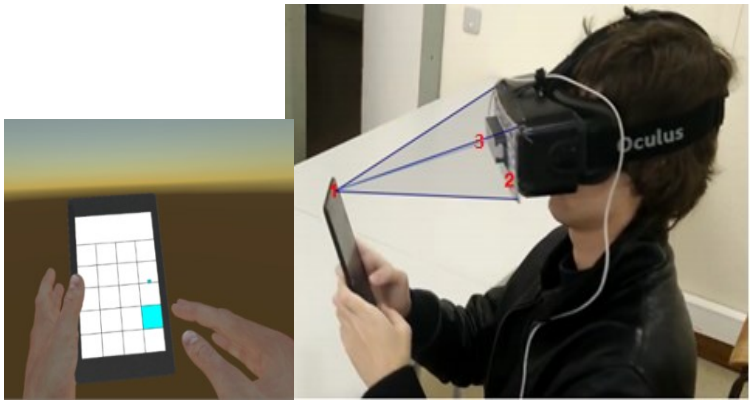
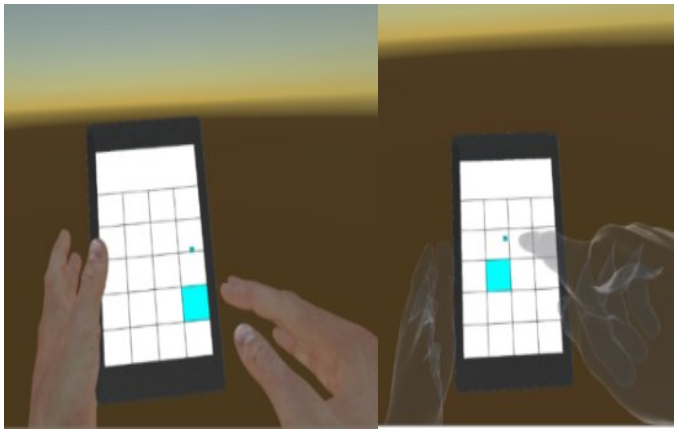
Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

# Evaluation in VR
## an example



# Studying the effect of hand-avatars in a immersive VE using a tablet as input device for a selection task



## Motivation

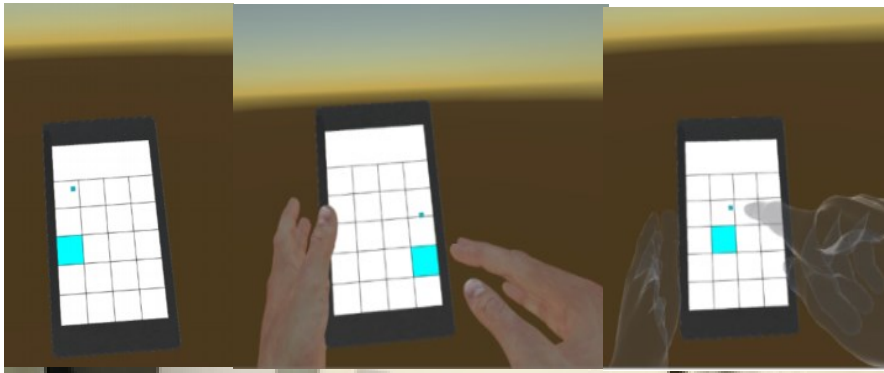
- Mobile devices have already been used as input to perform interactions in VEs
- Literature suggests their usage as input devices is viable and presents benefits
- The effect of using avatars in this situation is still an open issue

Luís Afonso, Paulo, Dias, Carlos Ferreira, Beatriz Sousa Santos, “Effect of Hand-Avatar in a Selection Task Using a Tablet as Input Device in an Immersive Virtual Environment”. IEEE Symposium on 3D User Interfaces (3DUI2017), pp. 247-248, Los Angeles, March 2017.

# Studying the effect of hand-avatars in a immersive VE using a tablet as input device for a selection task

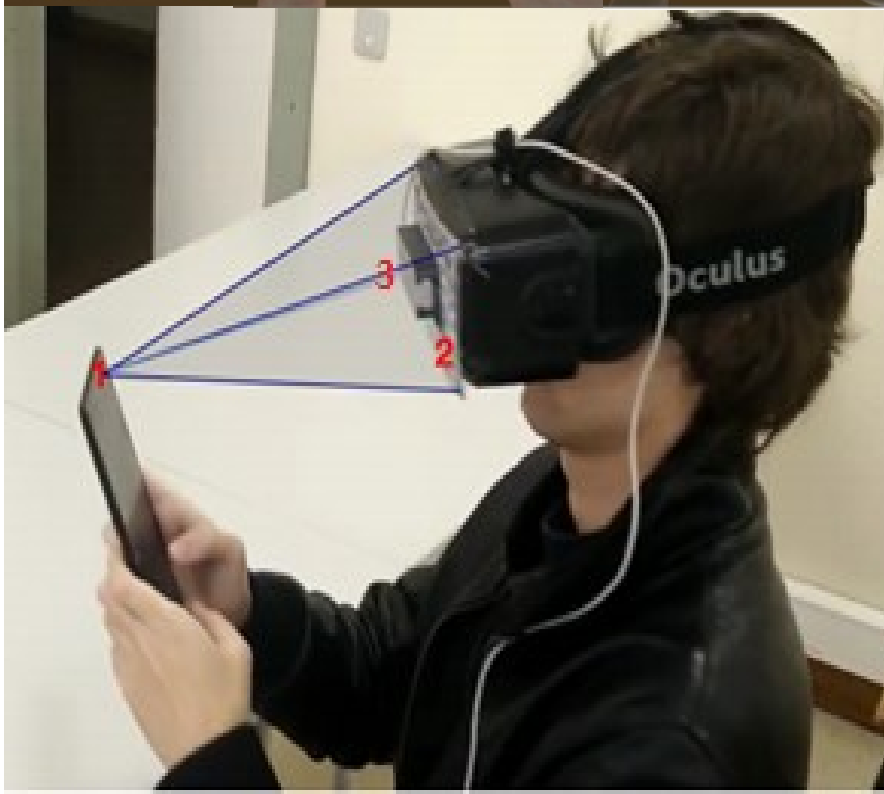
- **Task:**

- Selecting as fast as possible a highlighted button from a group of 25 buttons on the virtual tablet screen



- **Experimental Setup:**

- Oculus + Tablet + Leap Motion
- Unity + Vuforia
- Tablet front camera (1) tracking
- AR marker on the Oculus (2)
- Leap Motion (3) mounted on Oculus providing hands tracking

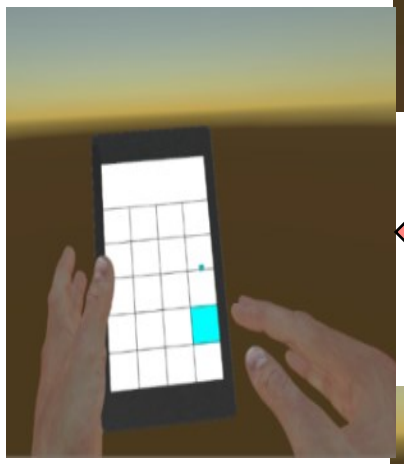


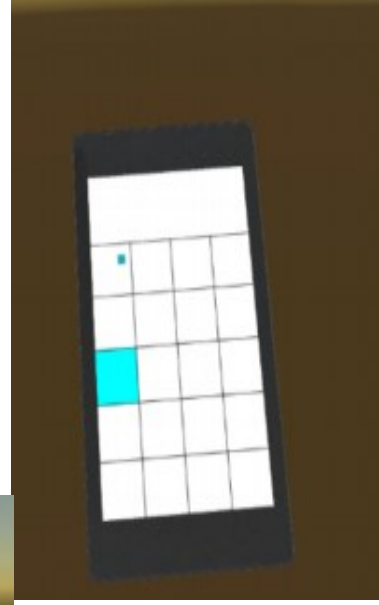
- **Hypothesis (Ho):**

- All conditions concerning hand avatar have similar usability (performance and opinion)

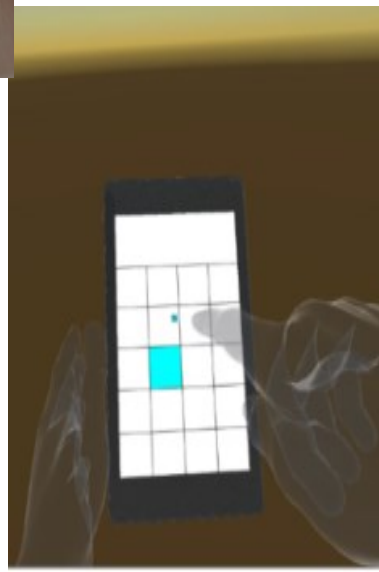
- **Independent variable: type of hand avatar (3 experimental conditions):**

- No hand avatar
- Realistic hand avatar
- Translucent hand avatar





No avatar
Realistic
Translucent



- **Dependent variables: performance and opinion:**

- Task completion time (seconds)
- Selection errors: number of incorrect buttons pressed
- Opinion (Lickert-like scale)

- **Experimental design: within-groups**
(all participants used the three experimental conditions in different order to compensate for learning)

- **Experimental procedure:**

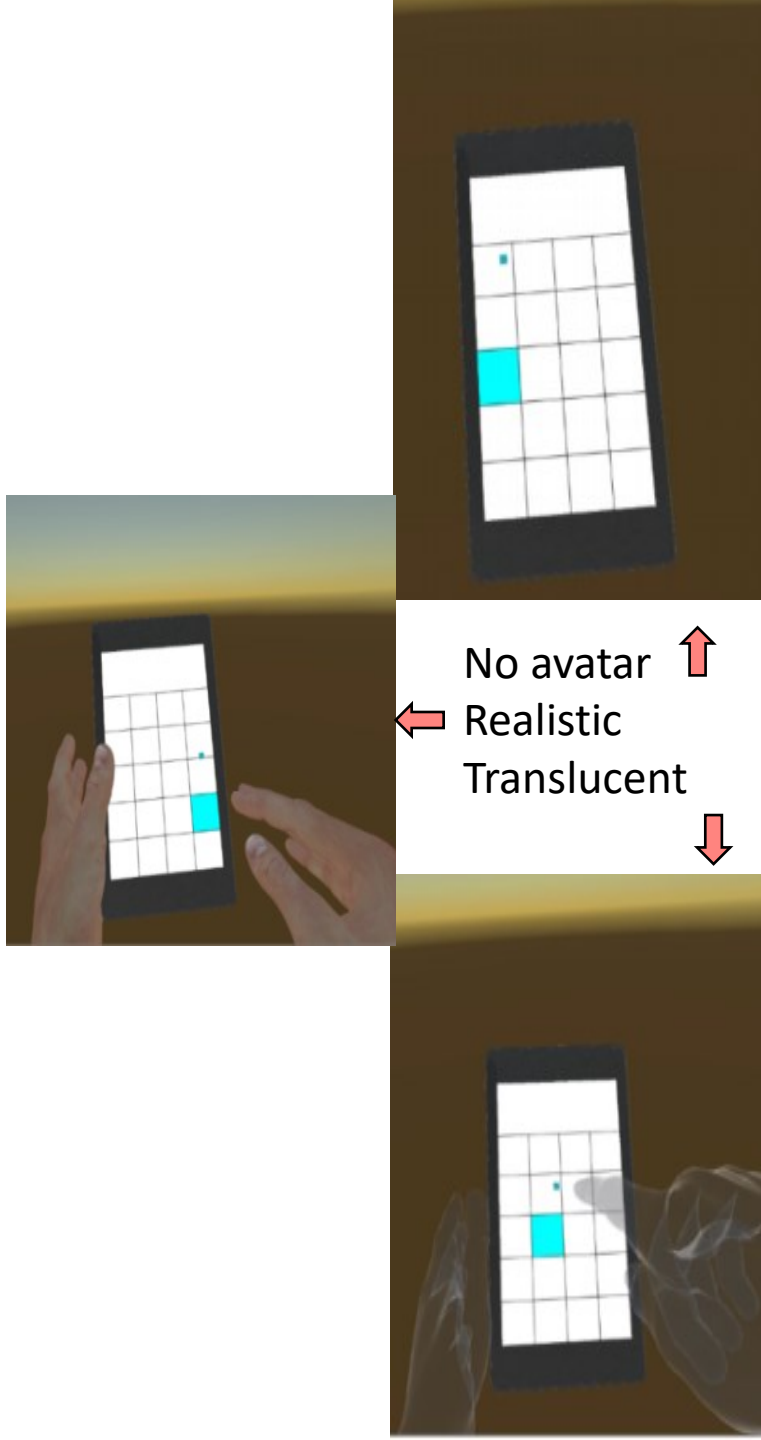
- Briefing about the experiment
- Familiarization with the setup
- Selecting 25 buttons
- Using three experimental conditions
- Questionnaire

- **Participants:**

- 55 students performed the tasks
- 52 answered the questionnaire
  (4 females; aged 19 to 28 years)
  (30 had never used VR before)

- **Statistical analysis:**

- Non parametric tests (Friedman) due to:
  - non normality of time and error data
  - ordinal nature of questionnaire data



# Questionnaire

## Hand representation experiment questionnaire

1. **User ID:** _____
2. **What is your age?** _____
3. **What is your gender?** ☐ Female ☐ Male
4. **Have you used Virtual Reality before?**
   - ☐ Yes
   - ☐ No
5. **Dominant hand:**
   - ☐ Right
   - ☐ Left
6. **How often do you use smartphone/tablet devices:**
   Never ☐—☐—☐—☐—☐ Regularly
7. **Please rank the three modes by preference:**
   No Hands (1) _____
   Realistic Hands (2) _____
   Transparent Hands (3) _____
8. **Explain why the mode [1/2/3] was your favorite:**
   _____
   _____
   _____
   _____
9. **How much physical fatigue did you experience in your arms while interacting with the environment?**
   None ☐—☐—☐—☐—☐ Extreme

### No Hand Representation

10. **The task was (1 difficult, 5 easy) to perform.**
    Difficult ☐—☐—☐—☐—☐ Easy
11. **I felt like I was able to interact with the tablet the way I wanted to.**
    Strongly Disagree ☐—☐—☐—☐—☐ Strongly Agree

### Realistic Hand Representation

12. **The task was (1 difficult, 5 easy) to perform.**
    Difficult ☐—☐—☐—☐—☐ Easy
13. **I felt like I was able to interact with the tablet the way I wanted to.**
    Strongly Disagree ☐—☐—☐—☐—☐ Strongly Agree
14. **I felt as if the virtual representation of the hand moved just like I wanted it to.**
    Strongly Disagree ☐—☐—☐—☐—☐ Strongly Agree

### Transparent Hand Representation

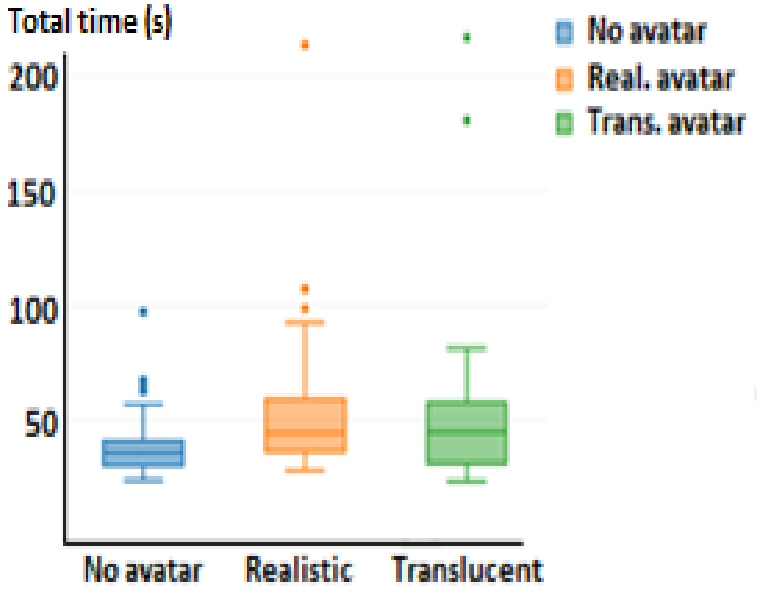
15. **The task was (1 difficult, 5 easy) to perform.**
    Difficult ☐—☐—☐—☐—☐ Easy
16. **I felt like I was able to interact with the tablet the way I wanted to.**
    Strongly Disagree ☐—☐—☐—☐—☐ Strongly Agree
17. **I felt as if the virtual representation of the hand moved just like I wanted it to.**
    Strongly Disagree ☐—☐—☐—☐—☐ Strongly Agree

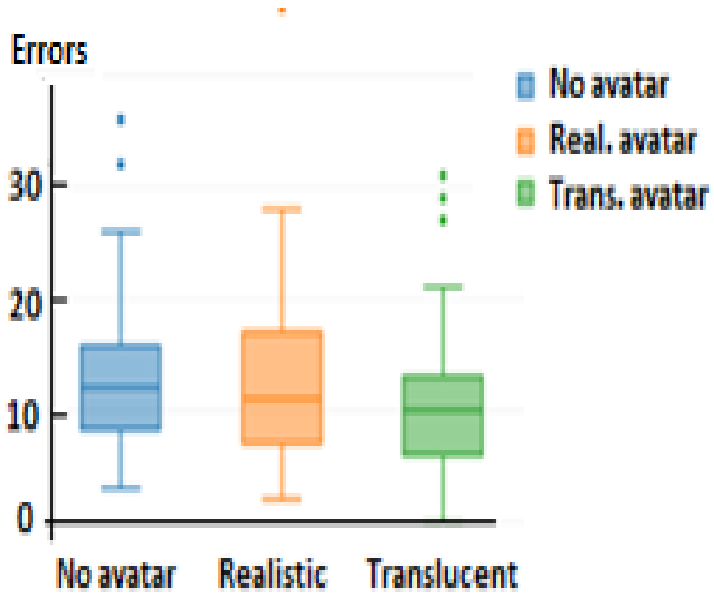
18. **Comments and/or suggestions about the equipment or the environment:**
    _____
    _____
    _____
    _____

# Main results concerning performance

Total task time and errors:

- Participants were faster but made more errors when there was no avatar
- Translucent avatar was the condition with less errors
- Friedman tests rejected the equality hypothesis -> differences are significant



Main results concerning preference and opinion (median values)
(ordinal data in a Lickert-like scale of 5 levels)

| **Question** (scale) | **No avatar** | **Real. avatar** | **Trans. avatar** |
|---|---|---|---|
| (number of 1st)<br>**Q1- Preference** (number of 2nd)<br>(number of 3rd) | **18**<br>**16**<br>**18** | **9**<br>**25**<br>**18** | **25**<br>**18**<br>**9** |
| **Q2- The task was**<br>**(1 difficult … 5 easy) to perform** | **3.5** | **3** | **4** |
| **Q3-I felt like I was able to interact with the tablet the way I wanted to**<br>**(1 Strongly Disagree… 5 Strongly Agree)** | **3** | **3** | **3** |
| **Q4- I felt as if the hand avatar moved just like I wanted it to**<br>**(1 Strongly Disagree … 5 Strongly Agree)** | **NA** | **3** | **3.5** |

All differences were statistically significant (ordinal data -> Friedman test)

# Conclusions of the study

The results of our study suggest that:

- An avatar may increase usability
- It does not need to be very realistic
  (in line with previous work regarding avatars in immersive VEs)
- The hands-representation provides feedback; however:
  - it may occlude the virtual screen,
  - and become distracting as a consequence of tracking inaccuracies
- The translucent avatar provides feedback not occluding
- Accurate tracking is crucial

# Future work

- Improve tracking
- Continue to explore the influence of the hands avatar, e.g.:
  - with other types of mobile devices,
  - to perform different tasks in VEs,
  - using other non-realistic (e.g. robot or cartoon-like) avatars