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Issues of a Map interface with SVI imagery in a Smart Campus Context

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Abstract:
The "Smart Cities" concepts have been adapted to several environments, to bring technology usage at infrastructure, planning, management, and people levels, in specific geographic space and time. UCM – University Campus Map [1] - is a smart campus initiative developed by Paraná Federal University, which provides geographic information – indoor and outdoor – applied to university campus usage. Data from UCM become an official university base map, considering several contexts of use and diverse necessities, from several actors. Also, the project supplies map interfaces that take into account navigational, querying, visualization, and interaction with all different environments from the University resources and facilities.

Cartographic products associated with UCM such as interactive 3D and 2D maps, street view (SV) based maps, and egocentric perspective maps, can represent large volumes and types of data, including the provision of data incorporation coming from sensors and those collected from collaboration (VGI data) or gathered from social media. Recently, Street View imagery (SVI) data became popular form of a navigational and ground-level data source [3]. With a level of detail similar to virtual environments, it is possible to integrate photographic information with map perspective, creating an interactive display that offers some degree of immersion. There is potential to integrate powerful map interfaces, together with 2D interactive maps, for spatial awareness and navigational tasks. Although studies with SVI data are common and have many applications [3][4], their use is yet to be more understood, especially from the point of view of interface usability, cartography, and potential contexts of navigation and other utilization.

The Federal University of Amazonas (UFAM) is a collaborating partner in the UCM project, situated in the Brazilian Amazon. The university's primary campus, spanning over 650 hectares of natural terrain, is located in Manaus (AM), within a protected area and comprises a rainforest fragment, comprising approximately 20% of constructed buildings and facilities. The campus witnesses a daily footfall of nearly 15,000 individuals, including both internal and external stakeholders. With over 20 river sources, 12 water streams, and 29 forest trails, UFAM conducts several scientific research initiatives in biology, forest engineering, environmental conservation, and other fields such as health, physical education, urbanism, and tourism. The university's campus also experiences social pressure from neighboring communities, posing regular concerns regarding security, transportation, and general management. Given the scale and diversity of usage and interest in conservation, mapping the study area is a challenging task. We believe that the map interfaces and database solutions provided by UCM would be invaluable to the community and the managers. This research, as a mapping study, specifically focuses on aiding the university audience and users in navigating the campus's indoor and outdoor environments. As suggested by the survey on user requirements, this context is essential as the project seeks to identify potential community products, technologies, and procedures.

This research proposes an experimental study to provide insights into the usage and interaction of an SVI + map interface, primarily concerning locating real-world features and navigation within the university context. The qualitative map study design seeks to address the following research questions: 1) Does the audience exhibit an interest in such an interface? 2) Is it feasible and attractive for users? 3) What potential issues may arise? 4) What are the implications of using SV imagery compared to conventional map apps and webmaps in terms of learnability and usability? The research focuses on office-based tasks, primarily related to planning routes. The ongoing work addresses in-situ navigation and its associated challenges. Moreover, users are currently being recruited for a quantitative analysis to assess the performance and accuracy of the interface, considering desirable positioning, routing, and landmarks' memorability.

We provided a simple interface with SVI (the open-source *mapillary* frame) dividing the screen with a traditional *OpenStreetMap* frame, linked by a point symbol. Users had to accomplish tasks representing common usage from the perspective of student and campus service providers, with low to high familiarity with the area. One task example was

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"You need to be at the 'Rio Amazonas' Conference Room, from the main campus entrance. How would you describe your route and reference points to get there?" Current data logging consisted of a cam focusing on the map display and user's hands, together with sound recording and a guided observation form, filled by us. After users completed the task or 25 minutes passed by, we asked them to fulfill a questionnaire, including questions about reference points and general feelings of performance and effort. Users remained seated during the test and were encouraged to speak about what they are experiencing – a think-aloud protocol – with a 5 minutes previous explanation, simulation, and training.

UFAM Campus has two main sectors (north and south), which are about 5km away, so tests were carried out in two different contexts: First, a test taken with audience planning routes to a different campus sector – i.e. you are in the north and should navigate to the south, find the room named "X"; second, a test taken with participants that hadn't been at the university at all. We also used two different displays, one with an Apple Ipad 9,7 in. display and the other with a 21' LCD monitor with a mouse and a keyboard. Finally, we divided groups of users: the group who interacted with an SVI + map; the other group using a "traditional" *OpenStreetMap* interface, with rooms and facilities identified as toponyms. In the guided form and data logging, we observed mobile and desktop acceptance and usability, identifying and talking about reference points, usage of navigation tools, interaction gestures, user's strategies, and any problems.

The present study aimed to investigate the usability of an SVI + map interface for real-world feature localization and navigation in a university context. It was conducted through a qualitative approach, and preliminary results have been obtained. The identified issues are outlined below: 1) Differences between the desktop and mobile interfaces were observed, mainly in the forms of interaction, with the use of a mouse producing fewer errors in clicking and enabling more fluid interaction with buttons and other functions compared to the use of touch gestures in iPad. 2) Difficulty in finding references when unfamiliar with the real environment was noted. Non-familiar users took more time observing SV imagery than the 2D map, seeking reference points to use. The integration between navigation on the 2D map and SVI was difficult to maintain due to the loss of reference between the images and the absence of navigation buttons in some points, possibly due to insufficient images in the base. 3) Difficulty in maintaining orientation when dealing with SV imagery was noted, which was caused by misalignment or the lack of points of interest, such as classroom name plates.4) Difficulty in integrating data from different floors in indoor buildings was observed, as the sequence of SV images was impaired in some environments, with navigation continuing on the floor immediately below or above. 5) There was a significant difference in the level of detail among users, depending on the type of interface used. Some users only used left-to-right conversions to describe routes and found the place using the traditional map, but did not notice barriers in the route or the impossibility of their plan in real-world navigation. Other users who used SVI + map identified more reference points but were slower and had a greater sense of failure. 6) Most of the users had not previously used an SVI + map to navigate or plan navigation, but expressed interest in using it. Even those who had not successfully found the proposed room or reference points expressed a desire to use it more.

Together with in-situ test results, we expect to obtain a solid base of how real users use the SVI interface in navigation tasks. In addition, to obtain guidelines for designing the Campus Map interface integrated with SVI data from "Mapillary", especially about the need to insert landmark symbols and considerations about other than interface aspects – like 3D positioning accuracy, image orientation, or imagery updating. Our study will generate some recommendations for the map interface itself in addition to the current webgis [6], in aspects such as symbology, continuity, scale, and perspective, but also to specific SVI issues, such as the need for better integration between the interface views. Thus, it will be possible to identify aspects of interest for the usability and attractiveness common to SVI interfaces, considering the performance of users in common navigation tasks in a smart campus environment.

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