

Virtual Reality for Emergency Healthcare Training

Peng Xia, Ji Ruan and Dave Parry

Department of Computer Science
Auckland University of Technology

Introduction

- Virtual Reality (VR)

- Low-cost simulation
- Full-immersive environment
- Interactive experience



Oculus VR set



Samsung Gear VR set



HTC VIVE VR set

- VR applied in healthcare and emergency response fields

- Healthcare and medical problem solving
- Emergency response
- Healthcare education



Stroke rehabilitation



Firefighting simulation



Anatomy education

Research Questions

- How to implement the VR technology to emergency healthcare training ?
 - Construct emergency healthcare workflow (EHW), and convert it into process diagrams
 - Develop VR software, informed by process diagrams
- How to evaluate the effectiveness of VR-based emergency healthcare training ?
 - Collect data from participants in the experiment
 - Evaluation based on personal features and performance data

EHW and Process Diagrams

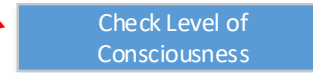
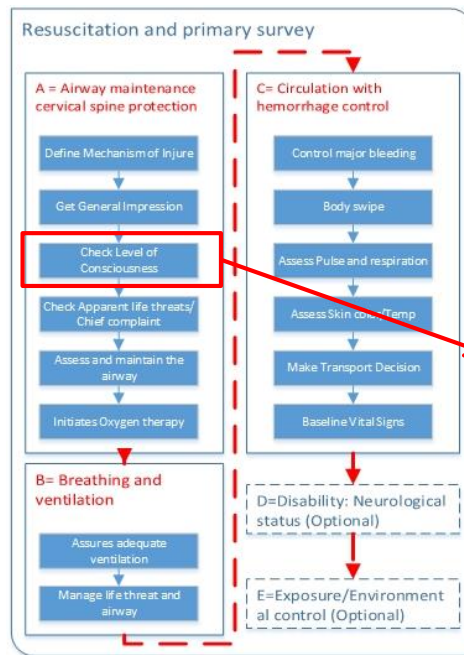
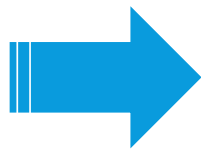
St John Ambulance

How to do the primary survey

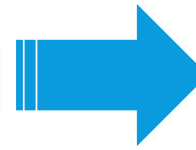


Dial 111
Ambulance / Police / Fire
Healthline New Zealand 24-hour health advice 0800 611 116

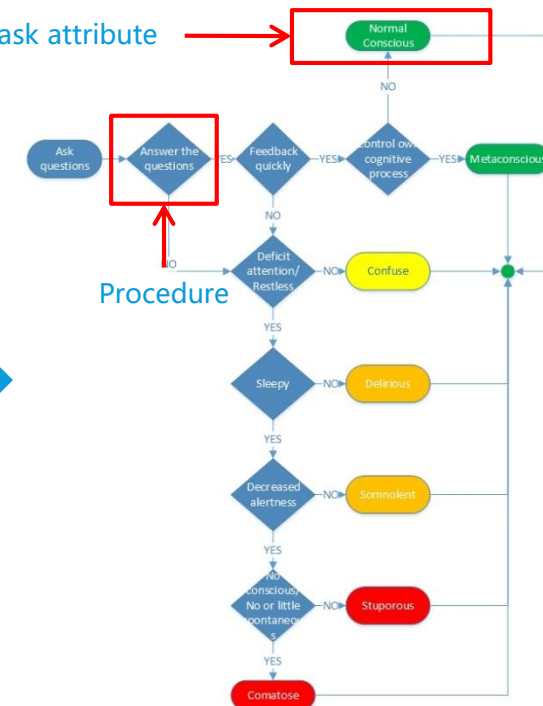
St John
Here for Life



Task



State of task attribute



Sub-Task Process Diagram (with procedures and task attributes)

References
(e.g. video, Book etc.)

Emergency Healthcare Workflow (EHW)

Development Platforms

- Software Platform

- .NET Framework
- Unity Engine
- Oculus APIs

- Hardware Platform

- Oculus VR headset
- Oculus controller and motion sensor

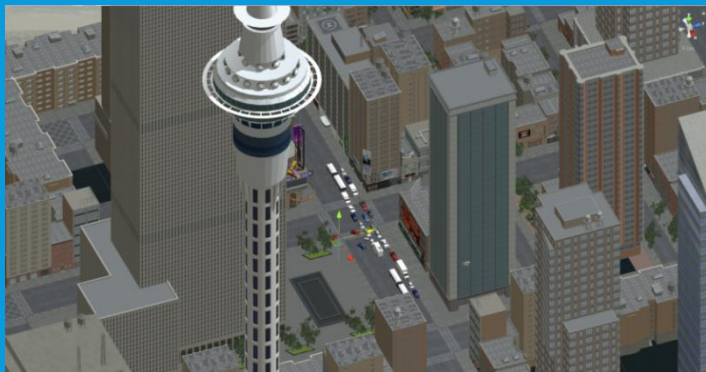


Experiment Scenarios and Training setup

● Scenarios

Scenario 1

Car accident simulation
Est finish time 45-50 minutes
10 Tasks (include 3 tutorial tasks)
33 Sub-tasks



Scenario 1

Scenario 2

Earthquake incident simulation
Est finish time 20 minutes
11 Tasks (include 1 tutorial task)
31 Sub-tasks



Scenario 2

● Training setup

Session 1
(Scenario 1)



10minutes interval

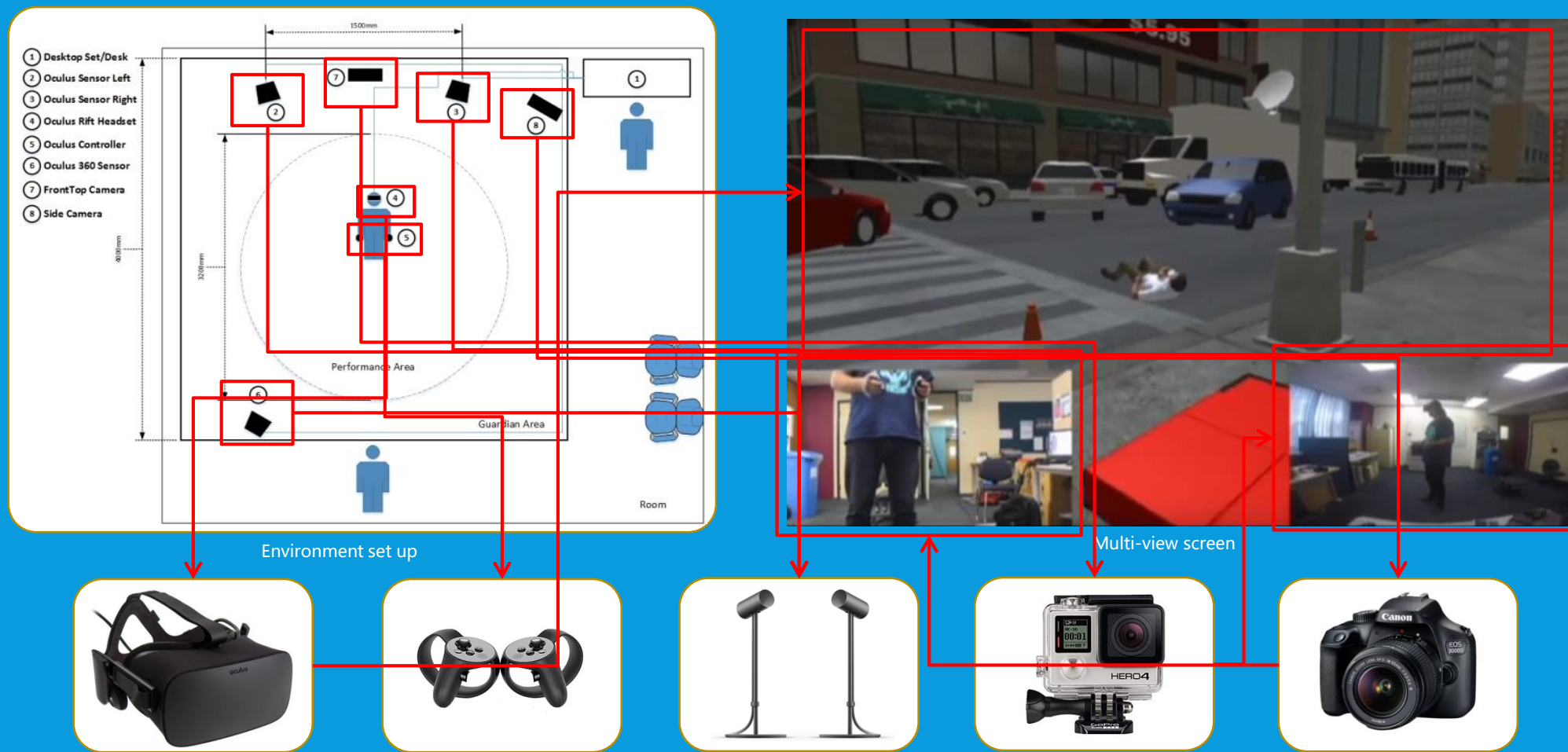
Session 2
(Scenario 1)



1 week interval

Session 3
(Scenario 2)

Experiment Environment



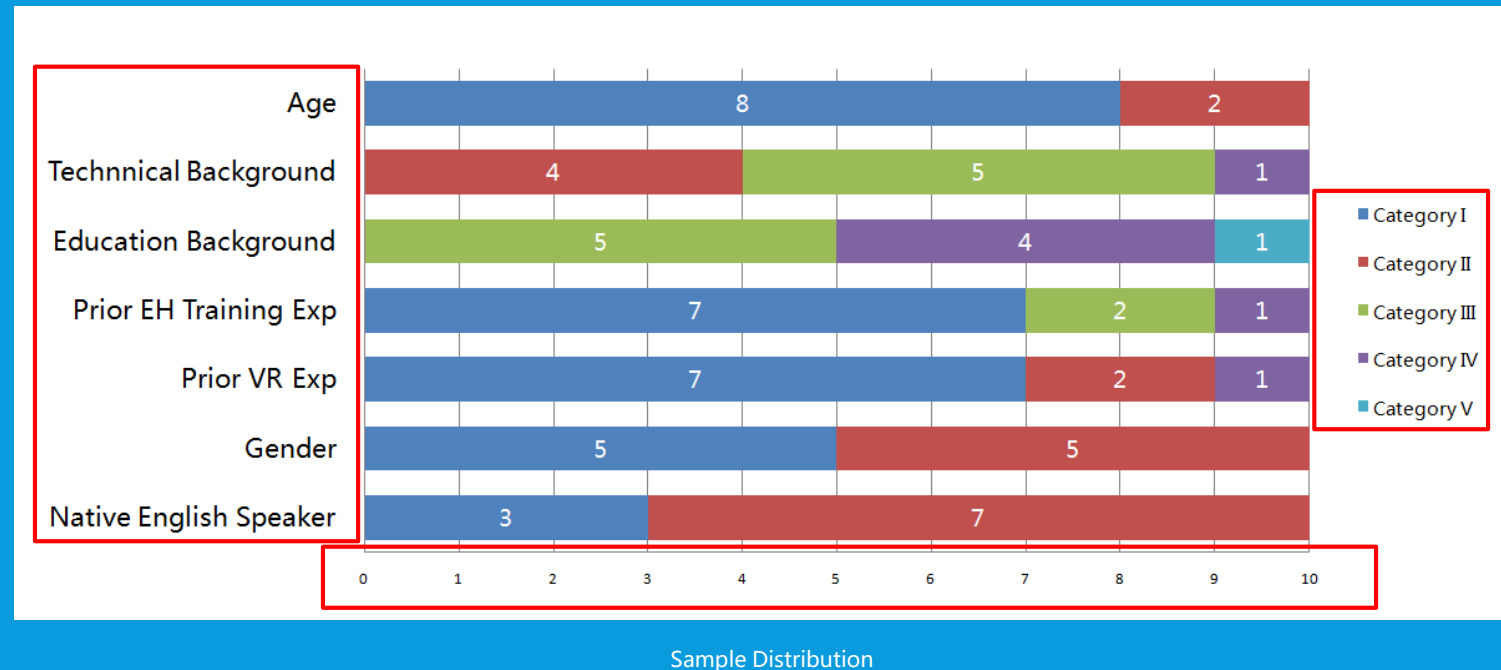
Experiment Data Collection and Sample Distribution

- Data Collection

- Personal data
- Sensor data
- Media stream data

- Sample Distribution

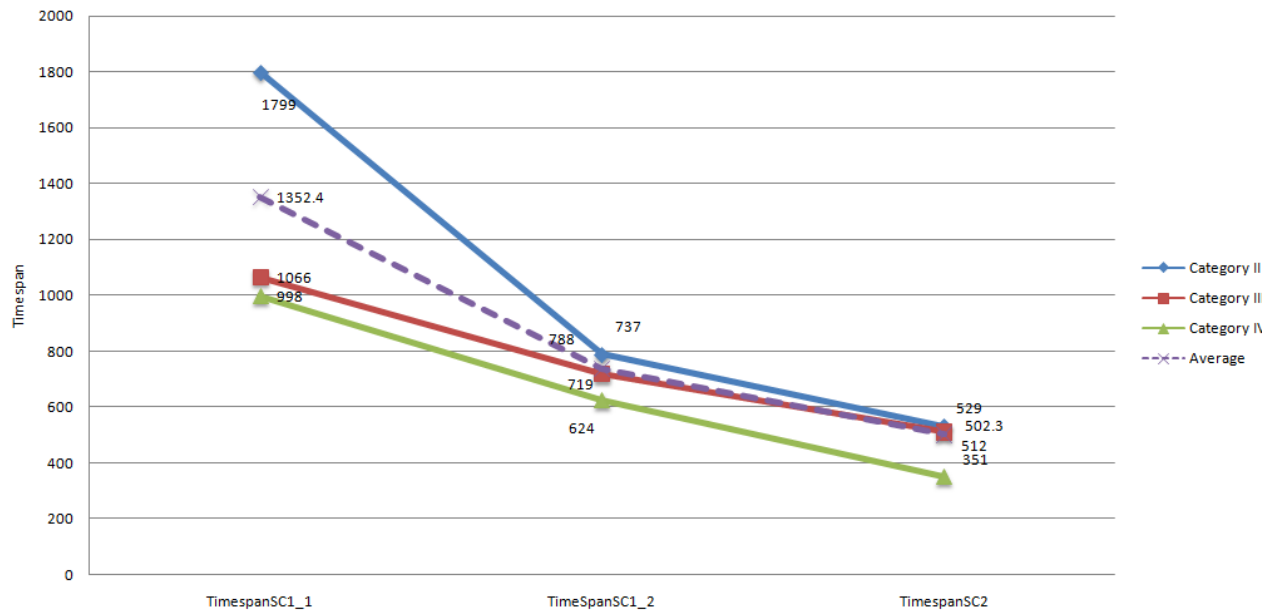
- 10 Participants
- 7 feature data is collected
- For each feature, 5 categories are classified (represented by color)



Experiment Data Analysis

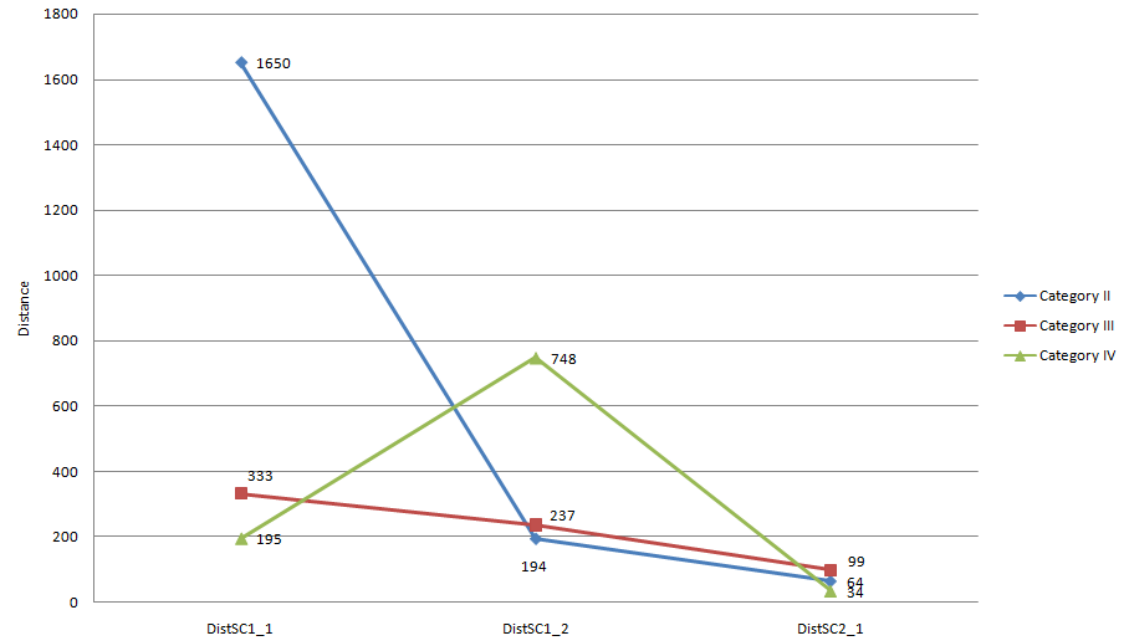
- Analytical Dimensions

Average Timespan by Technical Background



Average timespan by Technical Background among all sessions

Average Avatar Moving Distance by Technical Background



Average moving distance of Avatar by Technical Background among all sessions

Evaluation Method

- Evaluation Method

- Relative Deviation is employed

Suppose the overall average is v and the average of each category is $s_1 s_2 \dots s_n$ then the relative deviation rd_t for each training session t is given

$$\frac{s_i}{v} \rightarrow \left(\frac{s_i}{v} - 1\right)^2 \rightarrow rd_t = \sqrt{\frac{\sum_{i=1}^n \left(\frac{s_i}{v} - 1\right)^2}{n}}$$

s_j : average by categories

v : overall average

rd_t : relative deviation of session t

n : number of participant groups

i : participant category

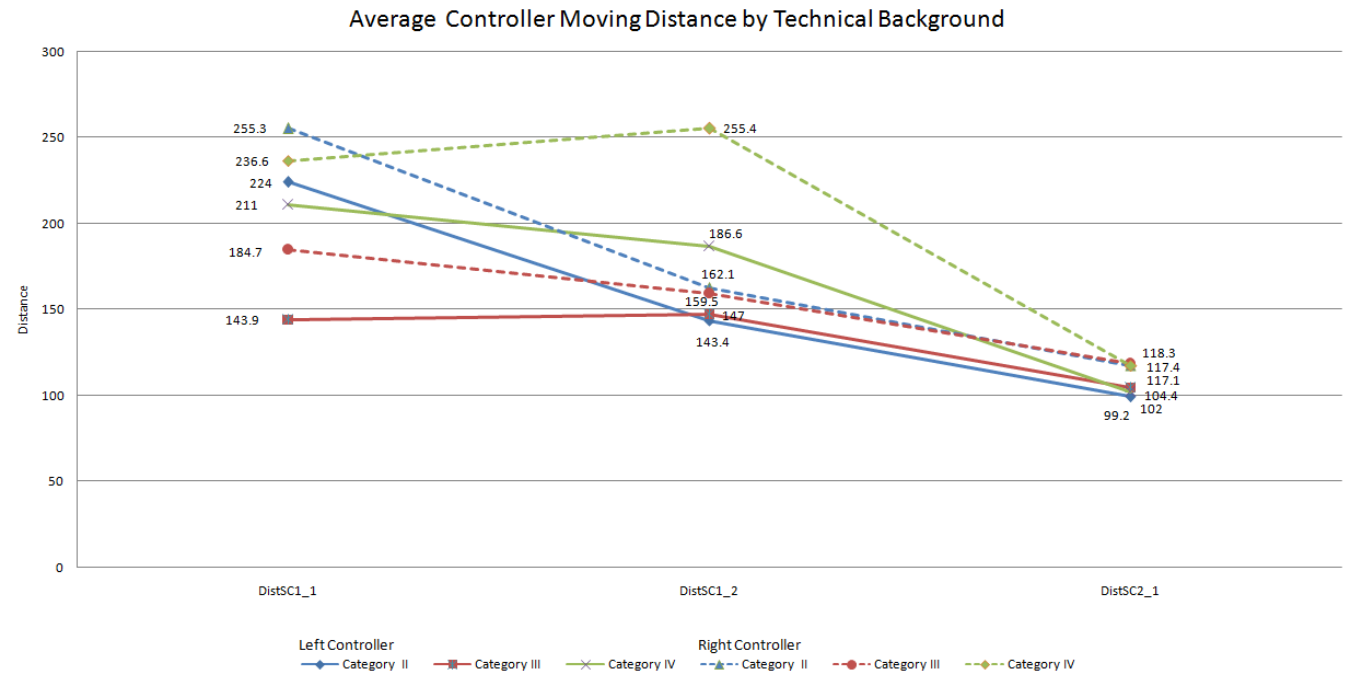
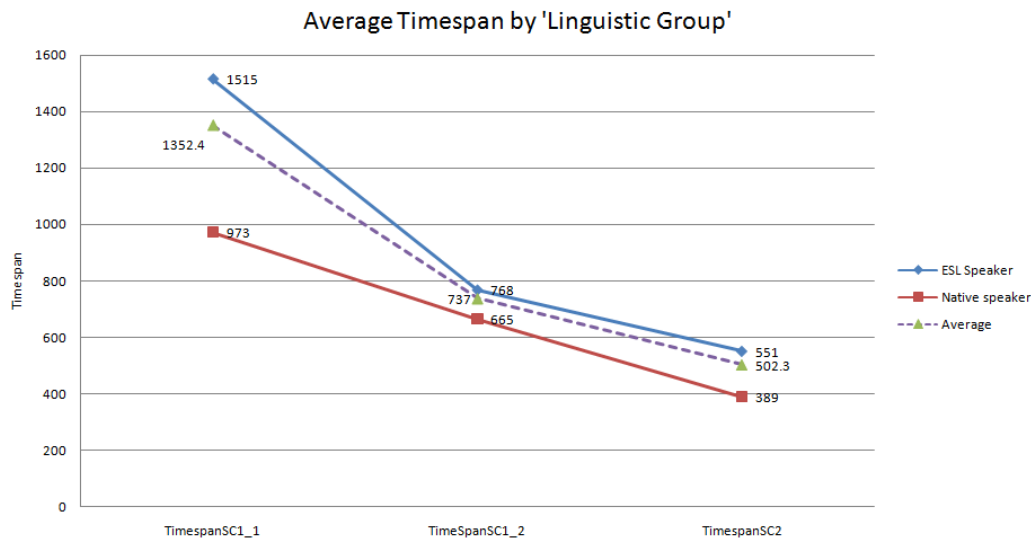
Experiment Results

- Experiment Results
 - Compare relative deviation among different features and sessions
 - Technical background has largest impact on timespan
 - Prior VR experience has smallest impact on timespan

	rd_{t_1}	rd_{t_2}	rd_{t_3}	$(rd_{t_1} - rd_{t_2})$	$(rd_{t_1} - rd_{t_3})$
Age	0.18	0.03	0.17	0.15	0.01
Technical Background	0.27	0.09	0.17	0.18	0.10
Education Background	0.17	0.08	0.18	0.09	-0.01
Prior EH Training Exp	0.22	0.13	0.26	0.09	-0.04
Prior VR Exp	0.16	0.01	0.13	0.15	0.03
Gender	0.17	0.07	0.03	0.10	0.07
Linguistic Bias	0.21	0.07	0.17	0.14	0.04

The relative deviation on three sessions over personal features

Other findings



- Native English speakers preferred to use vocal instructions, while the non-native English speakers preferred to read the texts.
- The average moving distance of the right controller is always larger than that of the left controller.

Conclusion

- Conclusion 1

Despite the different personal features, the participants, after repeated trainings, can improve their performance with reduced timespan and moving distance

- Conclusion 2

The Technical Background has the highest impact on the timespan initially and it is reduced most significantly after repeated trainings

THANK YOU