SEISMIC PREPAREDNESS FOR THE GENERAL PUBLIC USING VIRTUAL REALITY

MOTIVATION

As intense energies are released in earthquake strikes, it causes casualties and economic loss to the local area. Many initiatives have been used to raise the awareness of earthquake preparedness and reduce the damage caused by the earthquake. Few initiatives focus on interactive ways of identifying hazards, which is often a perilous issue during an earthquake. Therefore, an immersive earthquake training application on hazard identification is investigated to mitigate the loss from the earthquake and ideally help increase the aid of earthquake preparedness.

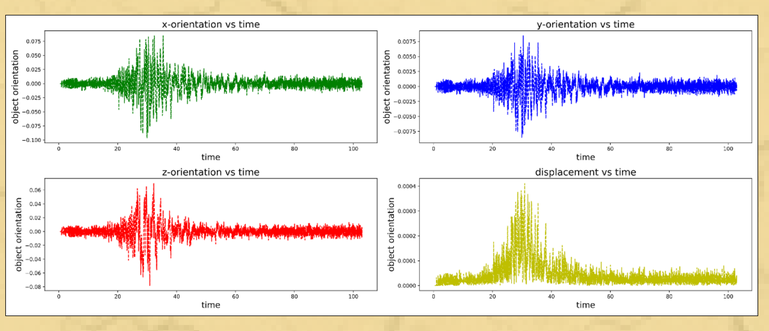
PROJECT GOALS

- Effectiveness of Training: Identify the effectiveness of learning between VR training and reading a guide.
- How do properties of game objects impact their behaviour during an earthquake simulation

PROJECT OVERVIEW

Research

- The research was conducted based on how different objects interacted during an earthquake. We compared different objects such as:
  - Cubes vs Cylinders
  - Objects of different densities
  - Objects on the floor vs Objects on top of objects
  - Objects of different heights
- We attached a script to the game objects which records data of that game object. The type of data recorded includes angular displacements and the displacement of the centre of mass of the object.



Mobile VR application

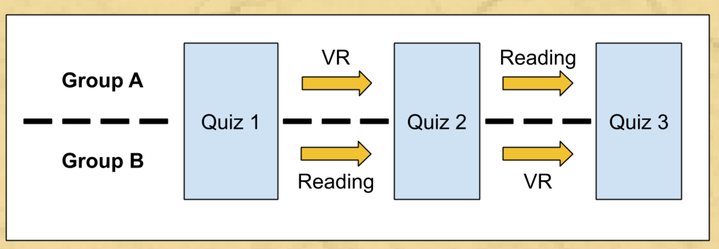
- Our VR earthquake application aims to teach users how objects behave under the influence of an earthquake
- 3 different scenarios: Office, Hospital and Living room
- Training mode contains sets of questions in each scenario, all of them relate to a critical point found during the research phase

- The user is presented a question that follows the users' gaze and will disappear after a few seconds.

- The user selects the appropriate answer and starts the earthquake simulator

- The user evaluates their decision and tries to analyse the patterns seen in objects during an earthquake.

User evaluation



- Users are split into 2 groups, reading first and VR training first
- Statistically analyse the differences in learning effectiveness of users between the 2 groups
- The last quiz acts as an opportunity for everyone to try VR and compare whether or not people have genuinely learnt how objects behave under an earthquake.
- We also ask the users if they have had any previous earthquake preparedness training before, we then analyse their scores in the first quiz

EVALUATION

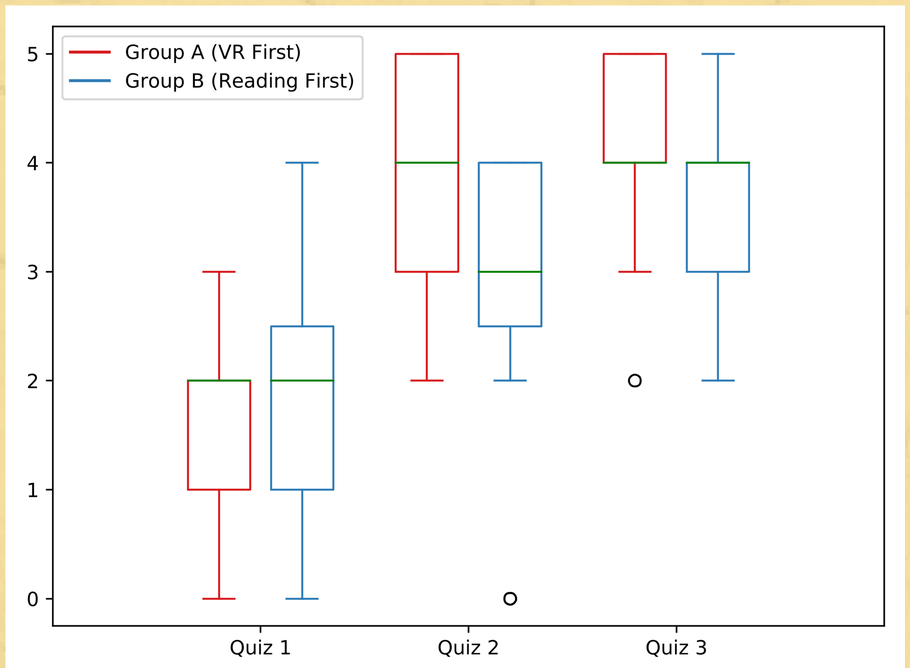
Research evaluation

Simulation experimentation results:

- Cuboid type objects are sturdier than cylindrical type objects
- The denser the object, the more likely it is to topple faster
- Objects that are situated on top of other objects are more unstable than objects that are situated on the floor
- Objects that sit on top of another object is more stable than the same object sitting on top of another object. The difference is that this object is split up to 3 pieces
- Taller objects are more unstable compared to shorter objects.

From this data gathered, we generate questions that have a theme based around one of the findings.

Quizzes



VR vs Reading

- The VR first group performs better in the second quiz (With z-value: 2.33 and p-value: 0.02 in Mann-Whitney U Test)
- The two groups perform similarly in the last quiz (With z-value: 0.85 and p-value: 0.39532 in Mann-Whitney U Test)

Improvements in preparedness

- Both VR and reading instructions are effective in earthquake preparedness learning (With a p-value: 0.0005 and 0.02 respectively in Wilcoxon Signed-Rank Test)
- VR is more effective than reading instructions (The absolute value of z-value in Group A is 3.3, which is higher than 2.3 in group B)

CONCLUSION

- VR mobile applications are **more effective** in teaching earthquake preparedness concepts compared to reading instructions.
- Participants commented that the VR application is immersive with the motion sickness as an area of improvement.

FUTURE WORK

- More variety of magnitudes of earthquakes
- Including breakable furniture models and immersive sound effect to the scene.
- Data analysis of user camera positions and rotations. To provide a better VR experience.

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