DMP title

Project Name An Architectural Approach to Virtual Reality Locomotion - DMP title

Project Identifier G079522N

Grant Title G079522N

Principal Investigator / Researcher Adalberto Simeone

Project Data Contact adalberto.simeone@kuleuven.be

Description This project investigates how Virtual Reality (VR) and architecture can, together, lead to the design and development of novel locomotion methods. Specifically, we aim to develop algorithmical solutions that allow users of Virtual Environments (VEs) to explore the virtual space by natural locomotion without resorting to 'supernatural' locomotion methods. We propose to enable natural locomotion through an architectural approach, to spatially transform a virtual environment in response to the movement of the user to create spaces that are not only functional but pleasant to inhabit. We thus propose a novel class of redirection methods - 'overt' architectural manipulations, by which we refer to dynamically changing architectural features in the VE depending on user behaviour. Through iterative development, we will implement these architectural transformations by developing a technological framework which will procedurally generate the appearance of a VE in real-time, depending on the behaviour of the VR user. We will evaluate our technological framework across a series of use-cases of increasing spatial complexity, from two contrasting modes of scientific inquiry: the experimental studies in Computer Science with the more phenomenological experience of space from Architectural Design Science.

Institution KU Leuven

1. General Information

Name applicant

Adalberto L. Simeone

FWO Project Number & Title

Project Title: An Architectural Approach to Virtual Reality Locomotion

Project Number: G079522N

Affiliation

- KU Leuven

2. Data description

Will you generate/collect new data and/or make use of existing data?

- Generate new data

Describe in detail the origin, type and format of the data (per dataset) and its (estimated) volume. This may be easiest in a table (see example) or as a data flow and per WP or objective of the project. If you reuse existing data, specify the source of these data. Distinguish data types (the kind of content) from data formats (the technical format).

Type of Data	Format	Volume	How Created
Audio recordings of interviews	Audio-recorded and stored as .mp3; transcribed into .docx	1-5 GB	Face-to-face interviews with adults aged 18-65 years
Observational data of participant behaviour	.docx	1-10 MB	Notes typed during user studies observing participant behaviour

Sketch maps	On paper	500-1000 sheets	Pen-on-paper sketch maps of the experienced virtual environment, as drawn by participants
Questionnaires	.csv; .Rmd	50-500 MB	Scores from questionnaires are exported as .csv from LimeSurvey (KU Leuven-hosted); processed in R Studio as .Rmd
Logged user coordinates during VR simulation	.csv; .Rmd	0.5-2 GB	Logged user coordinates (at a rate of 60 times per second) of participants in Virtual Reality, as exported from the VR simulation and saved in a KU-Leuven associated OneDrive account; processed in R Studio as .Rmd
Video recordings of participants' view of the virtual world	Screen-recorded and stored as .mkv/.mp4	10-20 GB	Screen-recordings of participants' first-person perspective of the virtual reality environment. Saved as .mp4.

Images (, figures of processed data, screenshots; explanatory diagrams)	.png; .pdf; .ai	.3-2 GB	- Figures of processed data generated from R Studio as .png/.pdf. - Screenshots taken from the VR simulation being evaluated. - Explanatory diagrams for publications created in Adobe Illustrator (.ai) and exported as .png/.pdf.

3. Legal and ethical issues

Will you use personal data? If so, shortly describe the kind of personal data you will use. Add the reference to your file in KU Leuven's Register of Data Processing for Research and Public Service Purposes (PRET application). Be aware that registering the fact that you process personal data is a legal obligation.

- Yes

Privacy Registry Reference:

Ethical approval will be obtained for all studies. The overarching PRET application for the project is currently under review (**G-2022-4730**).

Short description of the kind of personal data that will be used:

Depending on the study we will collect: gender; age; experience with immersive technologies; audio-recordings of interviews; questionnaire data regarding presence, simulator sickness, task load index, spatial perception, memory & recall tests; quantitative data regarding locomotion heatmaps, logged user coordinates, task completion times; sketchmaps; and screen recordings of the virtual reality simulation.

Are there any ethical issues concerning the creation and/or use of the data (e.g. experiments on humans or animals, dual use)? If so, add the reference to the formal approval by the relevant ethical review committee(s)

- Yes

Ethical approval will be obtained for all studies. The overarching PRET application for the project is currently under review (**G-2022-4730**).

Does your work possibly result in research data with potential for tech transfer and valorisation? Will IP restrictions be claimed for the data you created? If so, for what data and which restrictions will be asserted?

- No

Do existing 3rd party agreements restrict dissemination or exploitation of the data you (re)use? If so, to what data do they relate and what restrictions are in place?

- No

There are no 3rd party agreements restricting dissemination or exploitation and all software licenses of existing software are permissive.

4. Documentation and metadata

What documentation will be provided to enable reuse of the data collected/generated

in this project?

1. All metadata, unless otherwise mentioned, will be stored in a secure One-Drive linked with a KU Leuven account (associated with the researchers involved in this project).
2. Virtual Reality applications developed in this project will be documented and uploaded in the lab GitLab account, which is KU Leuven-hosted (see https://gitlab.kuleuven.be/aria). The project will be accompanied with a README .txt file for installation instructions (e.g., engine version required, dependencies, how to run the executable file).
3. Measurement data will be stored in .csv files accompanied by metadata headers. Since currently there is not a formalised metadata standard of acknowledging metadata in the context of virtual reality locomotion, we will ensure all metadata are described consistently during the project and are well documented.
4. For the interviews, details on the setting of the interviews, the informed consent process, and the subjects discussed will be documented in a .docx/.pdf.
5. For the sketchmaps, details on the setting of both the virtual and physical environment, the informed consent process, and any subjects discussed will be documented in a Microsoft Word document.

Will a metadata standard be used? If so, describe in detail which standard will be used. If no, state in detail which metadata will be created to make the data easy/easier to find and reuse.

- No

There is no current standard for acknowledging metadata in the context of virtual reality locomotion. See the previous question to read in detail how metadata will be created to make the data easier to find and reuse.

5. Data storage and backup during the FWO project

Where will the data be stored?

1. Electronic raw data and final electronic data will be stored on the password-protected JDrive and/or on KU Leuven's OneDrive. Any personal data will be pseudonymised at the earliest possible convenience (such as the deletion of interview audio files, which is considered a type of identifiable personal data, after transcription into a word/.txt document).
2. Collection of questionnaire data will be done as an online survey through the KU-Leuven hosted Limesurvey account, and exported into a KU Leuven OneDrive as a .csv file at the end of the experiment.
3. Paper data (sketchmaps) will be archived in a locked closet in the office of the researcher at the Department of Computer Science in KU Leuven.
4. If we collaborate with researchers from other research units within the EU, we will use a KU Leuven-associated OneDrive for active use of the data during the project.
5. If we collaborate with researchers outside of the EU: Data collected from user studies conducted within the EU will be stored within our KU Leuven-associated OneDrive. Other types of shared data will stored through one of the two methods: (1) Stored in our KU Leuven-associated OneDrive and shared via password-protected guest access to our collaborators; (2) Stored in our collaborator's data-base, and saved into our KU Leuven-associated OneDrive at the end of the experiment. Should any collaborations occur during the project, this DMP will be updated accordingly to reflect more specific details.

How is backup of the data provided?

Automatic back-up is ensured by using KU Leuven's OneDrive.

Is there currently sufficient storage & backup capacity during the project? If yes, specify concisely. If no or insufficient storage or backup capacities are available then explain how this will be taken care of.

- Yes

Every KU Leuven employee/student has 2000GB (2TB) of storage space (https://admin.kuleuven.be/icts/english/services/onedrive). Given the nature of our data we do not expect to exceed this storage capacity. In case we still do so, we will extend our capacity by requesting network storage from the systems group at the Department of Computer Science.

What are the expected costs for data storage and back up during the project? How

will these costs be covered?

As stated above, we do not expect extra costs for data storage. In case we need to extend the storage capacity, costs will be covered by the supervisor’s credit and/or the project's resources.

Data security: how will you ensure that the data are securely stored and not accessed or modified by unauthorized persons?

Data will be pseudonymised and stored on encrypted KU Leuven drives. The identification files are being stored externally, which ensures that identification of participants by others than the supervisor and the doctoral student is not possible.

For more details regarding the pseudonymisation process: Participants will be assigned an ID numeric value which will be associated with the data types (questionnaire data, interview recordings, sketches of maps). All identifying information will be deleted. No identifying information will be divulged or used in publications. The numeric ID will be entered when the participant fills in our questionnaires on limesurvey, and will be stored together with the questionnaire answers on our server. Video and audio recording files will be renamed with a file name that includes this ID but no other identifying information. Sketchmaps will be scanned and shredded immediately afterwards. Voice recordings will be transcribed immediately after being recorded then deleted. For participants who wish to stay informed on the outcome of the research, their e-mail address will be gathered in a separate questionnaire, not linked to their ID, at the end of the research. Email addresses will be deleted after the results have been sent out.

6. Data preservation after the FWO project

Which data will be retained for the expected 5 year period after the end of the project? In case only a selection of the data can/will be preserved, clearly state the reasons for this (legal or contractual restrictions, physical preservation issues, ...).

All collected data will be stored for at least 10 years, in order to enable reproducibility, verification, or reuse (https://www.kuleuven.be/rdm/nl/rdm-beleid/basisprincipes-rdm/#principe4). Regarding interviews, due to the sensitive nature of the data, raw audiofiles will be deleted after publication of the article. Moreover, sketchmaps on paper will be scanned and then saved electronically. Once the sketches have been saved electronically, paper data will be destroyed.

Where will the data be archived (= stored for the longer term)?

Collected data will be stored for on KU Leuven's OneDrive for 10 years (with automatic back-up procedures, conforming to the KU Leuven RDM policy), after which they will be deleted. Otherwise, the collected data will be re-evaluated whether it is still necessary to store them.

What are the expected costs for data preservation during the retention period of 5 years? How will the costs be covered?

Storing 1TB on the K-Drive costs approximately 200 Euro per year (https://ppw.kuleuven.be/ppw-dict/dictservicecatalog/access-to-shared-network-drives-and-printers-file-and-print). This storage capacity will be shared with other lab members, leading to (estimated) 30 Euro for data preservation annually (i.e., 150 Euro for the 5- year retention period; 300 Euro for 10 years). Costs will be covered by the supervisor’s credit and/or the project's resources.

7. Data sharing and reuse

Are there any factors restricting or preventing the sharing of (some of) the data (e.g. as defined in an agreement with a 3rd party, legal restrictions)?

- Yes. Specify:

Any data that has yet to be fully pseudonymised cannot be shared (e.g., raw audio files). Regarding the VR application (which is software removed from any personal data), we do not see any 3rd party agreements or legal restrictions that would prevent the sharing of our developed application. If we, however, see potential exploitation of our developed software, we will consider the use of a commerical license.

Which data will be made available after the end of the project?

Pseudonymised data will be shared upon motivated request. The VR application may be released under permissive license, unless exploitation potential prohibits this.

Where/how will the data be made available for reuse?

- In an Open Access repository

1. For participants who wish to stay informed on the outcome of the research, their e-mail address will be gathered in a separate questionnaire, not linked to their ID, at the end of the research. Email addresses will be deleted after the results have been sent out.
2. VR applications may be released via GitLab as open-source.

When will the data be made available?

- Upon publication of the research results

Data and software will be published and released as soon as we see fit and definitely upon publication of the research results. If particular software might have potential for valorisation, we might consider a closed (commercial) license.

Who will be able to access the data and under what conditions?

Access will be considered after a request is submitted explaining the planned reuse. Only uses for research purposes will be allowed and commercial reuse will be excluded. Researchers have to comply with the confidentiality rules for the given data. Pseudonymised data will only be made available upon publication of all results on this part of the data.

What are the expected costs for data sharing? How will the costs be covered?

None

8. Responsibilities

Who will be responsible for data documentation & metadata?

The PhD Student (Jihae Han) and the main supervisor (Adalberto L. Simeone) will be responsible.

Who will be responsible for data storage & back up during the project?

The PhD Student (Jihae Han) and the main supervisor (Adalberto L. Simeone) will be responsible.

Who will be responsible for ensuring data preservation and reuse ?

The PhD Student (Jihae Han) and the main supervisor (Adalberto L. Simeone) will be responsible.

Who bears the end responsibility for updating & implementing this DMP?

The PI bears the end responsibility of updating & implementing this DMP.