LoCoMoTe Dashboard: An Interactive Online Dashboard for the Standardised Categorisation of Natural Walking VR Experiments

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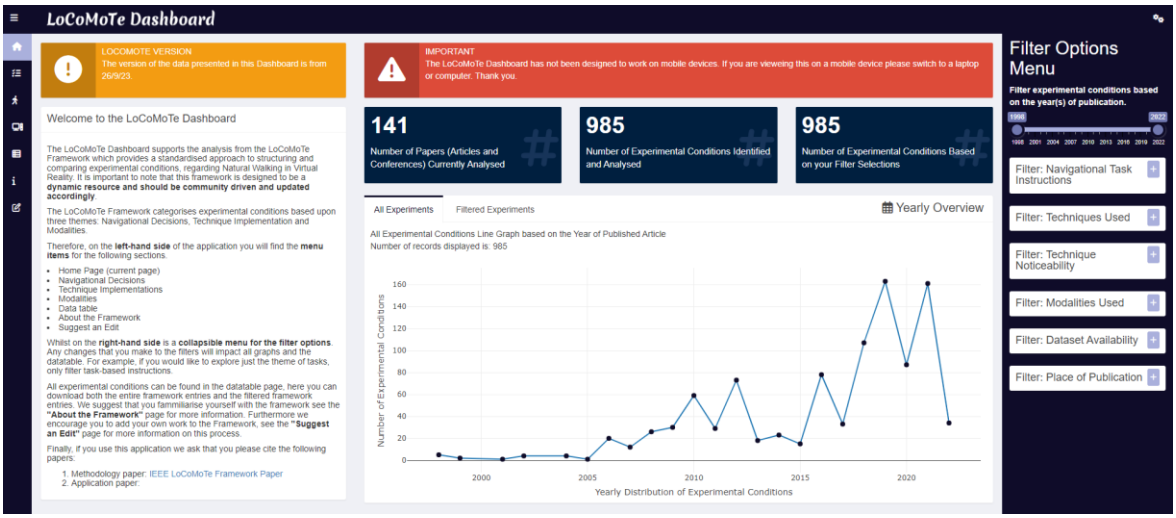

Figure 1: Home page of the LoCoMoTe dashboard.

ABSTRACT

This paper presents the 'LoCoMoTe Dashboard', a new interactive online application of the newly developed 'Locomotion categorisation by Task, Technique, and Modality Framework', referred to as the 'LoCoMoTe Framework'. The LoCoMoTe Framework was developed as a dynamic community-driven resource to give coherence to the virtual reality (VR) locomotion literature by categorising VR-based 'natural walking' experiments, supporting open-science and data sharing where appropriate, but without an accompanying tool; the framework remains static. Therefore, the development of the LoCoMoTe Dashboard facilitates this by providing researchers with a tool to visualise and cross-filter categorised experiments and download the results as CSV files. Additionally, the LoCoMoTe Dashboard documents a procedure on how researchers can suggest edits and add new experiments. Thus, the LoCoMoTe Dashboard facilitates the purpose of the LoCoMoTe Framework, supporting the vision for a more collaborative, knowledge-sharing, and reproducible research community.

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Index Terms: Human-Computer Interaction, Navigation, Redirected Walking, Virtual Reality

1 STATEMENT OF NEED

Research often sets out to answer a particular question; therefore, for all researchers, it is necessary to understand where their planned research sits within the literature. A researcher may conduct a systematic review, meta-analysis, narrative review or scoping review, each approach with its pros and cons [1]. Nevertheless, obtaining relevant resources takes time and effort and can result in missing relevant papers [2]. Therefore, to aid this research process, the newly developed '*LoCoMoTe Framework*' was created [3]. The LoCoMoTe Framework was developed to provide ongoing coherence and structure to the VR-based natural walking literature by categorising the methodologies behind research experiments into three themes: '*navigational decisions*', '*technique implementation*' and '*modalities*' [3].

The theme, '*navigational decisions*', accounts for task-based instructions given to participants during experiments and how these instructions relate to participants' opportunities to make navigational decisions. The task-based instructions are then assigned a categorical value that can describe relationships between instructions such as '*path following*' or '*finding specific items*'. The theme '*technique implementation*' denotes a technique used in an experiment, such as rotational gains and whether participants may be made aware of these techniques. For example, '*gain-based*' locomotion techniques that are used alongside research methods such as two-alternative forced choice tasks. The last theme, '*modalities*', accounts for equipment and other

information, such as using controllers and avatars in experiments [3]. With these thematic categorisations, a researcher may identify experiments with various research attributes of interest.

However, the current problem with the LoCoMoTe framework is that each categorised experiment is in an article format and is thus static. Having only a static repository does not support the long-term aim of the LoCoMoTe Framework, which is to be a dynamic community-driven resource that supports the ongoing structure and the comparison of VR-based natural walking experiments, further encouraging open science and data sharing where appropriate [3]. Furthermore, the current experimental categorisations are in a pdf format, presenting challenges regarding the identification, selection and comparison of experiments and the general scalability of the framework. Consequently, to better support the aim of the LoCoMoTe Framework, there needs to be an interactive tool that researchers can use to explore and view this information; the creation of a dashboard can achieve this [4].

2 User Needs, Design and Interactivity

To translate the information from the LoCoMoTe Framework into the LoCoMoTe Dashboard (Fig. 1), we used R version 4.2.2 [5], with various additional R packages [6], [7], [8], [9], [10], [11], [12], [13], [14], [15], [16], [17] [18]. The LoCoMoTe Dashboard has been developed for computer screens, has an overflow structure and contains a responsive web design that auto-scales the content. The pages in the LoCoMoTe Dashboard are: '*Home*', '*Navigational Decisions*', '*Technique Implementation*', '*Modalities*', '*Data Table*', '*About the Dashboard*', and '*Suggest an Edit*'.

The '*About the Dashboard*' page provides relevant information for individuals unfamiliar with the LoCoMoTe Framework and Dashboard and provides a web link for the LoCoMoTe Framework methodology paper. Additionally, on each page, there is simple, relevant information. For example, on the '*navigational decisions'* page, there is textual information regarding the categorical system in this theme from the LoCoMoTe Framework.

2.1 Functionality: Cross-Filter System

Initially, researchers are presented with all categorised experiments. However, a researcher can quickly identify relevant literature using the cross-filter functionality in collapsible boxes and sliders to customise their search parameters (Fig. 1). For example, research published between 2020-2024 used rotational gains and some form of audio information. Filter options relate directly to the themes of the LoCoMoTe Framework and introduce '*yearly'*, '*datasets'*, and '*place of publication*' filters that are anticipated researcher needs.

Each filter box contains subcategories; for example, when the '*Navigational Task Instructions*' filter box is expanded, researchers can see many different task-based instructions, such as '*path following*' or '*finding specific items*'. Researchers can edit the filters by deleting individual options and re-adding options by simply clicking.

2.2 Functionality: Interactive Graphs and Data Table

A researcher's selected filter options correspond to the data used to generate both the interactive graphs and the data table, which are updated accordingly. The data table provided to the researchers contains an additional search bar and options to show how many results appear on one page. Next to the data table, researchers can download their filtered experimental conditions and the entire data as CSV files. The downloaded CSV files also contain links to the relevant publications.

The interactive graphs enable researchers to visualise the distribution of experiments corresponding to the subcategories and themes from the LoCoMoTe Framework and are supported by the Plotly package [13]. Researchers can hover over areas of the graphs to read the corresponding number of experimental conditions within a subcategory, along with zoom functionality and the ability to download the graphs as PNG files.

For an example of the filter system, interactive graphs, and data table in the LoCoMoTe Dashboard (data_version_29/9/23), we refer the reader to our supplementary material for a short video.

3 Long-term Software Plan

The current plan at the time of this publication for maintenance of the LoCoMoTe dashboard, regarding the addition of future experiments, bug fixes and updates, is that the first author of this paper will act as the '*moderator'* of the LoCoMoTe dashboard. The role of the moderator is to assist and advise other researchers on categorising their experiments according to the LoCoMoTe Framework or amend categorised experiments and then ensure the dashboard is updated accordingly with a version number (based on the date the data is updated).

Furthermore, as explained in the frequently asked questions box on the '*suggest an edit*' page of the LoCoMoTe dashboard. Other researchers can assist with this maintenance process and future feature design. To become involved in the process, researchers will need to contact the moderator of the dashboard for further discussions.

Additionally, to account for errors with broken links to servers and old email addresses, all project files and a link to the current server can be found at our OSF repository: https://osf.io/p6xs7/.

3.1 Categorisation of New Experiments

Researchers cannot directly add new experiments to the LoCoMoTe Dashboard due to the maintenance and moderation procedures, and researchers are informed of this on the '*suggest an edit'* page. However, researchers are encouraged to categorise their VR-based experiments, which the moderator can then add to the LoCoMoTe Dashboard. To aid this process, the LoCoMoTe Dashboard provides researchers with all the information they need on the '*suggest an edit*' page, including a frequently asked questions section. If a researcher has additional questions, they are advised to email the moderator.

To aid researchers with the categorisation process, they are instructed to download the supplied pdf guide, which contains an overview of the themes from the LoCoMoTe Framework with corresponding examples. Additionally, researchers must download a template document to help structure their categorised experiments. The template document contains an example and a matching blank grid. Once the template has been completed, researchers are advised to email this to the moderator of the LoCoMoTe Dashboard so that the dashboard data can be amended.

4 Summary

In summary, the themes of the LoCoMoTe Framework are translated into the LoCoMoTe Dashboard with cross-filter functionality, dynamic interactive plots, and downloadable data tables. Researchers using the LoCoMoTe Dashboard can easily compare VR natural walking experiments and identify research trends and gaps to support a more collaborative, knowledge-sharing, and reproducible research community.

Author Contributions

Charlotte Croucher: Software, Writing – Original Draft and Editing, Visualization **Wendy Powell**: Supervision, Writing –

Review and Editing **Travis J. Wiltshire**: Supervision, Writing – Review and Editing **Pieter Spronck**: Supervision, Writing – Review and Editing.

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