of users.

Age (Età)
16 risposte

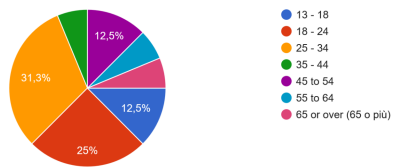


Figure 1: Age

How familiar are you with technology as a whole? (Quanta familiarità hai con la tecnologia in generale?)

16 risposte

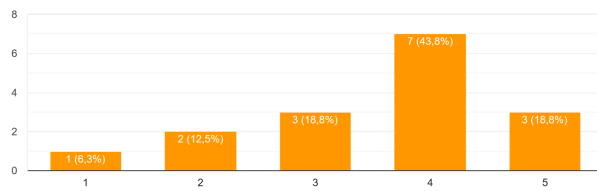


Figure 2: How familiar are you with technology as a whole?

How familiar are you with video games? (Quanta familiarità hai con i videogiochi?)

16 risposte

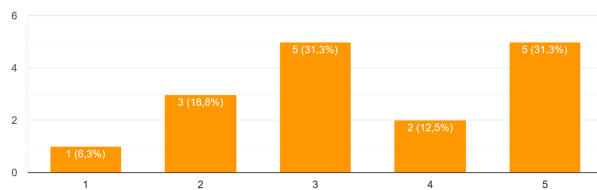


Figure 3: How familiar are you with video games?

How familiar are you with the world of augmented reality? (Quanta familiarità hai con la realtà aumentata?)

16 risposte

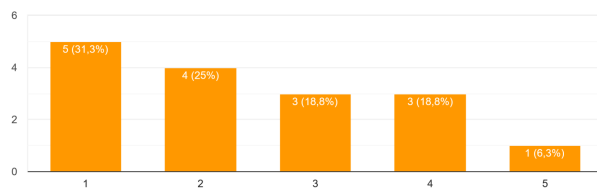


Figure 4: How familiar are you with the world of augmented reality?

AR drawing. This game mechanic received generally positive reviews. Participants had a clear preference for the "Multiple PoVs" variant of the mechanic, which unlike the alternative featured both the ability to move between views and multiple lines to retrace. As both improvements were present at once in the same variant, it is unclear if it was the first improvement, the second, or both that caused this result.

Did you struggle with the execution of the interaction? (Hai avuto difficoltà con lo svolgimento dell'interazione?)
16 risposte

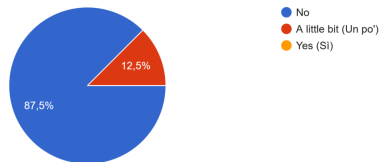


Figure 5: *Did you struggle with the execution of the interaction?*

Did you feel like you were really drawing on the real-life monument? (Hai avuto la sensazione di disegnare veramente sul monumento reale?)
16 risposte

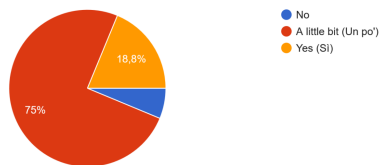


Figure 6: *Did you feel like you were really drawing on the real-life monument?*

Which of the two versions did you prefer? (Quale tra le due versioni hai preferito?)
16 risposte

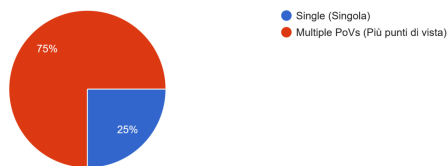


Figure 7: *Which of the two versions did you prefer?*

Did you like the game mechanic? (La meccanica ti è piaciuta?)
16 risposte

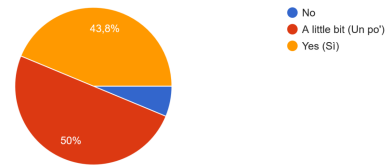


Figure 8: *Did you like the game mechanic?*

Does this gameplay mechanic feel natural to you in the context of mixed reality? (Questa meccanica di gioco ti sembra naturale nel contesto della realtà mista?)
16 risposte

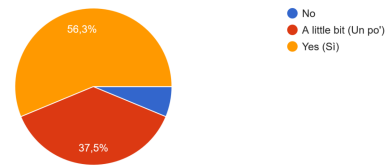


Figure 9: *Does this gameplay mechanic feel natural to you in the context of mixed reality?*

Tossing a coin into the well. This is the most well received game mechanic (see question 27). The slider variant was slightly more popular than the swipe one. A sizable minority of users, however, struggled with understanding the controls of one or the other. Negative feedback for the swipe version controls might be due to the demo builds supporting only desktop platforms, requiring the original touch-based input gesture to be emulated with a mouse.

Which of the two available input modes did you prefer? (Quale tra le due modalità di input disponibili preferisci?)

16 risposte

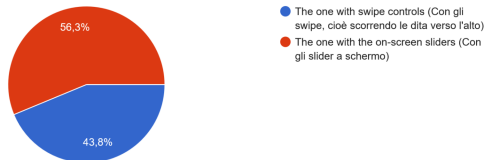


Figure 10: Which of the two available input modes did you prefer?

In the swipe version, did you find the coin tossing intuitive? (Nella versione con swipe, hai trovato il lancio delle monete intuitivo?)

16 risposte

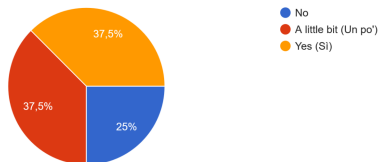


Figure 11: In the swipe version, did you find the coin tossing intuitive?

In the slider version, did you find the on-screen controls intuitive? (Nella versione con slider, hai trovato i comandi a schermo intuitivi?)

16 risposte

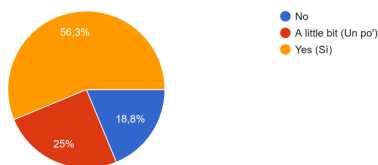


Figure 12: In the slider version, did you find the on-screen controls intuitive?

Did you like the game mechanic? (La meccanica ti è piaciuta?)

16 risposte

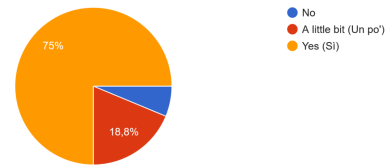


Figure 13: Did you like the game mechanic?

Does this gameplay mechanic feel natural to you in the context of mixed reality? (Questa meccanica di gioco ti sembra naturale nel contesto della realtà mista?)

16 risposte

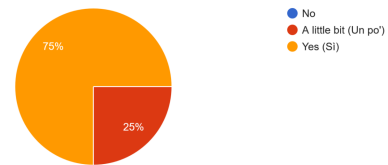


Figure 14: Does this gameplay mechanic feel natural to you in the context of mixed reality?

Object searching ("hot or cold"). While this mechanic received generally positive responses, it also received some negative feedback. A minority of users did not like the mechanic itself, or its mixed reality aspects (questions 17, 18).

Did you struggle understanding how the game mechanics worked? (Hai avuto difficoltà nel comprendere il funzionamento della meccanica di gioco?)
16 risposte

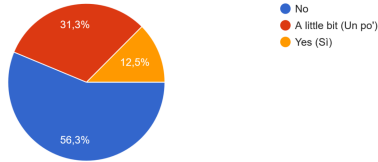


Figure 15: *Did you struggle understanding how the game mechanics worked?*

Did you struggle with finding the requested items? (Hai avuto difficoltà nel trovare gli oggetti richiesti?)
16 risposte

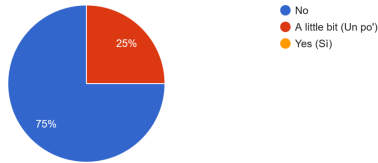


Figure 16: *Did you struggle with finding the requested items?*

Did you find it interesting that the path always develops along the physical scene? (Hai trovato interessante il fatto che il percorso si sviluppa sempre lungo la scena fisica?)
16 risposte

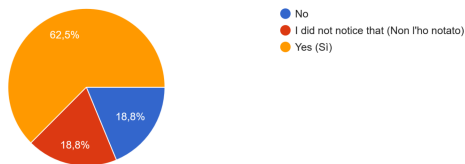


Figure 17: *Did you find it interesting that the path always develops along the physical scene?*

Did you like the game mechanic? (La meccanica ti è piaciuta?)
16 risposte

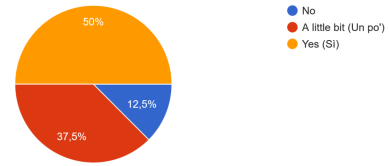


Figure 18: *Did you like the game mechanic?*

Does this gameplay mechanic feel natural to you in the context of mixed reality? (Questa meccanica di gioco ti sembra naturale nel contesto della realtà mista?)
16 risposte

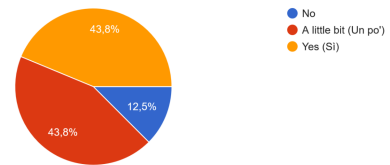


Figure 19: *Does this gameplay mechanic feel natural to you in the context of mixed reality?*

Image navigation and view matching. This mechanic received generally positive responses. Almost no one found the view matching portion challenging, likely due to the simplistic graph in the demo (a full circle around the Arco dei Gavi, with few branching paths).

Was navigating around the monument intuitive? (La navigazione attorno al monumento era intuitiva?)
16 risposte

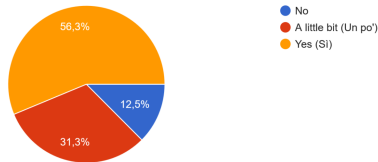


Figure 20: Was navigating around the monument intuitive?

Did the text boxes placed on the monument increase your sense of immersion? (Il testo posizionato sul monumento ha aumentato il senso di immersione?)
16 risposte

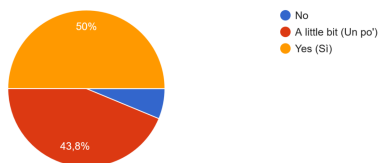


Figure 21: Did the text placed on the monument increase your sense of immersion?

Did you struggle with finding the correct view? (Hai avuto difficoltà con la ricerca della vista corretta?)
16 risposte

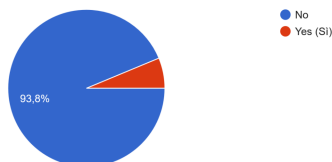


Figure 22: Did you struggle with finding the correct view?

Did you like the game mechanic? (La meccanica ti è piaciuta?)
16 risposte

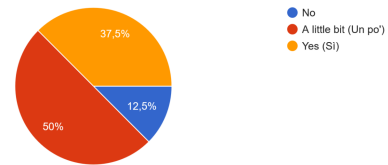


Figure 23: Did you like the game mechanic?

Does this gameplay mechanic feel natural to you in the context of mixed reality? (Questa meccanica di gioco ti sembra naturale nel contesto della realtà mista?)
16 risposte

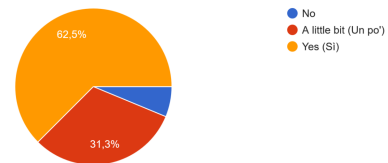


Figure 24: Does this gameplay mechanic feel natural to you in the context of mixed reality?

Final questions. A majority of participants rated the demos as "a bit more" or "more" engaging than a traditional, non-AR application (question 25), and most expressed interest for a more complete application with this set of mechanics (question 26). All users reported the demos as increasing their interest in the pictured monuments by at least a little bit (question 28), validating their gamification aspects. Lastly, we can also clearly see that coin tossing was the most popular mechanic, with exactly 50% of votes (question 25). AR drawing and object searching received a similar share of votes, but navigation only received 1 vote, possibly due to the lack of gameplay elements.

How would you rate this mixed reality experience compared to a more regular video game? (Come valuti questa esperienza di realtà mista rispetto a un gioco più classico?)

16 risposte

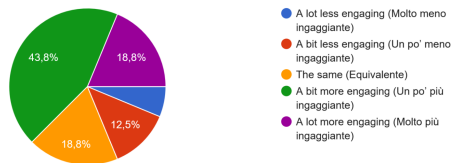


Figure 25: How would you rate this mixed reality experience compared to a more regular video game?

Would you be interested in playing a more complete application that implements a similar set of mechanics? (Ti interesserebbe giocare a una applic...a che implementi una serie di meccaniche simili?)

16 risposte

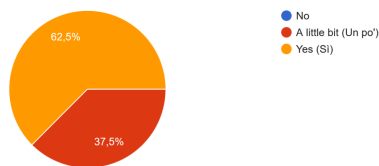


Figure 26: Would you be interested in playing a more complete application that implements a similar set of mechanics?

Which was your favourite game mechanic? (Qual è stata la tua meccanica preferita tra le quattro?)

16 risposte

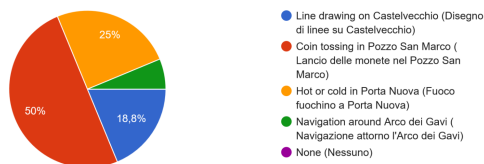


Figure 27: Which was your favourite game mechanic?

Did these ways of interacting increase your interest towards the monuments depicted? (Queste modalità di interazione hanno aumentato il tuo interesse verso i monumenti raffigurati?)

16 risposte

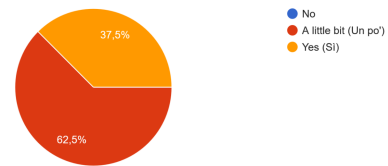


Figure 28: Did these ways of interacting increase your interest towards the monument depicted?