Augmented Geology Field Trips
Master 2 Internship

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Internship period: starting in March/April 2024, 5 or 6 months duration.
Supervisors: Vanessa Peña-Araya and Emmanuel Pietriga.
Location: ILDA, Université Paris-Saclay, building 660.

Context

Before going to the field, geologists need to study the place they are going to. This initial recognition phase requires to understand both the physical characteristics of the place as much as the literature that have previously studied it. Once they have a sense of what they are interested in searching for and where, they go to the field to extract and collect soil samples. These samples are later analyzed in order to link them to a geographical and historical event.

For example, let's consider Tephrochronology, a discipline of Earth Sciences that analyzes samples of volcanic eruptions in order to reconstruct the volcanic history of a place. When going to the field, Tephrochronologists extract soil samples in places close to certain volcanoes. They later analyze these samples to extract information such as their geo-chemical composition and age with specialized machines. To associate the sample to a volcanic eruption, they correlate the extracted information of a new sample with previous analyzed samples published in the literature.

An important problem in this process is that information is disconnected between steps, making the process hard to conduct. On the one hand, geologists in the field usually do not have access to the analysis they conducted before going to the place. Furthermore, even if they have tablets to see the data in static forms (e.g. the PDF of a published paper) it is hard to make interactive queries adapted to new hypotheses formulated in the place itself. On the other hand, any notes they take in the field are not well integrated to that analysis later.

Internship goal:

The goal of this internship is to explore ways to use augmented reality to give situated information to geologists in addition to support for note taking in the field. To achieve this goal, we need to consider several aspects: how to represent data of past analysis, how to query for particular subsets of this data, how to input information about the new samples collected, how to link new data to samples previously published in the literature when formulating new hypotheses, etc. These questions span a broad range of topics, including: the study of visual perception in outdoor augmented reality; the design of situated visualizations [2, 4] that are properly registered with the physical environment; the design of effective interaction techniques, either free-hand or supported by appropriate handheld devices such as smartphones and tablets [1, 3] to query & visualize data as well as input new data on the fly.

It won't be possible to cover all the topics above in only one internship as they are limited to have a duration between 5 or 6 months. Therefore, the specific topic and research question to explore will be refined with the candidate based on their interest.

Work plan:

Regardless of the chosen topic, the overall work of the internship will be divided in four main tasks:

1. Review relevant literature in situated visualization and augmented reality.
2. Design initial prototypes and assess their feasibility.
3. Implement a set of those initial prototypes.
4. Evaluate prototypes of the new designs in a user study.

Requirements for Applicants: Basics of Information Visualization and HCI, in addition to user evaluation and prototyping methods. Knowledge of programming in Unity or WebXR is a big plus.

References

[1] Brasier, E., Pietriga, E., and Appert, C. Ar-enhanced widgets for smartphone-centric interaction. In *Proceedings of the 23rd International Conference on Human-Computer Interaction with Mobile Devices and Services* (2021), MobileHCI '21, ACM.

[2] Bressa, N., Korsgaard, H., Tabard, A., Houben, S., and Vermeulen, J. What's the situation with situated visualization? a survey and perspectives on situatedness. *IEEE Transactions on Visualization and Computer Graphics 28*, 1 (2022), 107–117.

[3] Di Gioia, F. R., Brasier, E., Pietriga, E., and Appert, C. Investigating the use of ar glasses for content annotation on mobile devices. *Proc. ACM Hum.-Comput. Interact. 6*, ISS (nov 2022).

[4] Lee, B., Sedlmair, M., and Schmalstieg, D. Design patterns for situated visualization in augmented reality. *IEEE Transactions on Visualization and Computer Graphics* (2023), 1–12.