VR Experience for Spatial Data Visualization and Annotation

Individual Project Presentation
by Luca Simonato

Supervisor
Dr. Thomas Heinis

Introduction

Introduction

- Why?

Introduction

- Why?
- What?

Introduction

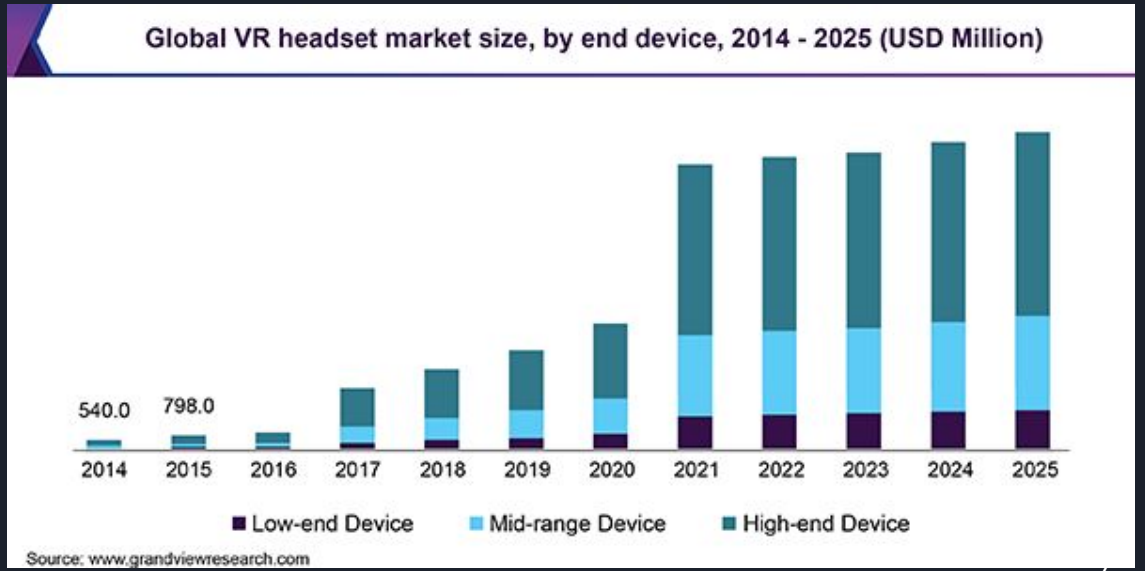
- Why?
- What?
- How?

Introduction

- Why?
- What?
- How?
- Results

Why?

- Personal deep belief in Virtual Reality Technologies
- Fast growing field
- Data Visualization enhanced by VR navigation



What?

Software should be a VR experience and ideally have the following features:

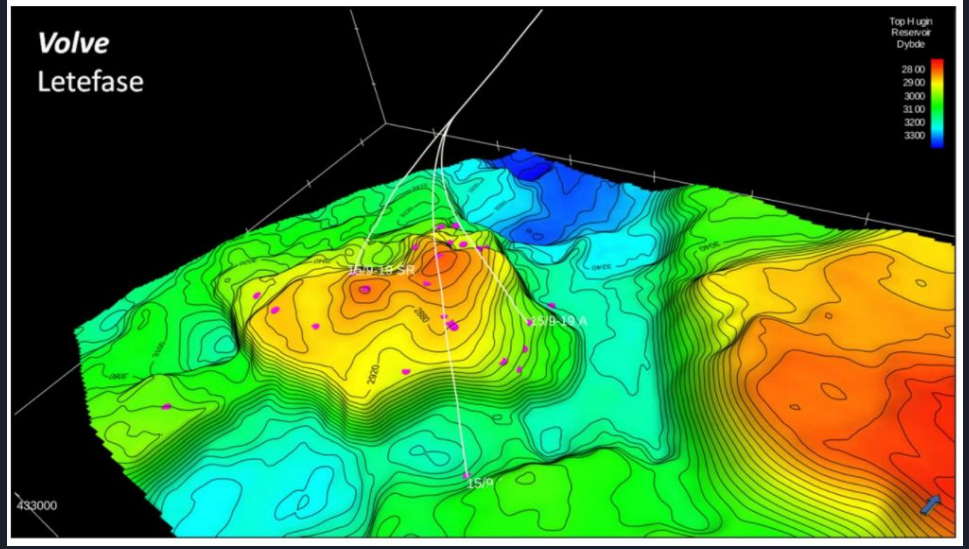
- Ability to visualize data rendered as 3D model
- Ability to adapt how the model is viewed by the user
- Possibility to annotate the data

How?

equinor

Disclosing all Volve data

June 14, 2018 08:00 CEST | Last modified June 15, 2018 12:01 CEST



Source: https://www.equinor.com/en/news/14jun2018-disclosing-volve-data.html

Results

The project’s contribution consists of the following:

- A completely immersive VR experience to visualize, navigate and annotate spatial data about the Volve field
- A secondary non-immersive experience to provide a direct comparison
- The demonstration that VR systems could improve user experience in spatial data visualization

Design

Design

- Annotation method

Design

- Annotation method
- UI design

Design

- Annotation method
- UI design
- Intended use scenario

Annotating data

Many different annotation systems:

Annotating data

Many different annotation systems:

- Localized annotations
- Region annotations
- Free hand sketching
- Text annotations
- Audio annotations
- Multimodal annotations
- Single mode annotations

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Keep
it
Simple

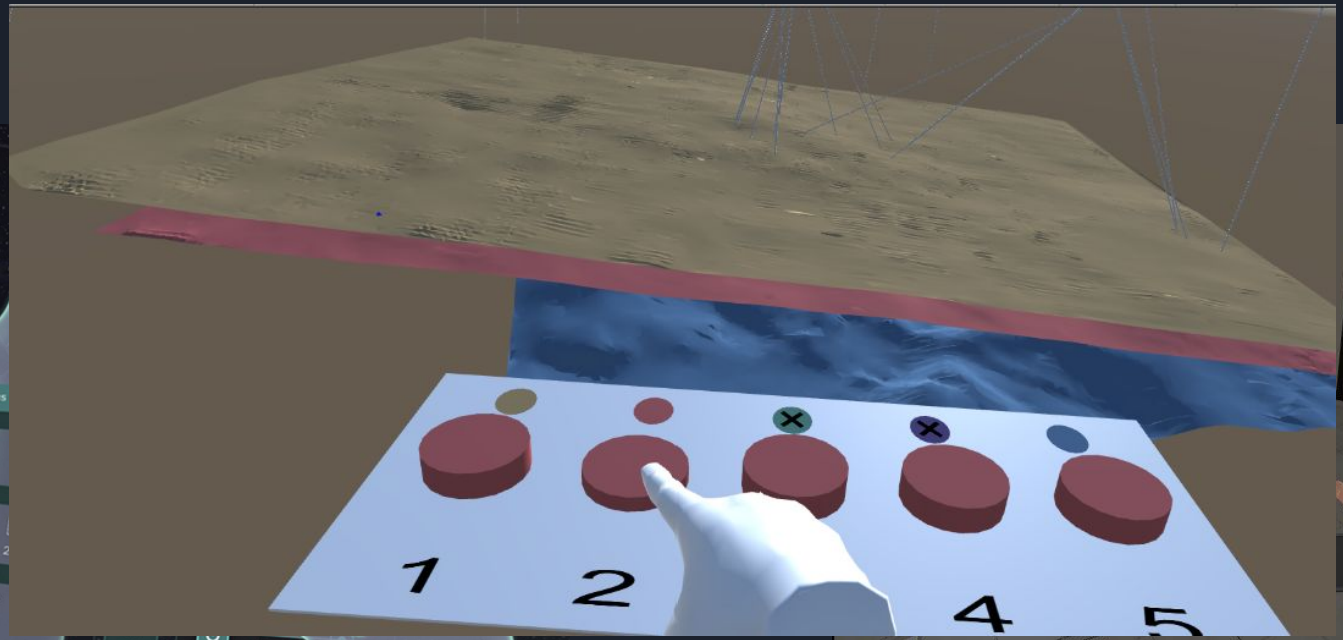
Exploiting VR features

The upsides of audio annotations choice:

- Possibility of recording/playing clips while exploring data
- Best way to express opinions and perceive expressions
- Oculus Quest includes a microphone and speakers

A minimalistic UI

A minimalistic UI



Intended use situation

The application is designed to be experienced in specific situation:

- Users are supposed to be field experts
- Headset is going to be shared within the office
- Office space is limited, users aren’t required to move
- Users should be seated on a swivel chair, or standing

Implementation

Implementation

- Model Generation

Implementation

- Model Generation
- Data Navigation Scene

Implementation

- Model Generation
- Data Navigation Scene
- Welcome Scene

Model generation

```
10031.0000000,2477.0000000,432256.0248349,6477720.4242047,3172.8281250
10032.0000000,2477.0000000,432259.0492085,6477732.5528128,3175.6452637
10033.0000000,2477.0000000,432262.0735821,6477744.6814209,3177.7917480
10034.0000000,2477.0000000,432265.0979557,6477756.8100290,3180.6823730
10035.0000000,2477.0000000,432268.1223293,6477768.9386371,3183.5729980
10036.0000000,2477.0000000,432271.1467030,6477781.0672453,3186.4636230
10037.0000000,2477.0000000,432274.1710766,6477793.1958534,3188.7197266
10038.0000000,2477.0000000,432277.1954502,6477805.3244615,3190.6840820
10007.0000000,2476.0000000,432195.5684763,6477426.3132317,3162.8098145
10008.0000000,2476.0000000,432198.5928499,6477438.4418398,3163.6945801
10009.0000000,2476.0000000,432201.6172235,6477450.5704479,3163.9333496
10010.0000000,2476.0000000,432204.6415971,6477462.6990561,3164.3923340
10011.0000000,2476.0000000,432207.6659707,6477474.8276642,3160.6501465
```

Model generation

	A	B	C	D	E	F	G	H	I	J	K
1	x	y	z		normalizec	normalizec	normalized z		mean x	mean y	mean z
2	432256	6477720	3172.828		-2918.55	-956.644	232.5022		435174.6	6478677	2940.326
3	432259	6477733	3175.645		-2915.53	-944.515	235.3193		435174.6	6478677	2940.326
4	432262.1	6477745	3177.792		-2912.51	-932.386	237.4658		435174.6	6478677	2940.326
5	432265.1	6477757	3180.682		-2909.48	-920.258	240.3564		435174.6	6478677	2940.326
6	432268.1	6477769	3183.573		-2906.46	-908.129	243.2471		435174.6	6478677	2940.326
7	432271.1	6477781	3186.464		-2903.43	-896.001	246.1377		435174.6	6478677	2940.326

```
10036.0000000,2477.0000000,432271.1467030,6477781.0672453,3186.4636230
10037.0000000,2477.0000000,432274.1710766,6477793.1958534,3188.7197266
10038.0000000,2477.0000000,432277.1954502,6477805.3244615,3190.6840820
10007.0000000,2476.0000000,432195.5684763,6477426.3132317,3162.8098145
10008.0000000,2476.0000000,432198.5928499,6477438.4418398,3163.6945801
10009.0000000,2476.0000000,432201.6172235,6477450.5704479,3163.9333496
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10011.0000000,2476.0000000,432207.6659707,6477474.8276642,3160.6501465
```
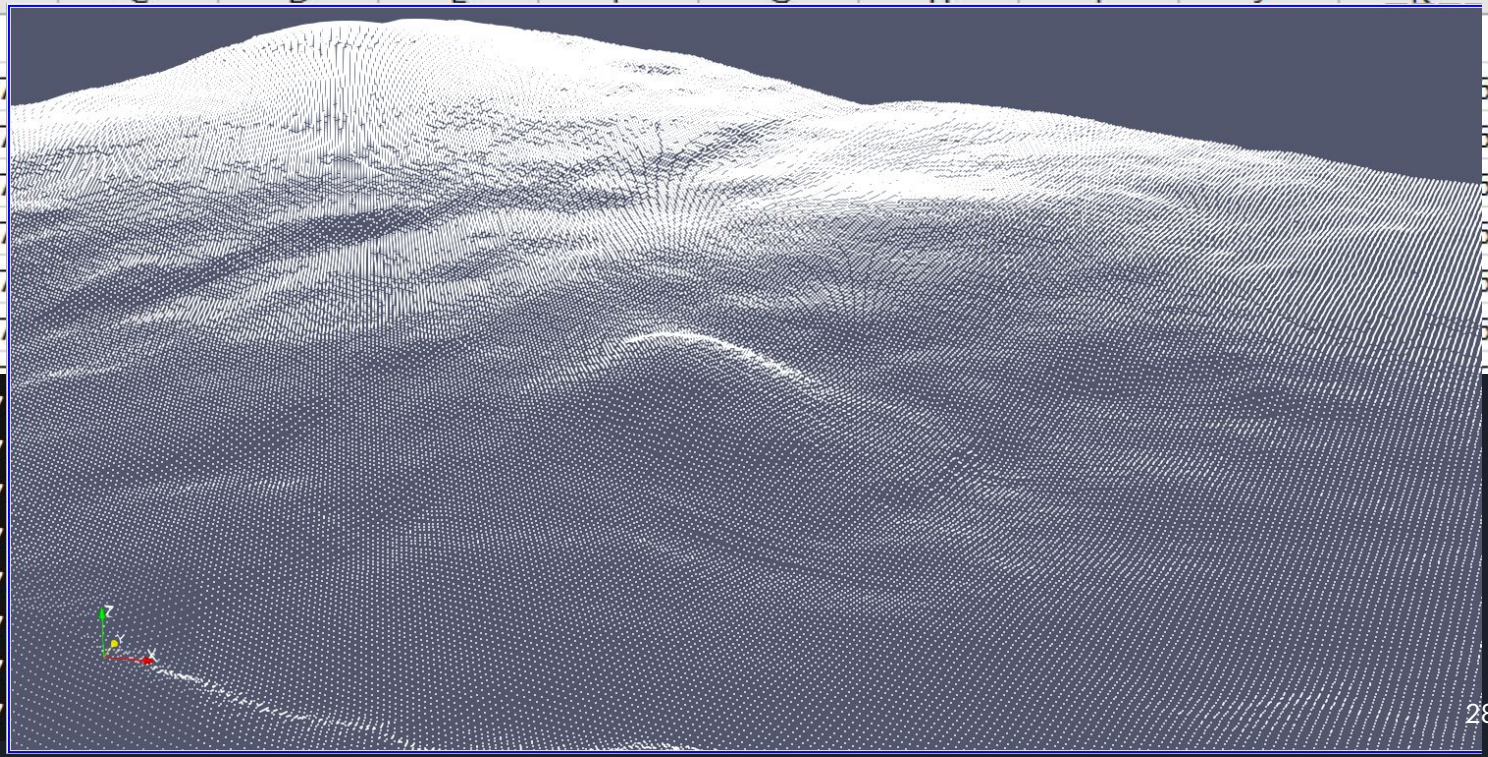

Model generation

	A	B
1	x	y
2	432256	6477
3	432259	6477
4	432262.1	6477
5	432265.1	6477
6	432268.1	6477
7	432271.1	6477

10036.0000000,247
10037.0000000,247
10038.0000000,247
10007.0000000,247
10008.0000000,247
10009.0000000,247
10010.0000000,247
10011.0000000,247



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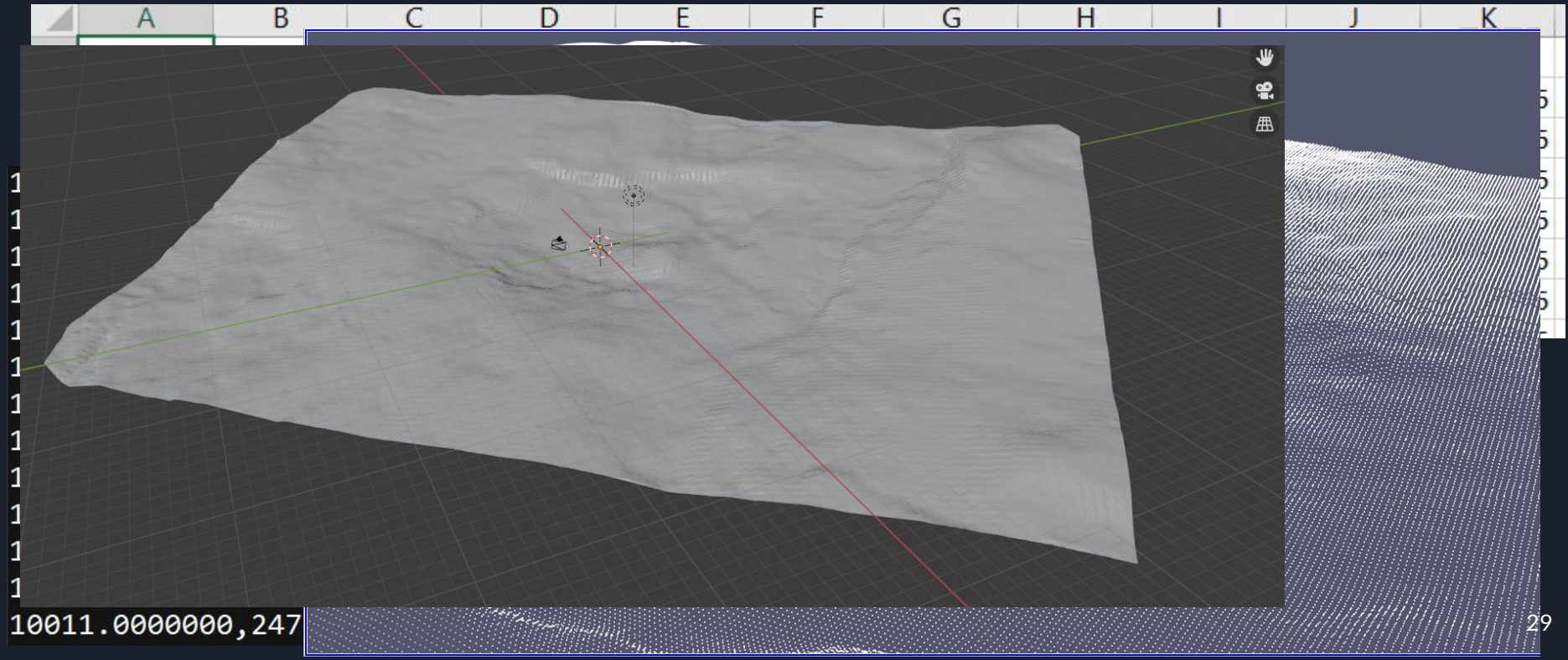
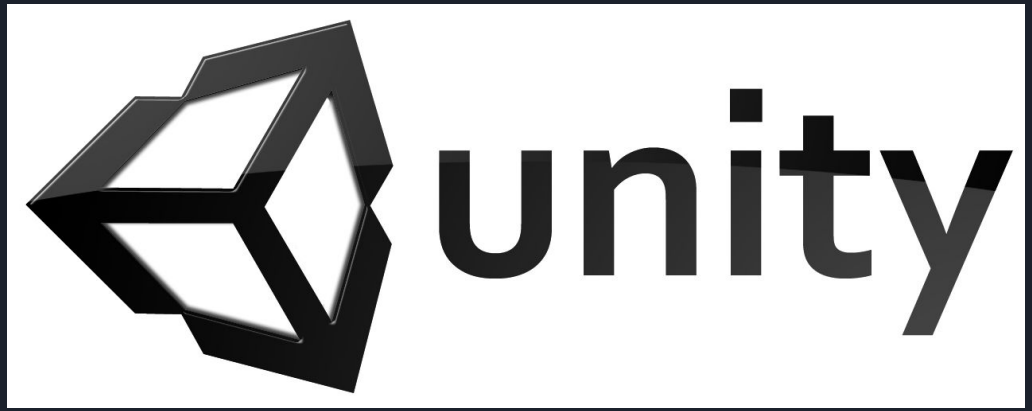


Navigation Scene



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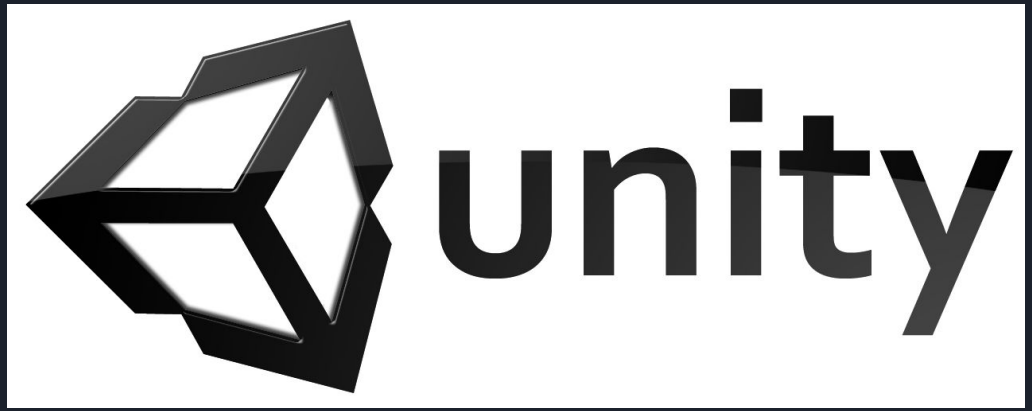
Navigation Scene



- Modify model’s Transform
- Edit layers’ visibility
- Annotate and reproduce annotations
- Move and rotate camera

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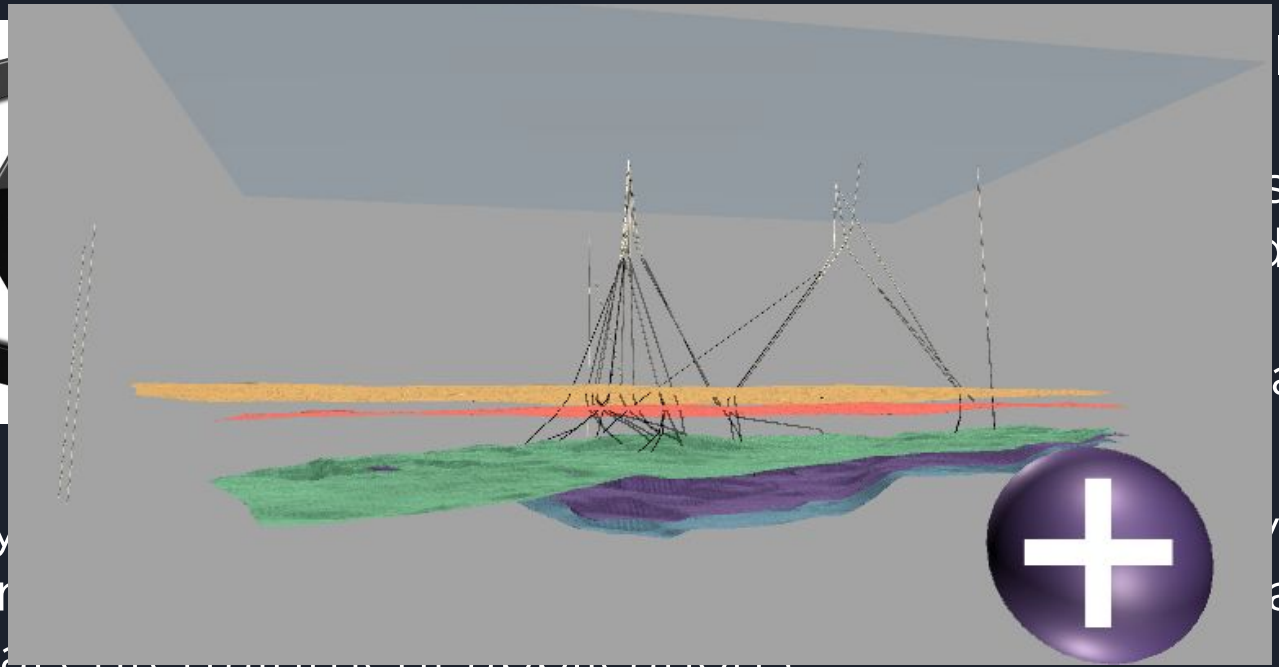
Navigation Scene



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sibility
d reproduce

ate camera

Unity
the ir
digita

used in
active

Layers Mode

Layers Mode

Used to control visibility of ground layers.

Both user hands visible in the scene, hands are used to press virtual buttons.

Virtual buttons are placed on floating table , following the user’s movements.

DEMO

LAYERS MODE

Model Mode

Model Mode

Used to manipulate Model’s Transform

Both user hands visible in the scene, hands are used move and scale model through natural gestures

Gestures functionality is controlled through controllers’ inputs and colliders system

DEMO

MODEL MODE

Annotation Mode

Annotation Mode

Virtual pointer allows to select objects and point to locations from a distance

Audio Collections can be created by recording and placing a new annotation in the scene

Wells and audio Collections can be selected to allocate new annotations

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Annotation Mode

Saving annotations is as important as recording them

This is achieved by using by using Permanent Storage to save clips as .wav

To remember annotations location and order, Player Preferences are used instead

Player Preferences are also used to store audio Collections' locations

DEMO

ANNOTATION MODE

Welcome Scene

Welcome Scene

Application is designed to be expandable and include multiple datasets

Main menu is needed. UI exclusion led to creation of new scene

Welcome scene allows user to select the dataset to navigate

Each model is previewed on a separate table, users can change scene clicking a virtual button

DEMO

WELCOME SCENE

Evaluation

Evaluation

- Computer Comparison

Evaluation

- Computer Comparison
- Stabilizing framerate

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- Computer Comparison
- Stabilizing framerate
- Decimating the model

Computer Version

The computer version of the software can be used to compare spatial data navigation ease.

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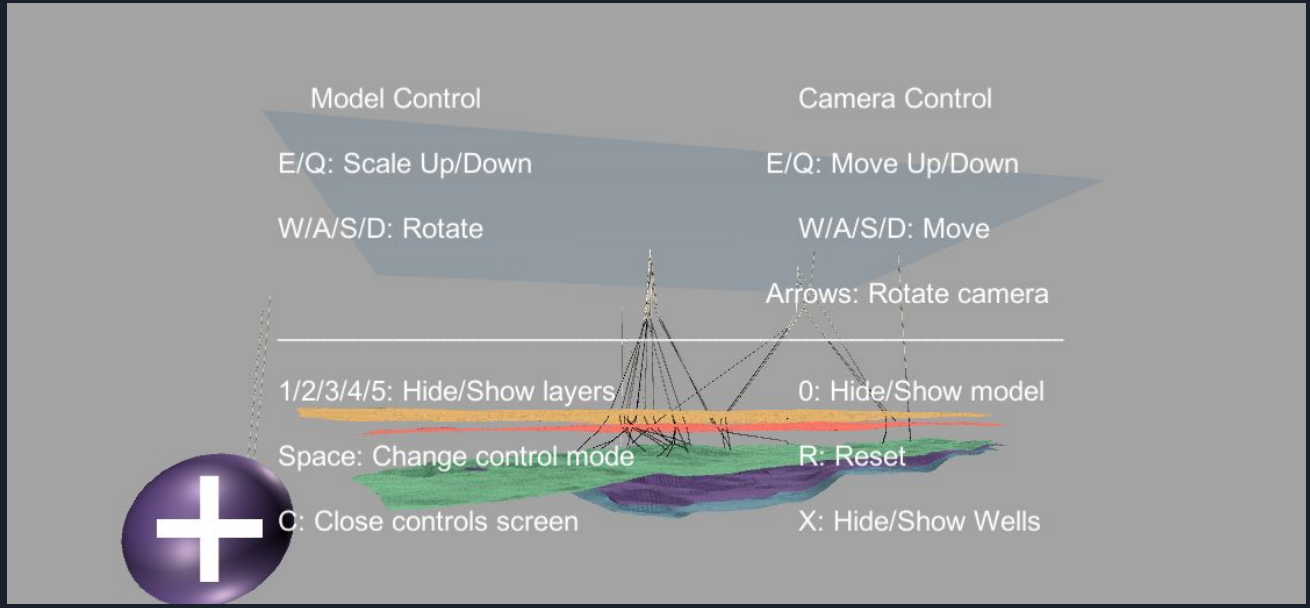

Stabilizing framerate

Stable frame rate is top priority, especially in VR

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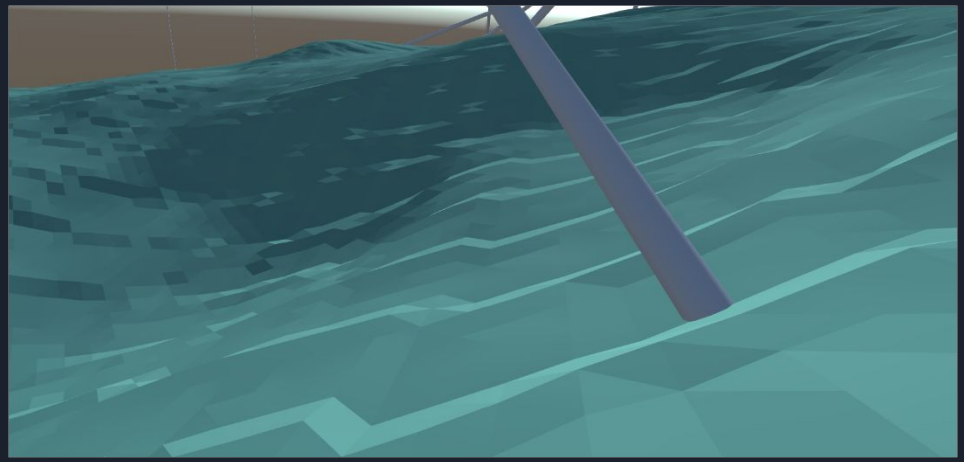

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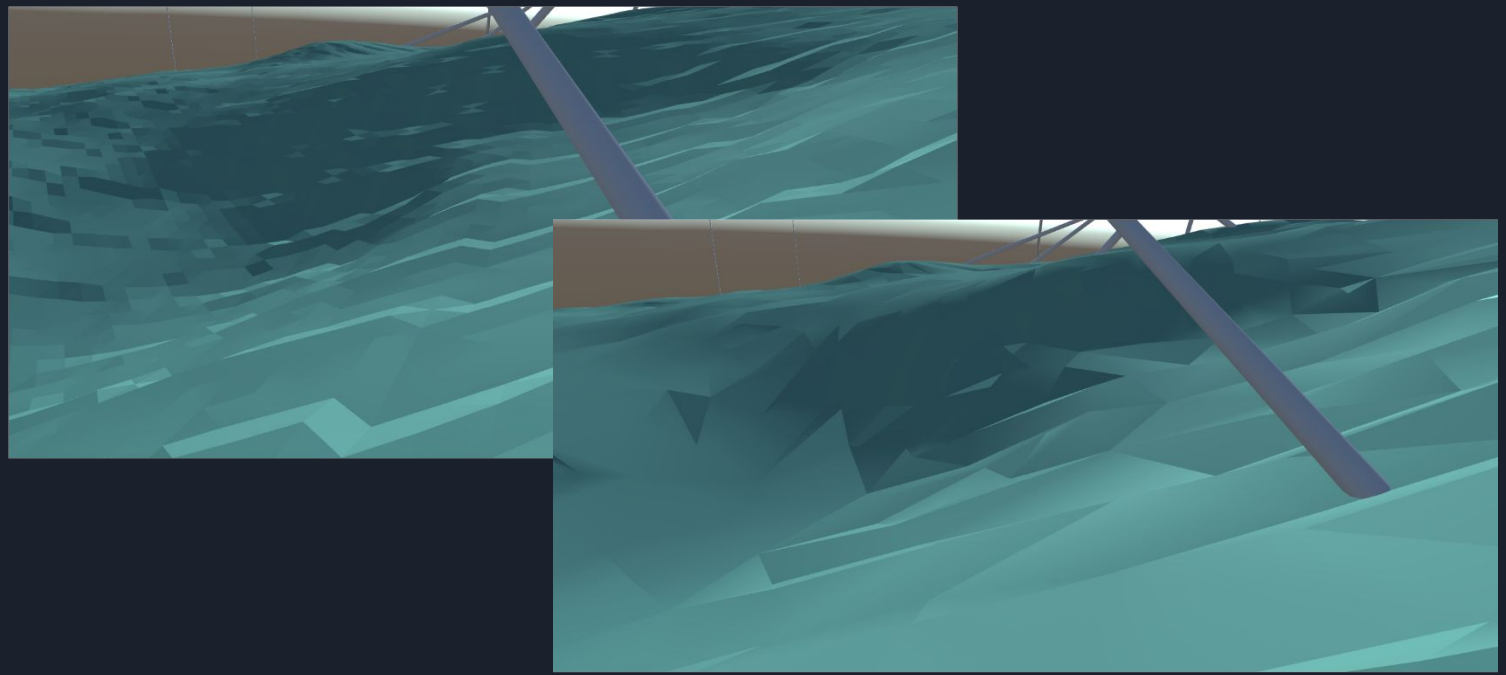

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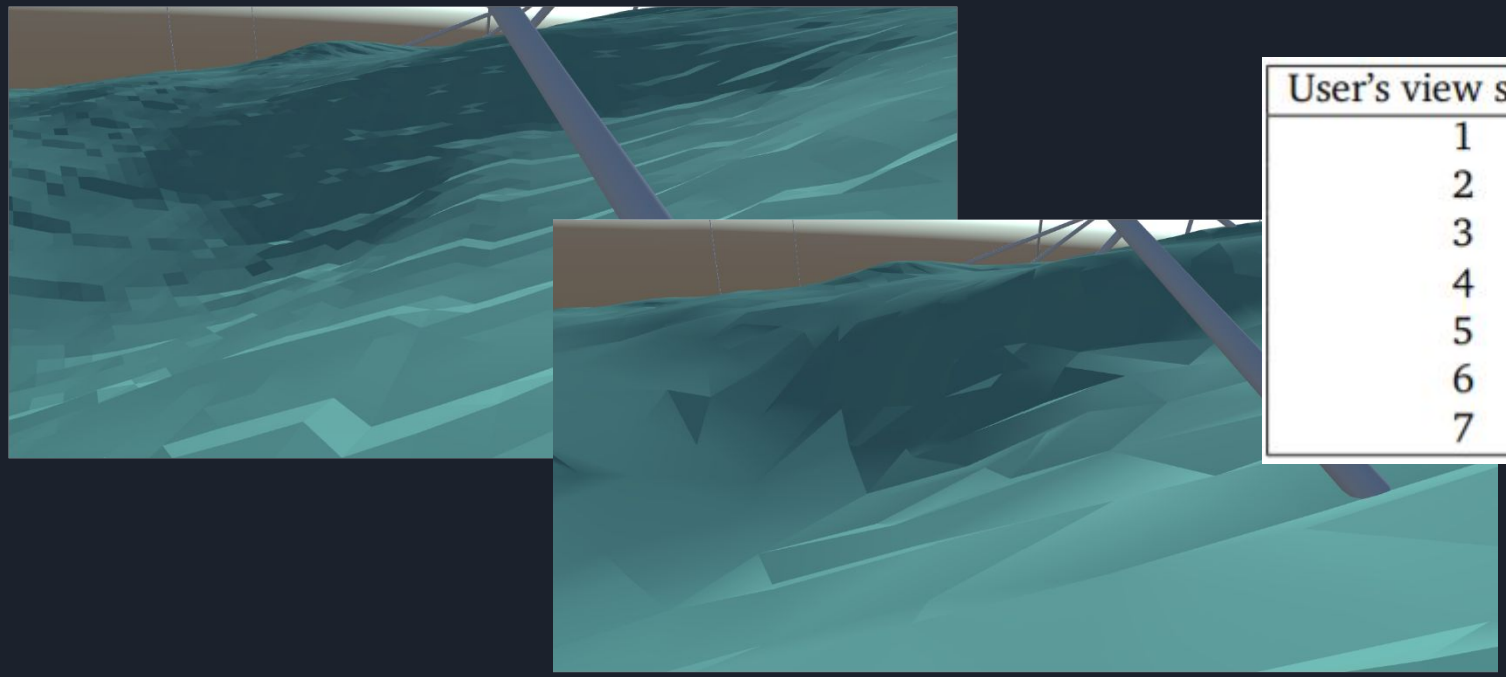

User's view scenario	FPS
1	72
2	72
3	72
4	72
5	72
6	72
7	61

Conclusion

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- Future Work

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- Future Work
- Contribution Recap

Future Work

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Application personalization to allow more accessibility

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Automatic model generation from imported datasets

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Annotation sharing through remote database

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Multiplayer features for demonstration purposes

Contribution Recap

To recap on the project contribution, this project achieved:

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- A complete and usable VR experience to visualize and vocally annotate spatial data about the Volve field
- The possibility to easily extend such software for future work or to include different datasets
- The demonstration that Virtual Reality technology could improve ease of use and immersion in spatial data visualization

THANK YOU

QUESTIONS

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