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Building a distributed XR immersive environment for data visualization

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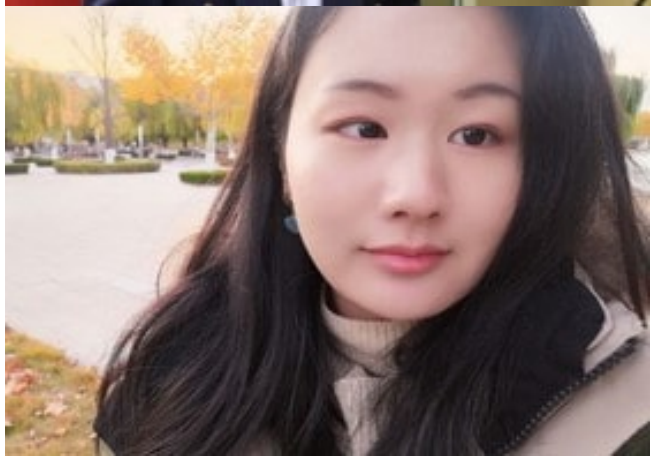

Session 5: Augmented reality and machine learning for future spatial applications and services

Paper S5.1: Building a distributed XR immersive environment for data visualization

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  - To support data understanding.
  - For either **individual** or **collaborative** decision-making.

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- Collaboration:

  Geographical distance, temporal distance

  Multi-user environment

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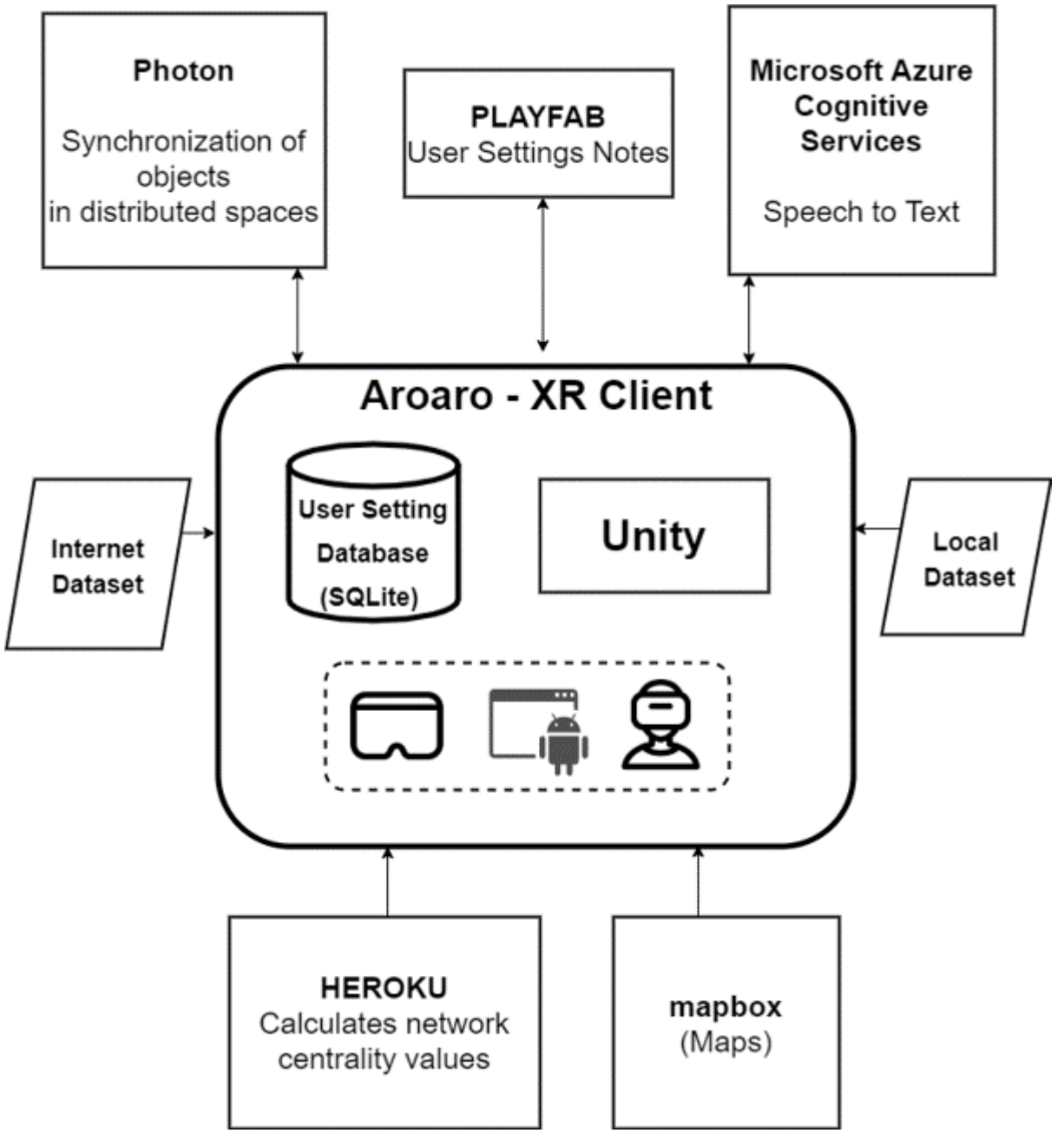
- We conducted lab experiments to investigate the relative performance of subjects in an Aroaro's IA facility vis-à-vis a traditional 2D data visualization approach.

Aroaro architecture

- Aroaro uses **Unity**.
- The **Microsoft Mixed-Reality Toolkit** is used to provide client services.



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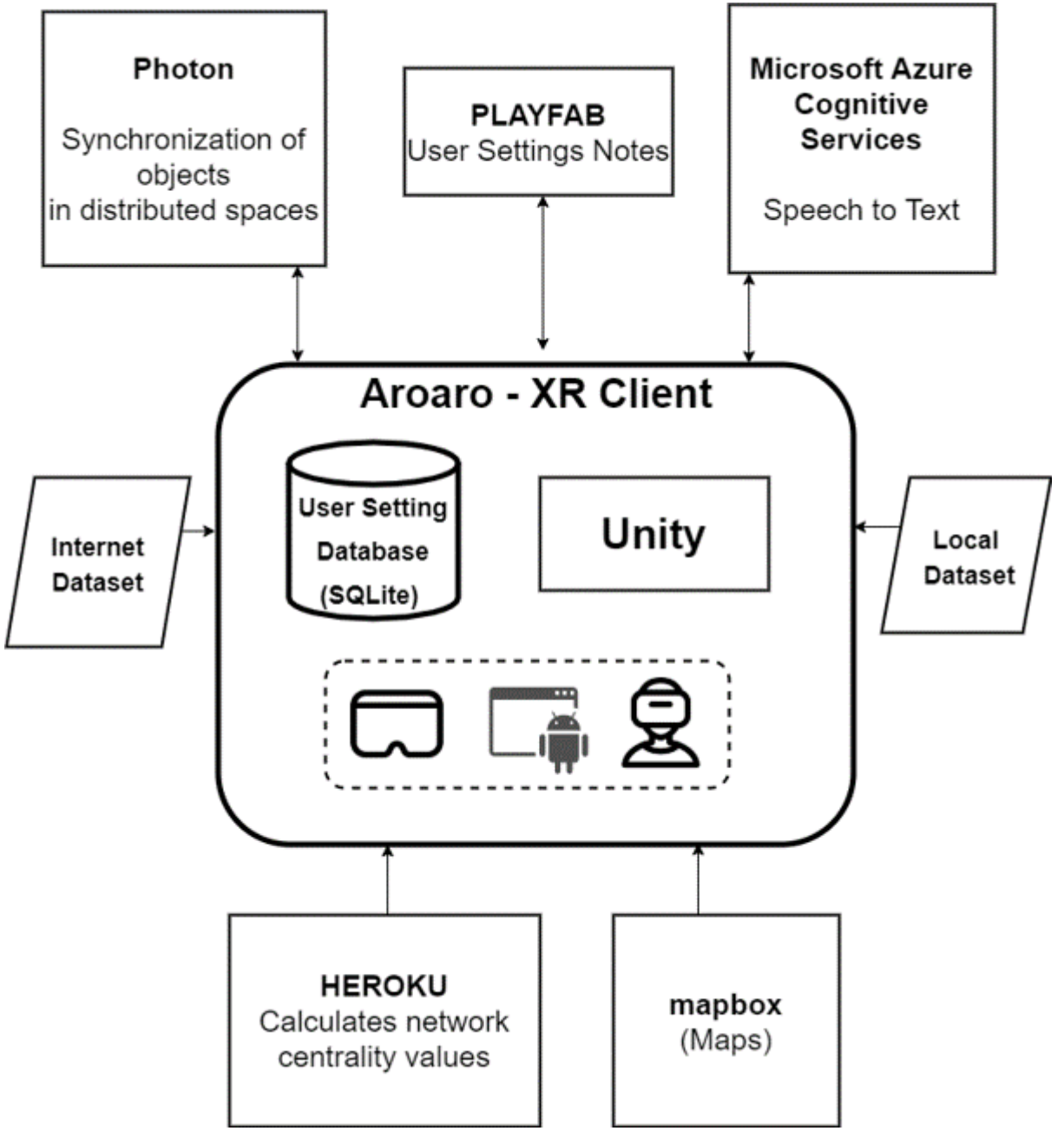

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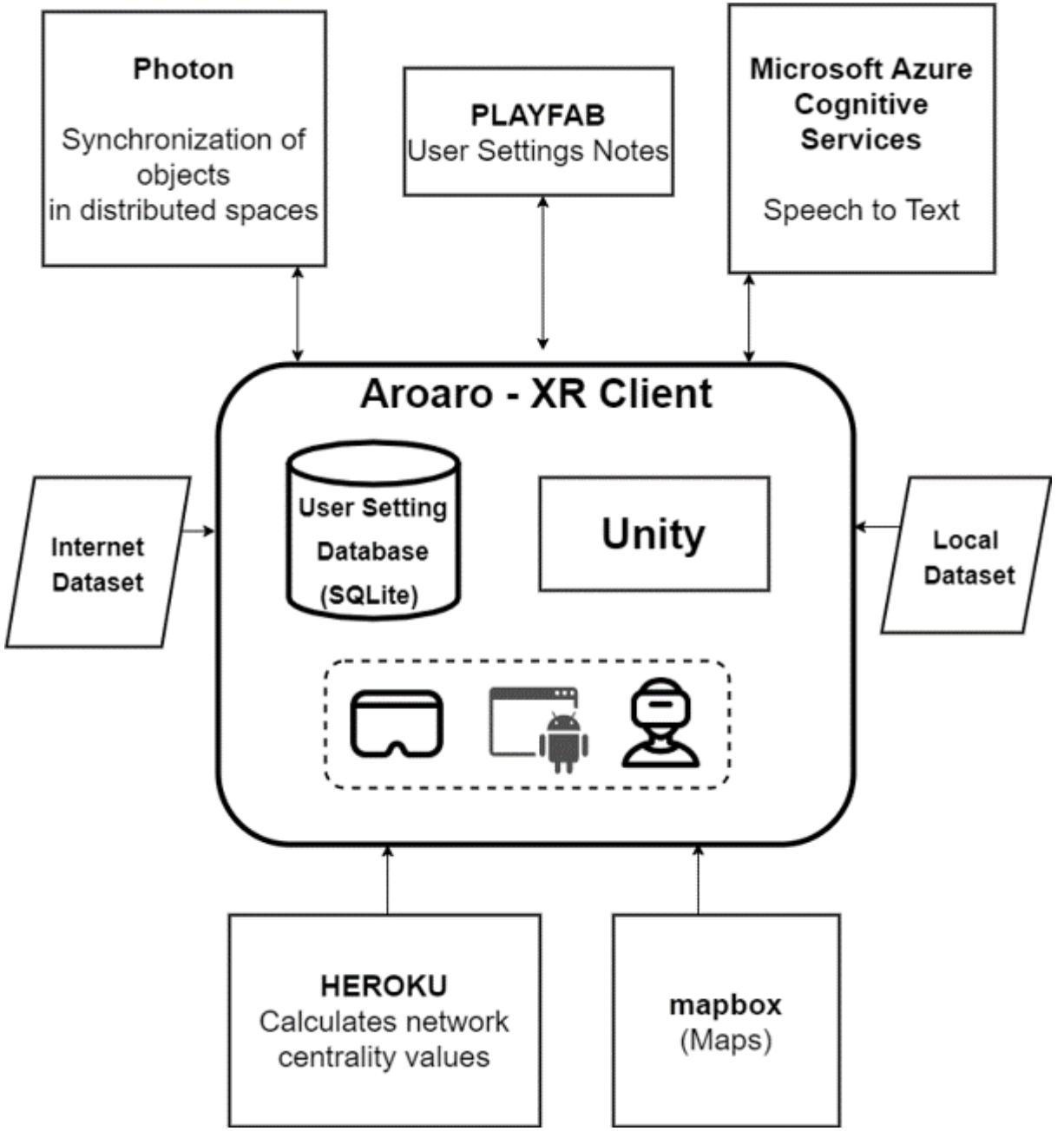
- **PlayFab** is a backend tool to provide user management and to store scene objects.
- **Heroku** hosts the code that calculates network measures such as centrality and other degree-based network properties.



Network data visualization

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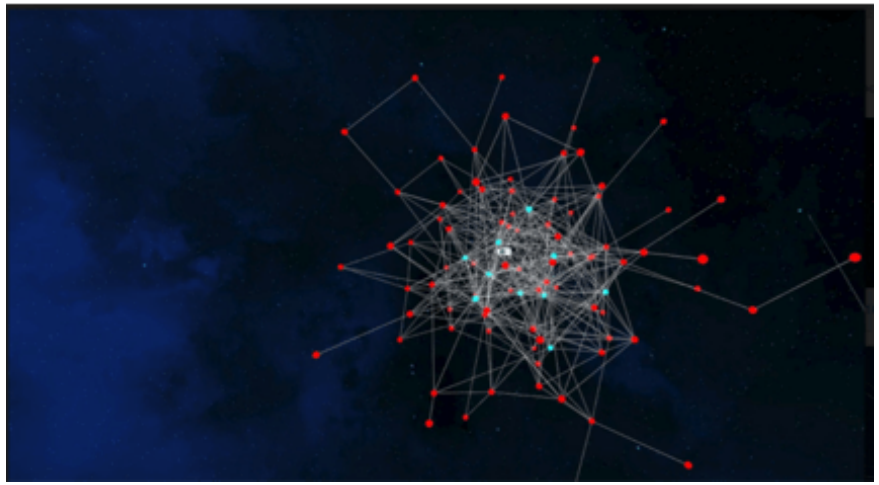

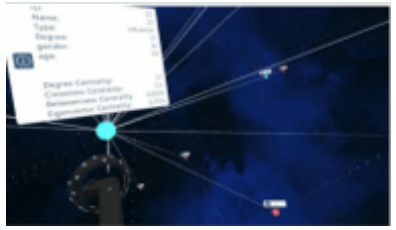

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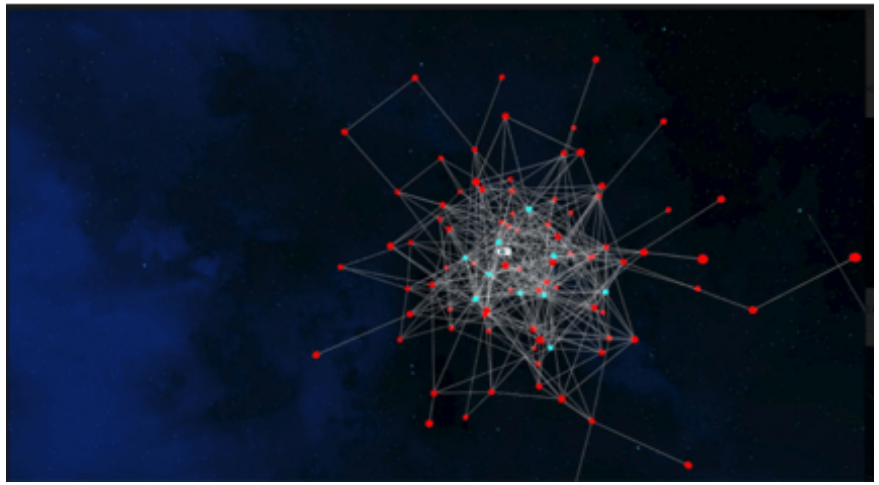

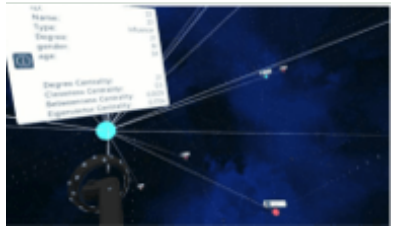

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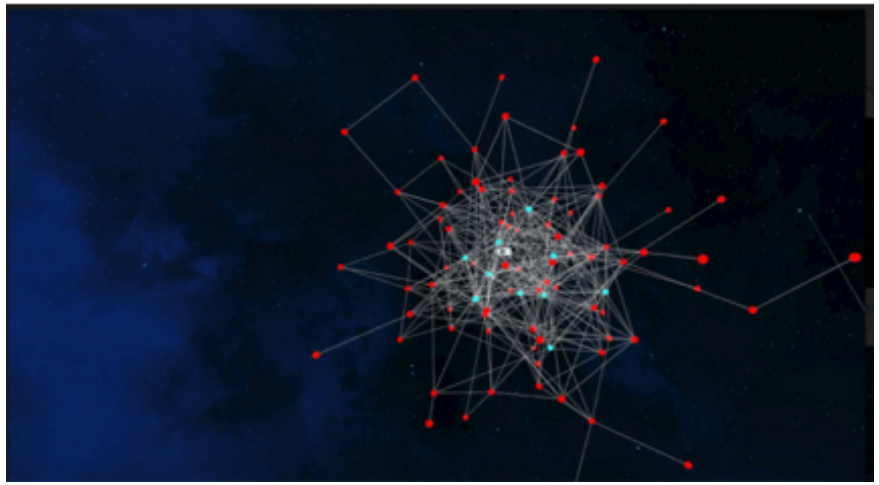

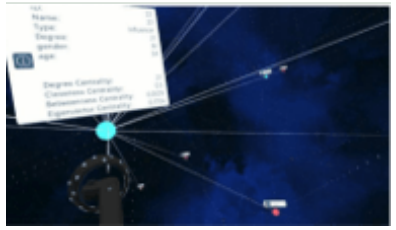

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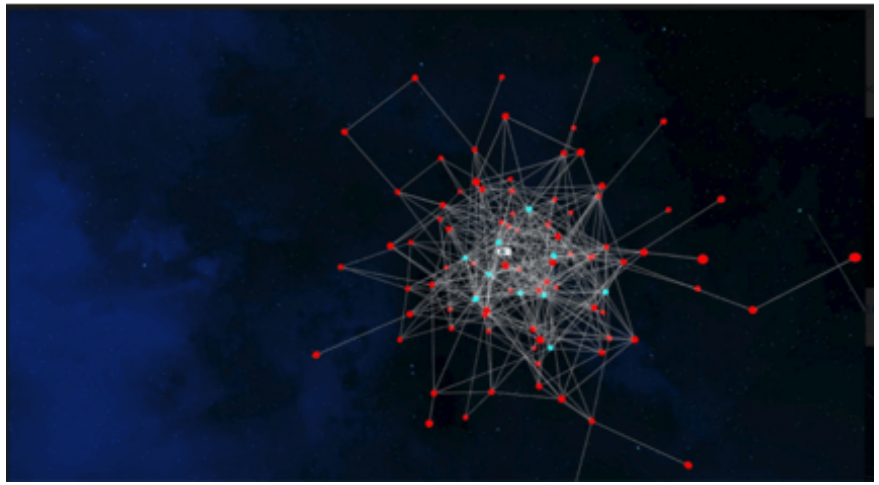
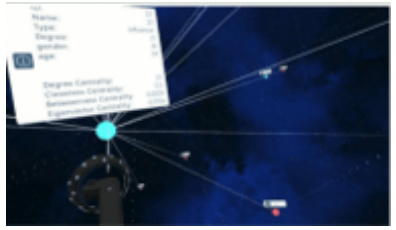
- Useful features that support our network data visualization take:
  - Optimal spacing of nodes and links in the scene
  - Ability to “fly” around, over, below and into the network
  - Query-oriented menu





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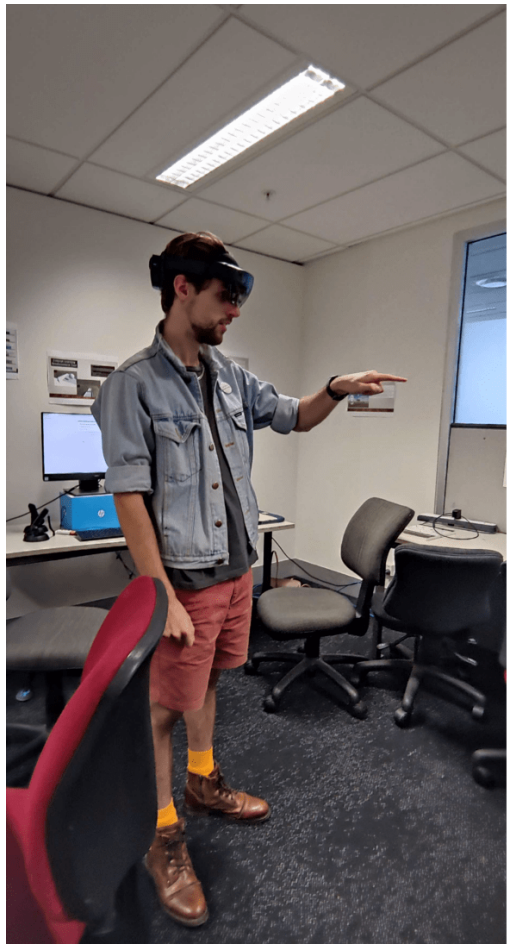
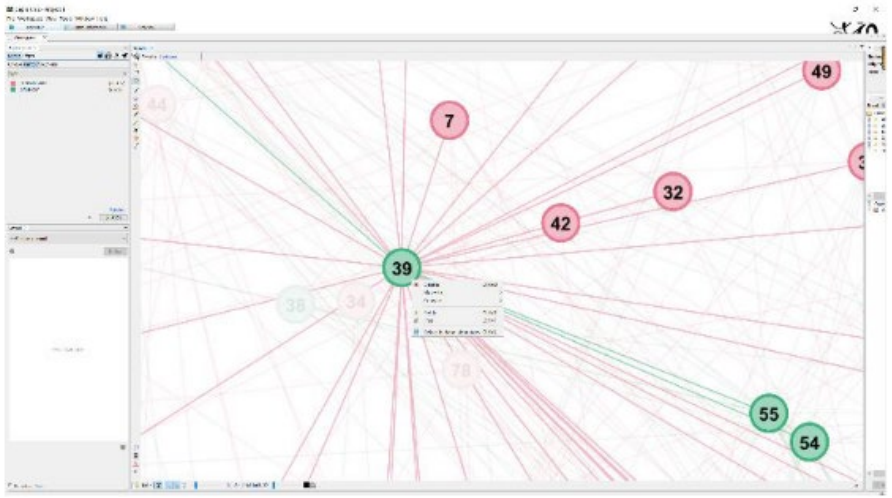
  - First 3 questions: **low cognitive effort (LCE);** remaining 3 questions, **high cognitive effort (HCE).**

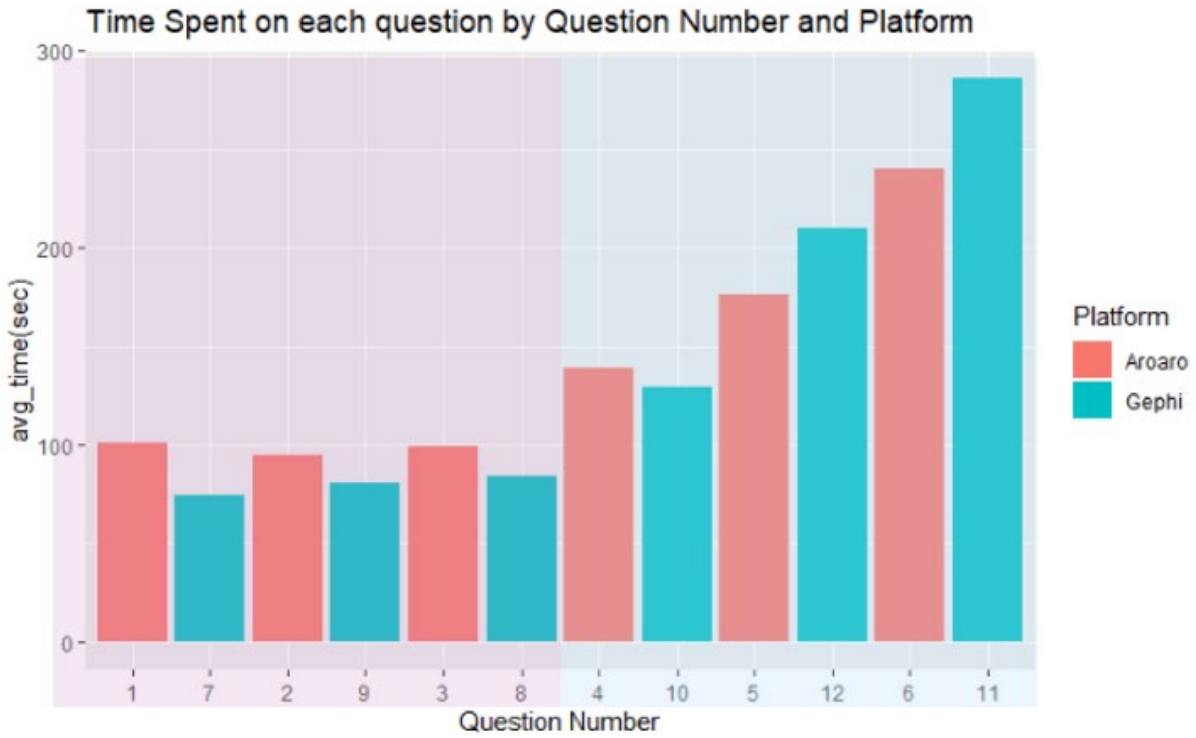
Experiment Snapshot





Results of Experiments:

Time Spent on LCE and HCE questions on each platform



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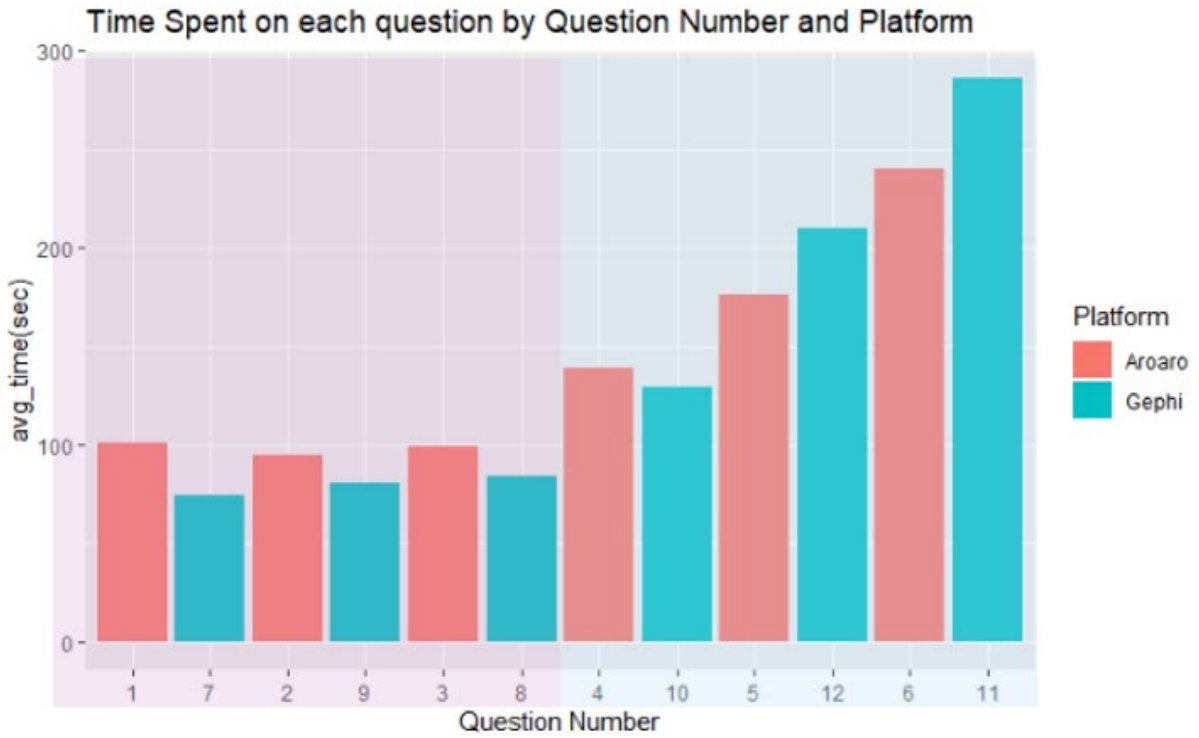

Average Quality of Decision

	Question Type	
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Aroaro	0.81	2.21
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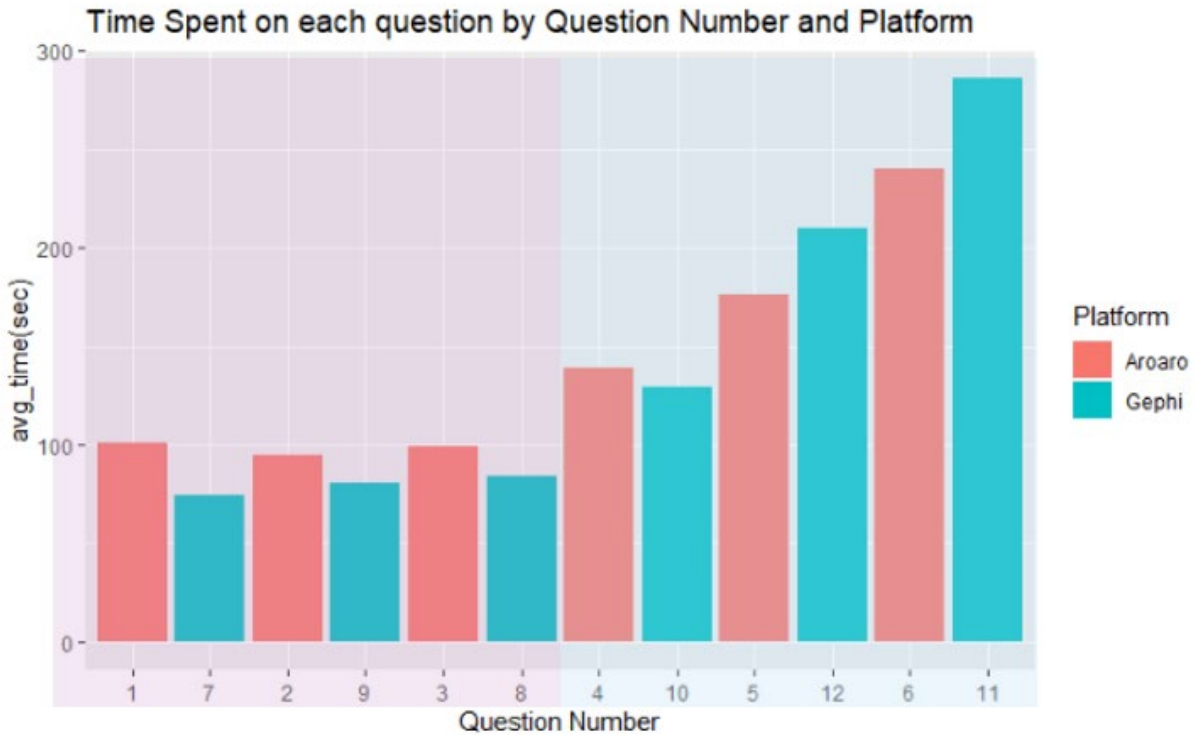

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Average Quality of Decision by Participant Groups

Participant Groups	Questions in Aroaro	Questions in Gephi
Aroaro-first	1.44	1.33
Gephi-first	1.56	1.42

Concluding: What can network data visualization do for a decision maker?

- Aroaro's network data visualization engine:
  - Enhances users' understanding of relations between nodes and links.
  - Enhances users' understanding of network connectivity.
  - Helps users to discover hidden information and relations.
- All of the above while providing multiple visual perspectives.
- Our results point at higher quality decisions when decision makers face High Cognitive Effort (HCE) questions.
- Also, it helps decision makers overcome cognitive roadblocks in the process of discovering associations, relations and features of the network data.

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Thank you!

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