The Information Availability: The influence of user interface on spatial awareness

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Introduction

Technologies providing three-dimensional visualization of the geographical data are widely discussed. Human perception and understanding of the information presented in virtual environments are conditioned by the way of information depiction and also by the specific options of interaction with the user interface (UI). The way how user interpret the depicted situation is crucial in terms of geographical theories (Hirmas et al., 2014; Coltekin et al., 2016) as well as in many applied areas such as crisis management (Bandrova et al., 2012) or aviation and vehicular traffic. Regarding used technologies, the 3D UIs are not equivalent in the number of provided interaction options. The specific interface setting of outputs and inputs (i.e. technology used) may hugely influence the process of interaction with such an environment. We explore the impact of specific UI setting of virtual geographical environment (VGEs) on the user's perceptual, sensory-motor and cognitive processes (movement pattern/memory recollection).

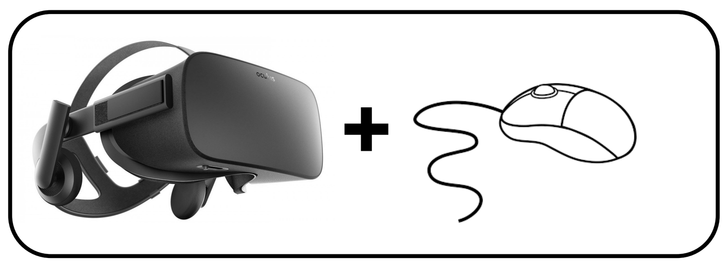
The aim of the study is to **compare** the **behavioral activity** of users interacting with the **informationally equivalent virtual environments** via **different UI settings**. We expect UI differences would affect user's **interaction patterns (sensory-motor level)** as well as **memory recollection (cognitive level)** when working with virtual geovisualization.

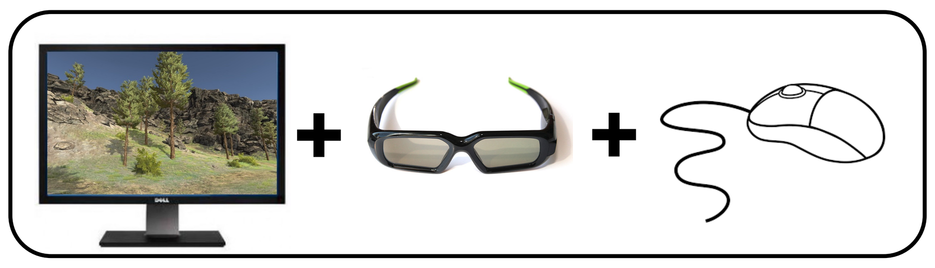
Apparatus and Method

Software platform UNITY was used to optimize the VGE for the research purposes (see Fig. 1). UNITY is used to customize the VGEs for Oculus Rift use and for recording the users' virtual movement in the virtual terrain as well as his real control actions including head-movements.

Fig. 1 – Virtual 3D geographical environment

We engaged 2 different types of 3D visualization (UI settings):





UI settings:

Oculus Rift (OR) – Head-mounted display (6 DoF) for real 3D vision + computer mouse as the input device (1 DoF; 6 DoF in total)

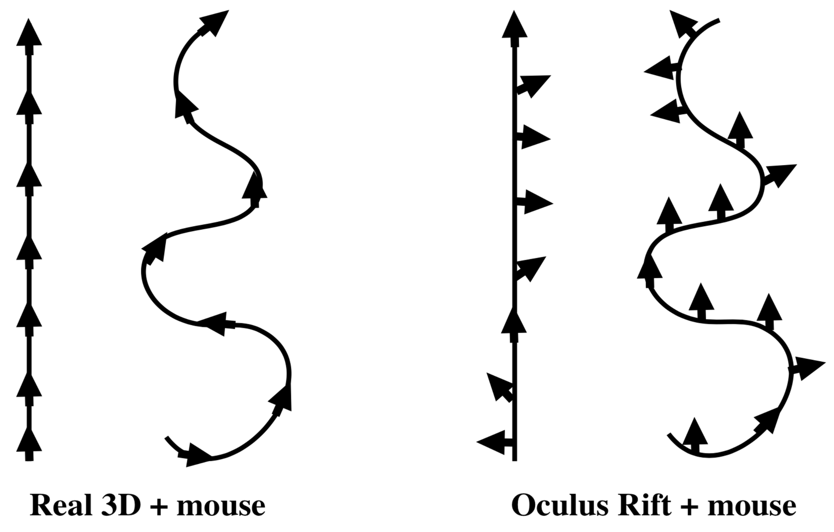
Real 3D – PC monitor, Active Shutter 3D glasses + computer mouse as the input device (2 DoF in total)

Participants:

We engaged 2 participants for the pilot testing period with the purpose to demonstrate system functionality.

This research was supported by funding from the project of Masaryk University under the grant agreement No. MUNI/M/0846/2015, which is called 'The Influence of Cartographic Visualization Methods on the Success in Solving Practical and Educational Spatial Tasks'.

Interaction options



OR technology offers the option of looking around without change of the direction when moving in the virtual environment. Real 3D setting doesn't allow user to look around (when moving) without changing the direction of his egocentric forward movement (as illustrated in Fig. 2).

Fig. 2 – Movment options in Real 3D/OR setting

Data and analysis

With the proposed UI we can specify which behavioral aspects exactly will be measured due to the suggested hypotheses.

The interface setting allows us to measure crucial interaction parameters:

- **walk-through lengths/pattern** – distance travelled, movement map
- **time needed** to reach specific point of interest
- **look-around rate** (camera rotation) – as participants explored the scene while looking around, we can quantify their looking around rate
- **eye-tracking** – exact spots in VGE where participant looked (in OR only)

Next to behavioral activity, cognitive aspects such as memory recollection and mental maps reconstruction will be captured.

With the UNITY SW we can produce maps showing users' movement through the VGE and the direction of their view (including exact data).

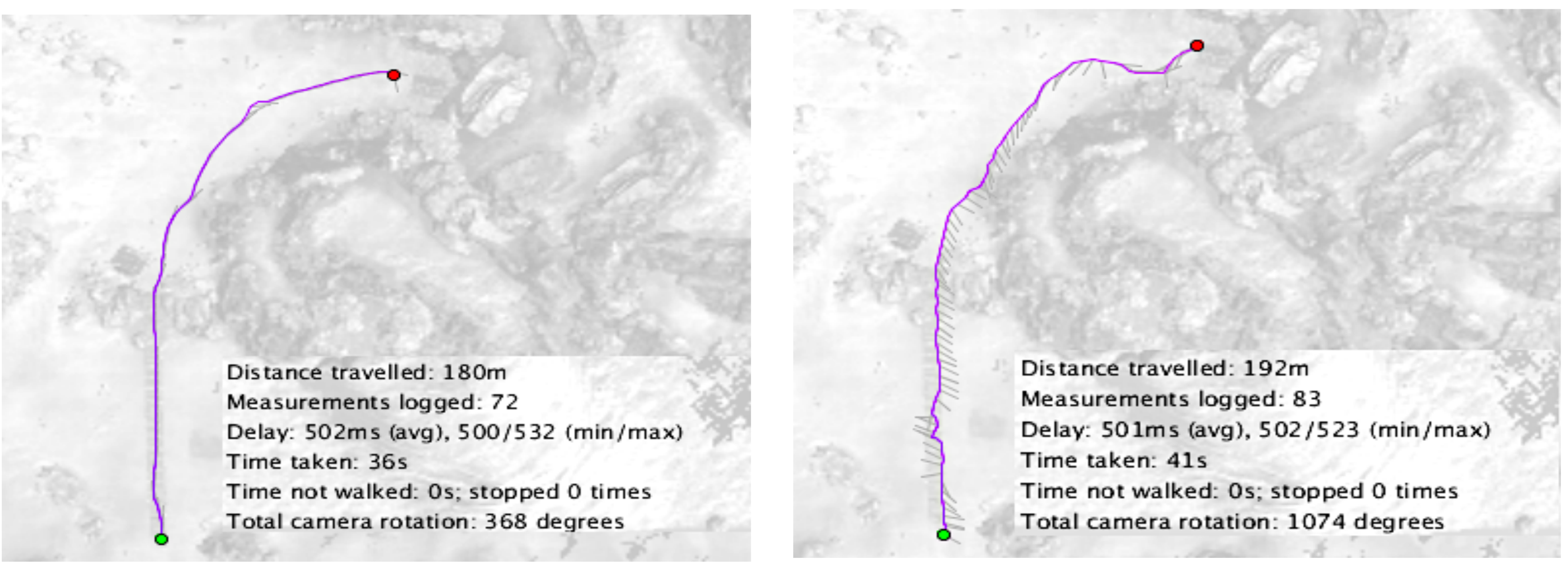


Fig. 3 – Comparison of two different walk-throughs (left – Real 3D; right – OR) with the exact data about users' movement and looking-around rate

Discussion

We created an interactive 3D virtual geographic interface for exploration of human behavioral and cognitive performance in VGEs. The suggested study expects that different UI setting of informationally equivalent 3D VGEs provides different interaction options, which lead to different behavioral patterns and hence also to different sensory-motor and perceptual processing of information. These differences on sensory-motor level, which can be labeled as interactional non-equivalence, predetermine the specific interaction and thus also information availability of specific cues in the virtual geovisualizations as well as particular cognitive processing and computation of displayed content. With the use of suggested technology we can precisely measure user's activity for the purpose of further statistical analysis. In follow-up experiment will compare two suggested UI settings with respect to users' performance in the 3D VGEs while dealing with the perceptual and cognitive tasks.

References

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