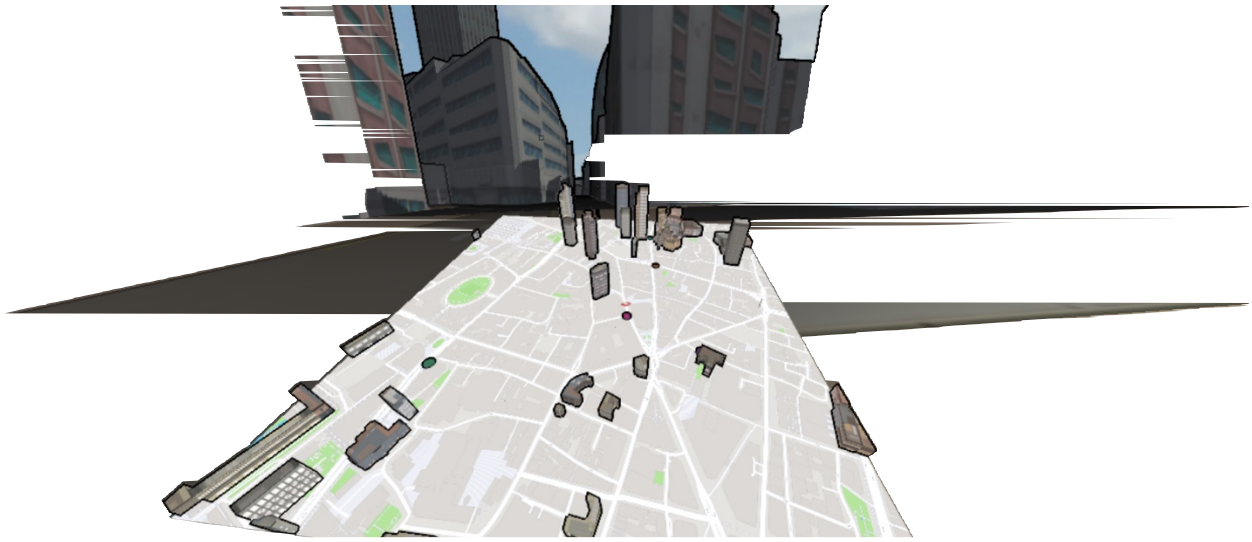
Département d'**informatique**
Unité de formation et de recherche
de mathématique et d'informatique
Université de Strasbourg

Sujet de stage recherche

Wayfinding performance using an interactive 3D map in VR

Accueil : Équipe **IGG** (Informatique Géométrique et Graphique) Laboratoire **ICube** (Laboratoire des sciences de l'ingénieur, de l'informatique et de l'imagerie), Strasbourg

Encadrement : Sabah BOUSTILA, postdoc et Dominique BECHMANN, professeure



Hybrid map: 2D track-up map enriched with 3D landmarks
and aligned with the virtual environment.

Wayfinding in an unfamiliar environment requires information about the destination, current location, and possible routes. It has been argued that this information must be picked up from external sources such as maps, floor plans, and other people [1]. While maps are here to support wayfinding tasks; users need to align the map with the real environment and then translate the route planned on a map into physical movement in the environment.

Previous works have found that landmarks help in map alignment and wayfinding tasks. Moreover, it has been proved that landmarks improve wayfinding performance. They are used in formulating routes and as reference for route following. Additional landmark information used with maps has been proved to be more efficient than route instructions enriched with landmarks. Several digital maps leverage landmark information as an asset for improving navigation performance. They have integrated 3D models of salient landmarks into maps as when using Google Maps or Sygic App.
This new feature expands information about the area with landmarks. This additional feature is expected to improve navigation task performance (wayfinding, route planning, etc.) and could support building up spatial knowledge. However, navigation systems could encounter an important design issue related to the choice of landmarks, their density in the area and how to present them on the map.

Research Idea

While 3D maps have been studied and used in several navigation aid systems, very little research has explored 3D maps in VR and particularly maps enriched with 3D landmarks for wayfinding. With the use of VR/AR, it is possible to provide a hybrid map offering the spatial layout of the area (2D map) enriched with 3D landmarks (such as buildings in 3D like in the image next page). Thus, this map makes available all spatial information important for building up a cognitive map of the environment: landmark, route and survey information.

For this purpose, a track-up hybrid map for VR was developed using Mapbox SDK. This map needs to be interactive to allow the user modifying the map in real-time.

The aim of the research will focus on:

1- Ensure that the influence of 3D landmarks on hybrid maps is improving wayfinding performance in VR/AR.

2- Investigate the effect of landmark density on map effects in other words, how many landmarks are needed to improve task performance?

Programming tasks

A prototype for navigation was developed in Unity 5, it consists of a 3D real environment; developed using Wrld API and a 2/3D map; developed using Mapbox API. Wrld API allows choosing the area to display by specifying (on Unity) the real coordinate system (latitude, longitude). The prototype can be visualized in VR using an Oculus Rift.

The 3D map currently is a track-up map which means that the forward direction on the map is usually aligned with the looking direction in the 3D environment (such as on Google maps) while a self-marker centered on the map shows the current position and orientation. The track-up map displays the area, which is within 2 km surrounding the user, the map is updated (to display new area) when the user moves.

The next step is to allow interactions with this map. In fact, Mapbox API offers many filters that could be specified on Unity interface before-hand such as extrude buildings and filter them according to a specific height (e.g. display buildings higher than 100m). The challenge of this work is to provide real-time interaction with the map in order to allow the user to customize the map according to his/her preferences. Therefore, the user should have access to these filters on the 3D environment using menus in order to change the map. As for the navigation task, we aim at adding new point of interest (POI) on the map to specify target locations, this could be done by adding new objects (e.g. cylinders) on the map (before-hand).

Références bibliographiques :

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[2] McKenzie, G., & Klippel, A. (2016). The Interaction of Landmarks and Map Alignment in You-Are-Here Maps. Cartographic Journal, 53(1), 43-54. https://doi.org/10.1179/1743277414Y.0000000101

[3] Xiaolong Zhang. 2007. M2S maps: supporting real-world navigation with mobile VR. Virtual Real. 11, 2-3 (June 2007), 161-173. DOI: https://doi.org/10.1007/s10055-006-0062-2