A Mobile App Supporting Field Trip Organization for Natural and Cultural Heritage Exploration

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ABSTRACT

Mobile tourist guides have great potential to promote Cultural and Natural Heritage but usually do this from a narrow perspective, such as a single exhibition or museum, failing to provide users with an integrated viewpoint of the resources available in a geographical area. The organization of tourist plans might thus be challenging because of the many information sources to be consulted. Current tourist guides also limit users' freedom in building custom trips because they almost fully control the itinerary generation process. Moreover, they fail to recognize that cultural and scientific tours might include both the visit to places and the execution of activities aimed at deepening people's experience through experimental work. This is a limitation, especially for the learning field, which recognizes the importance of practical activities in strengthening students' knowledge and understanding.

To address this issue, we developed the FieldTripOrganizer application as a model to create mobile tourist guides that support the design of plans suitable for cultural/scientific tourism. FieldTripOrganizer empowers users to design a trip by helping them select Points of Interest and activities that are relevant to the interests and knowledge background of the people who will participate in the tour. Moreover, it simultaneously provides information filtering, automated scheduling, and user-awareness support to let users compose the itinerary from scratch while being informed about the feasibility of the options that can be included without violating its time constraints. We exploited FieldTripOrganizer to present the Cultural and Natural resources provided by the Geodidalab scientific laboratory located in the area of Ivrea (Piedmont, Italy).

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CCS CONCEPTS

• **Information systems** → *Web searching and information discovery*; *Recommender systems*; • **Human-centered computing** → *Interaction techniques.*

KEYWORDS

Field Trip Organization, Natural Heritage, Cultural Heritage

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1 INTRODUCTION

Promoting geological, natural, and cultural heritage is crucial for increasing public awareness of the relevance of the sciences in everyday life [27, 33]. Specifically, to achieve sustainable usage of the land and provide economic support to local communities, it is essential to find new ways to communicate the values of Natural and Cultural Heritage [18].

The increasing diffusion of mobile tourist guides can dramatically enhance the promotion of this heritage in a territory by making information accessible at a low cost through the Internet. However, these guides limit the potential of exploration because they are either specific to a single site (and thus fail to provide a unified view of what is available in a geographical region), or they model resources as generic Points of Interest (PoIs) to be visited; e.g., see Roadtrippers[1], and wanderlog[2]. Indeed, the itineraries that support a rich exploration of territory have as a key aspect the execution of activities and possibly experiments supporting a deeper understanding of natural phenomena. Thus, similar to what is done on

[1]https://roadtrippers.com/
[2]https://wanderlog.com/

the websites of specific cultural places, PoIs have to be modeled as complex entities that might include cultural and scientific activities to be carried out.

As part of the OPENALPLAB project[3], we are conducting research on the development of a web app that provides active educational support for preschool, elementary and secondary school, and universities with a specific focus on Piedmont (Piemonte), a region in the North-West of Italy. We propose the FieldTripOrganizer application as a model for the development of tourist guides that provide an effective, integrated view of Cultural and Natural Heritage, supporting both the visit to places and the planning of cultural and scientific activities while traveling. The flexibility of this application is based on:

- A semantic representation that supports the specification of PoIs as complex entities that can offer different types of activities.
- The provision of filters supporting the selection of the domains of interest of PoIs, and activities (to distinguish, e.g., historical or archaeological places from natural, petrographic or glaciological ones), and of the school level required by the activities (for everybody, starting from primary or secondary school, and so forth).
- An itinerary generation service that supports the incremental design of a schedule satisfying the specified time constraints, while being constantly aware of which PoIs and activities can be selected without exceeding the time limits of the tour.

By offering these functions, the mobile guide becomes a digital companion that helps the user (i) find interesting items to be included in the itinerary, and (ii) design a schedule that is consistent with the overall constraints of the tour. Our application is suitable to support teachers in the organization of field trips for student classes, but also families and other tourist groups, who can consult the mobile app to autonomously design the tours.

In the following, Section 2 relates our work to out-of-school learning and field trips. Section 3 positions it in the related work about tourist guides. Section 4 describes the OPENALPLAB project and Section 5 presents FieldTripOrganizer. Section 6 discusses how the application might be improved by enhancing its capability to adapt to the individual user, or to the tourist group that the user represents. Section 8 discusses our future work and concludes the paper.

2 FIELD TRIPS

While FieldTripOrganizer can help different types of users in the design of tourist plans, its capability to integrate cultural visits and the execution of activities within an itinerary makes it particularly suitable to support teachers in planning field trips for their student classes. This is relevant to all school levels but privileges the organization of didactic activities for young students, who can particularly benefit from field trips and out-of-school learning.

A lot of research has focused over the years on students' understanding and learning of scientific phenomena: [10] highlights that knowledge of natural environments in early childhood education has particular relevance for people's future academic education. Young children develop ideas about their environment based on their everyday experiences [9, 22]. They are intrinsically interested and motivated to explore and enjoy the environment [12, 30], at the point that they have been described as "natural" scientists [34]. Many studies showed that scientific content related to processes underlying biological and physical phenomena is highly attractive to children at an early age because they are biologically prepared to learn about their environment [10].

To effectively learn a scientific subject, visiting natural environments and performing field experiments are very important. In particular, *nature field trips* have been shown to be a valuable tool for learning science [8, 26, 31]. These are pedagogical experiences with three key features: they happen outside the classroom, they have an educational objective, and they create practical activities and experiences for the students [15]. Nature field trips are an exceptional pedagogical tool for science learning, compared to traditional teaching, as they provide a multisensory environment where to connect abstract content developed in the classroom with the real world, improving the understanding of knowledge and producing strong long-term memories.

3 TOURIST GUIDES

The research about mobile tourist guides developed several location-based hypertext models that take the user's preferences into account to support the exploration of information. For instance, GUIDE [5] exploited individual user profiles to present PoIs. PIL [19] advanced hypertext with multimedia content preparation and ubiquitous user modeling to personalize the visit and content presentation. OnToMap [23] enhanced the presentation of information about a geographical region through faceted information search. Braunhofer and Ricci [2] extended mobile guides to take the user's context into account. Other works investigated the adoption of personalization strategies to improve advanced user interfaces for Cultural Heritage exploration [1, 7]. All these applications offer advanced and personalized support for information exploration but most of them fail to support itinerary scheduling, which is a key feature of our work. Moreover, they overlook the possibility to carry out activities within the PoIs, which is particularly relevant for Natural Heritage exploration but can be relevant to other types of visits, such as, e.g., arts or history-related ones.

Tourist trip planners manage the temporal aspects of travel plans but, different from our work, they fail to support the user in the autonomous design of such plans. Specifically, these systems generate optimized itineraries based on the acquisition of user preferences concerning location, budget, travel dates, and categories of places to be visited [11, 20]. Moreover, recent tour planners personalize the travel plans by analyzing other tourists' past behavior and/or the popularity of places [4, 6, 17], or building an individual user profile that describes the user's traveling behavior, as in PersTour [21]. Context-aware tourist recommender systems take both preferences and rich context parameters, such as the user's mood into account [2, 3]. Some systems use information extracted from Location-Based Social Networks for personalization [28], and other ones apply techniques to nudge people towards sustainable tourism [24]. Finally, some systems enable the user to criticize the proposed solutions or to modify them by adding/removing places, as in the case of

[3]https://openalplab.unito.it/

City Trip Planner [32], but they do not support her/him in the incremental creation of the tour plan.

Analogously, most current commercial trip planners fail to support the collaborative design of tour plans because they present ready-made solutions. Only in some cases, as in wanderlog[4], the user has full control of the selection of PoIs but (s)he is also responsible for scheduling the itinerary because the system does not offer this function. In comparison, we aim to empower the user to actively build the tourist plan considering both the visits to places and the execution of activities during the tour.

4 INTEGRATING THE FRUITION OF CULTURAL AND NATURAL HERITAGE

4.1 Background

The geodiversity of the Piedmont region materializes in some sites having high scientific, educational, and touristic value. The sites where this geoheritage is preserved (geosites) therefore have both public and private interests. They are subjects of research, content for educational activities, and destinations for geotourism proposals. They can also become targets for projects of geoconservation, economic valorization, sustainable management, and conscious usage. In this context, some of the authors of this paper developed the ProgeoPiemonte [13] and GeoDIVE [14] projects, which focus on scientific education and communication touching on the following aspects:

- PROGRESS IN THE SCIENTIFIC KNOWLEDGE – Specialized research groups collaborate to increase scientific knowledge about the geological history of Piedmont, climate and environmental changes, natural hazards, land use, and georesources.
- LAND DEVELOPMENT, EDUCATION, AND COMMUNICATION – The knowledge is not only shown through the geological sites, but also through the development of museum collections, exhibitions, and nature trails designed to promote geological tourism in Piedmont. The projects involve the development of techniques for the visual representation of the geological processes and the setting up of experimental projects with schools, which will allow the preparation of educational tools useful for spreading Earth Science knowledge.
- COLLABORATION WITH THE LOCAL COMMUNITIES – All activities are carried out in collaboration with qualified local partners to clarify the needs of local asset management. The economic assessment of geodiversity at the local and regional scale will allow the production of guidelines for the geoconservation and the integrated management of Piedmont's geological heritage.

4.2 The OPENALPLAB Project

OPENALPLAB focuses on field trip creation and management by means of a dedicated web app. This project aims at developing and disseminating knowledge to the general public. Specifically, it focuses on the areas where the Mosso Institute (Cimalegna plateau, Monte Rosa, Valle d'Aosta) and the Geodidalab educational laboratory (Lago San Michele, Ivrea) are located. These areas are easily accessible and heavily frequented but are subject to different issues. They are strongly related to the surrounding territory and offer numerous and diversified ecosystem services, provided their natural balance is not compromised by anthropic factors. The Mosso Institute was established on the Cimalegna plateau in 1907 for physiological studies at high altitudes. It was then upgraded by a Geophysical Observatory in 1927 and, later, by the Snow and Alpine Soils Laboratory. The GeoDidaLab established at the "Polveriera" park on Lake San Michele, is an environmental education and research laboratory now directed by the Department of Earth Sciences, University of Turin (Italy). In the GeoDidaLab, students are involved in a variety of indoor and outdoor educational experiences, mainly realized using recycled and/or recyclable materials. To improve the use of these areas, we are working to create a network of researchers, administrators, and local stakeholders who can share a multidisciplinary knowledge framework, with a perspective of dissemination and public engagement aimed at environmental protection. In this context, OPENALPLAB becomes an effective tool to generate positive economic and cultural impacts, both direct (self-financing of educational and tourist services) and indirect (promotion of employment induced by environmental resources, development of geotourism, and environmental education).

[4]https://wanderlog.com/

5 THE FIELDTRIPORGANIZER APPLICATION

Within the OPENALPLAB project, we developed the FieldTripOrganizer app, which supports the design and booking of travel itineraries from mobile phones, tablets, and laptop devices. The current instance of the app is configured to present Cultural and Natural Heritage information about the geographical area around Ivrea but the knowledge base of the system can be extended to cover other geographical areas.

5.1 Itinerary Design

In the first step of the interaction with the user, the application elicits the time constraints of the tour, which are used to support the selection of items that can be included in the itinerary without violating any time constraints.

An important feature of our system is that, while the user builds the itinerary, it continuously keeps her/him aware of the spare time for adding further items without exceeding the maximum duration of the tour. The system estimates this information by invoking a scheduling service that optimizes the partial itinerary and shows the spare time in the top-left portion of the user interface; see component "Tempo a disposizione rimanente" (letter A) of Figure 1.

In the left portion of the user interface, FieldTripOrganizer shows a set of filters that enable the user to focus on the types of items that are relevant to the tour. The filters enable the user to select: the geographical area of interest (letter B - "Seleziona un'area"), the domains of interest of PoIs and activities (letter C - "Interessi luoghi", e.g., historical, natural, archaeological, etc.), the school level of the activities (letter D - "Difficoltà attività", e.g. for everybody, from primary school up, etc.), and by type (letter E - "Tipologia attività", i.e., indoors or outdoors). This supports dynamic filtering [29]; the

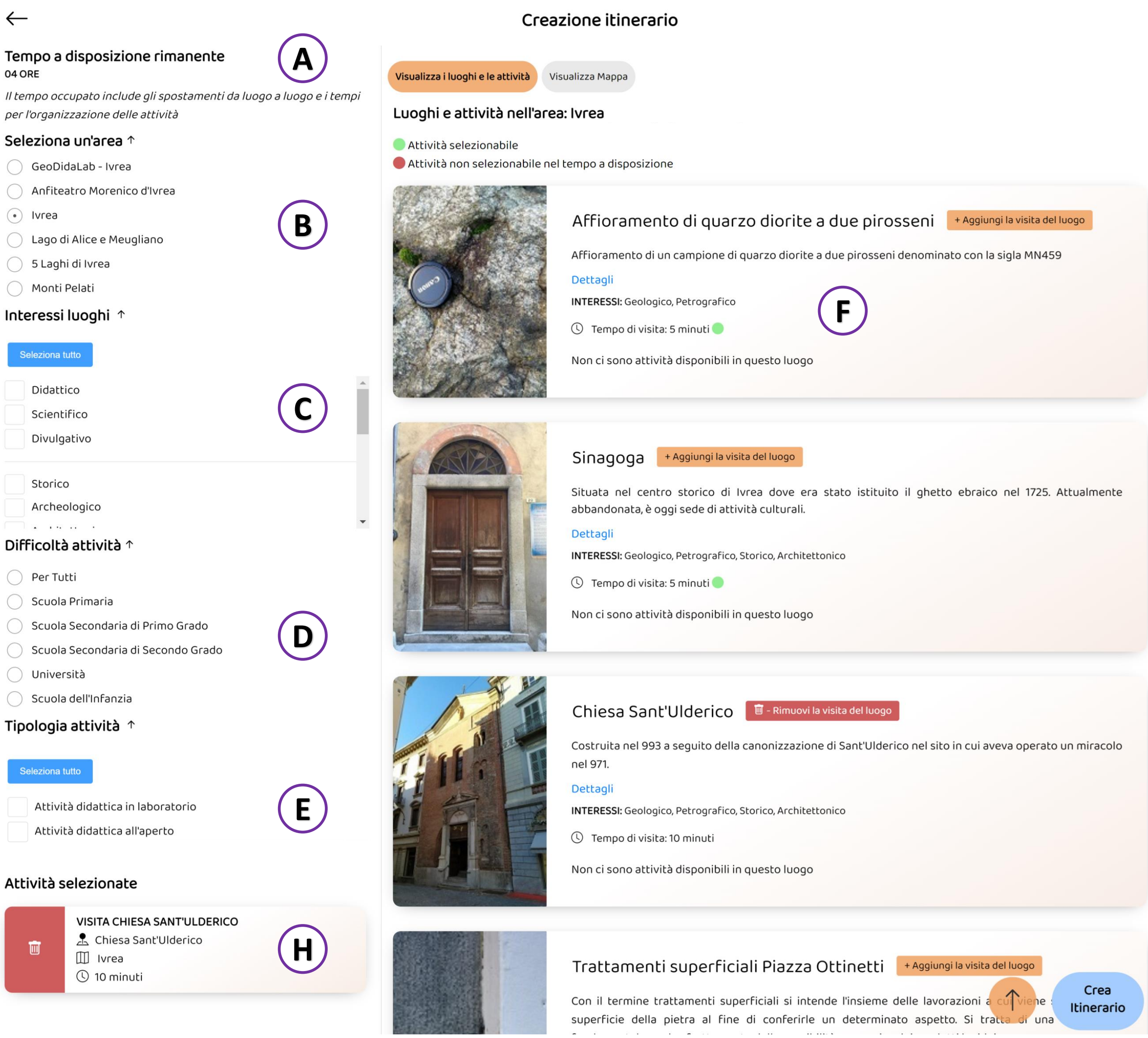

Figure 1: User interface to select the items of the field trip. Layout for a tablet or laptop.

right portion of the page shows the list of PoIs and activities that satisfy the user's selections (letter F).

The presentation of the PoIs and activities that satisfy the filters applied by the user is organized by using the PoIs as pivots: if a PoI offers any activities, the system lists them within the widget that describes it, as in Figure 2 (letter G). The key feature is the visual annotation of items with semaphores that inform the user about the feasibility of visits and activities within the partial itinerary. As shown in the figure, for each item the application shows:

- the title of the item;
- its expected duration, and a green (or red) semaphore that specifies whether it can be safely added to the itinerary or not;
- if the item is an activity, which the school level is required to carry it out;
- the domains of interest of the item;
- a button ("Più dettagli") to view more information about it;
- on the right, each item has an orange button ("Aggiungi attività") to add it to the itinerary, or to remove it from the itinerary after having included it.

The traffic lights next to the duration of the items are aimed at preventing the user from breaking the time constraints by selecting an activity, or a PoI, that takes too much to be reached from the places of the partial itinerary or has an excessive duration.

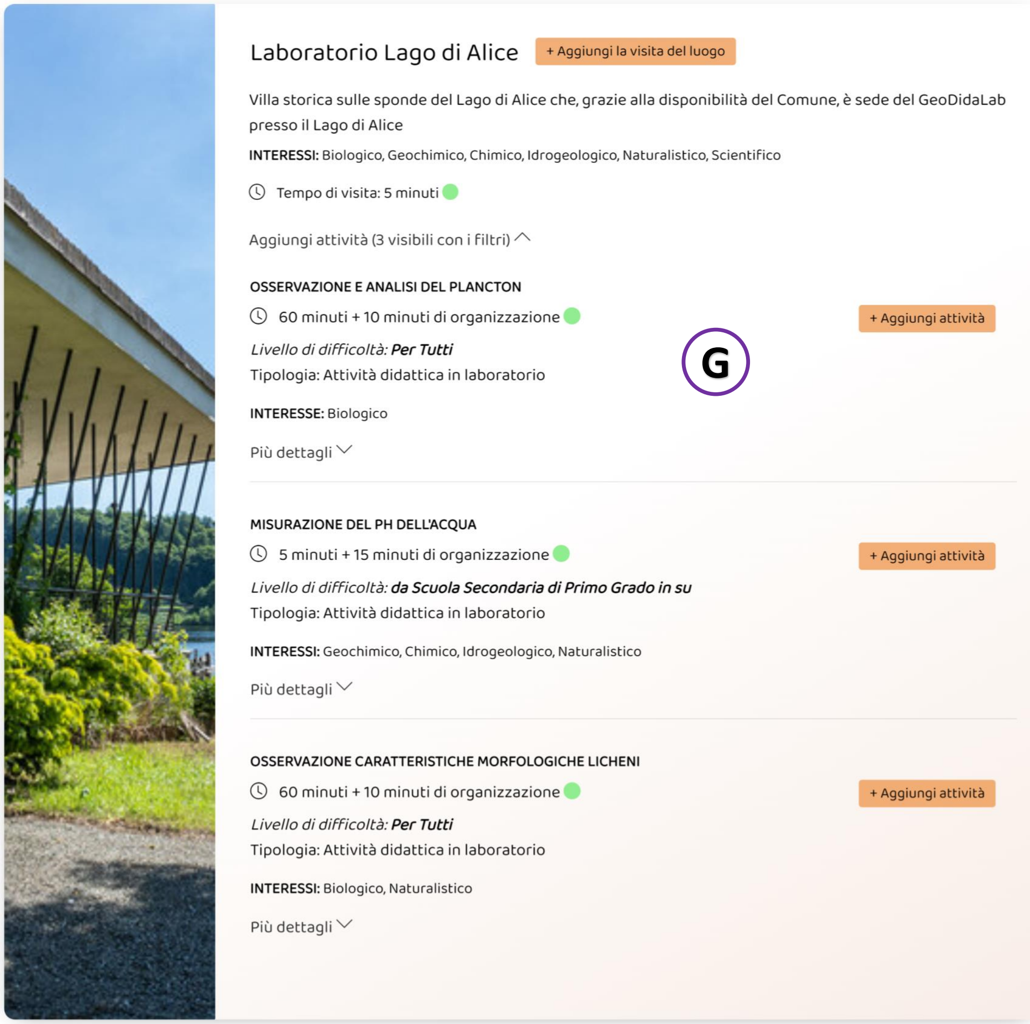

Figure 2: Visualization of the activities offered by a Point of Interest (Lago di Alice, a lake). Layout for a tablet or laptop.

5.2 Finalization of the Itinerary

The user can iteratively revise the itinerary that, during this phase, is shown as a list of activities (letter H). When (s)he finalizes it, the application refreshes the user interface as in Figure 3. The visualization reports its overall time span (letter I) and the presentation of its schedule (letter L), as computed by the internal itinerary generator. The schedule is presented both in a geographical map (right portion of the user interface) and as a sorted list of items that includes a card for each PoI or activity (cards are interactive and can be clicked to receive details about items). If two adjacent cards describe different places, in the itinerary they are separated by the displacement time. For instance, the itinerary in Figure 3 includes a 10 minutes transfer from the place of the first item to that of the second one.

The system enables the user to book the itinerary with the local team that will assist the tourist group during the tour: by clicking the "Prenota itinerario" button in the top-left section of the user interface, it is possible to send an e-mail message to the local team that will respond with the organizational details.

Notice that the current version of FieldTripOrganizer does not support the enactment of the itinerary and the tracking of the activities while they are performed during the field trip. This is part of our future work.

Figure 4 shows the same itinerary as Figure 3 on a mobile phone. In this layout, the map and the items of the itinerary are alternative components that the user can visualize by clicking on buttons "Elenco delle attività" (list of activities) and "Mappa" (map), respectively. Below such buttons, the user interface shows the schedule.

6 THE NEED TO PERSONALIZE

The current model underlying FieldTripOrganizer supports information filtering and automated scheduling to enhance the interaction with the user. However, other aspects concerning the user interface, and the functions it offers, might be improved by extending the

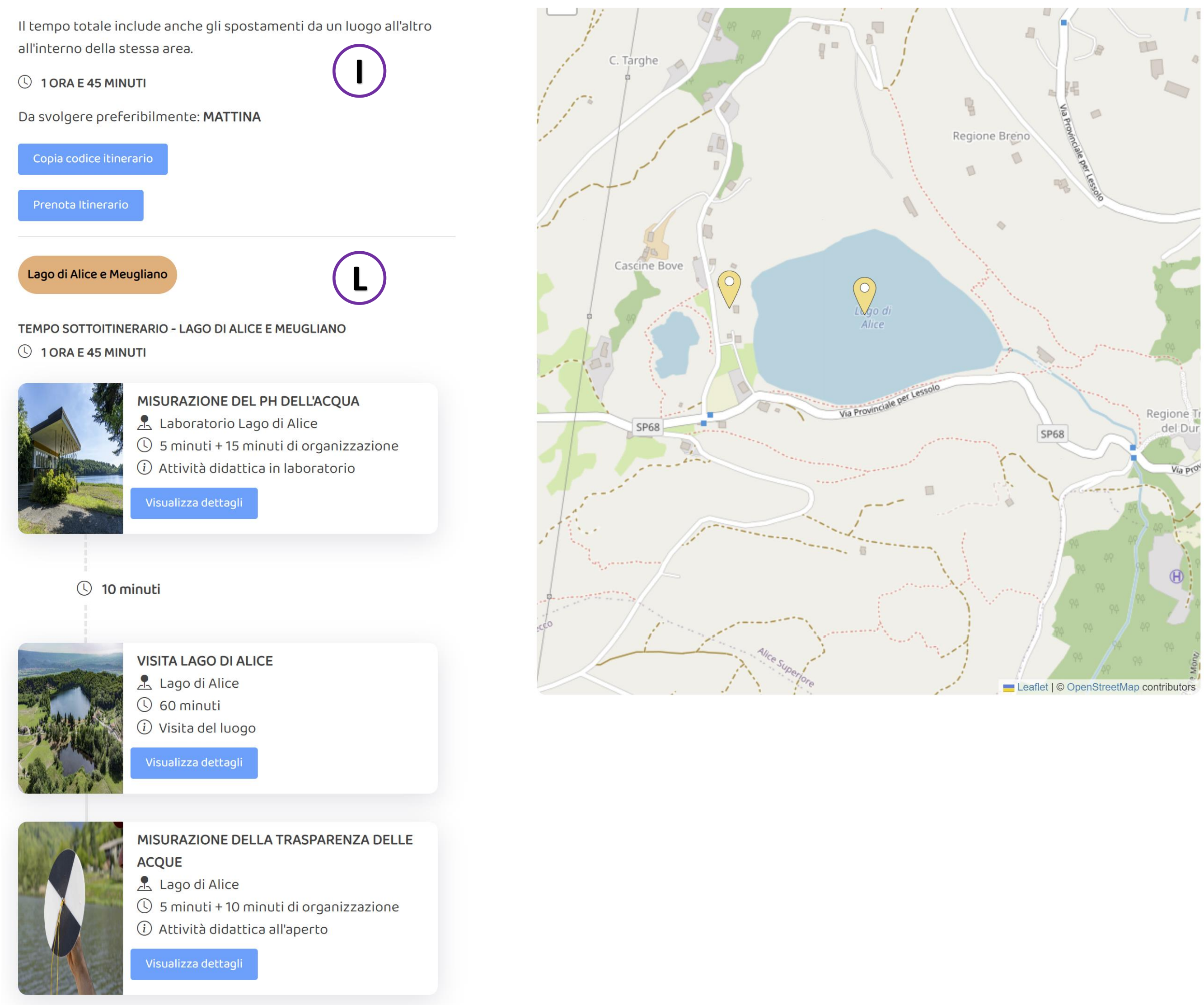

Figure 3: Visualization of an itinerary on a tablet or laptop. By clicking on an item in the itinerary, the corresponding pin becomes highlighted - not shown in the figure.

application with personalization techniques. In the following, we briefly report them:

- The first aspect concerns the presentation style, which is currently based on the one-size-for-all model. To improve the user interface, we might consider the adaptation of the item descriptions to the user's domain expertise, either by acquiring details about the user or simply enabling her/him to select the technicality level of the presentation. The current version is mainly targeted to science teachers, and in fact, it presents items using a somehow technical language. Obviously, the introduction of multiple presentation styles is knowledge-intensive and, for the moment, we have supported a minimum tuning of presentation detail by organizing the knowledge about items in two levels, the surface one (which is directly shown in the user interface) and the detailed one, which can be visualized on demand, by clicking on the *more information* links associated with items.
- The second aspect concerns the scheduling of the activities. Currently, the itinerary generator assumes a fixed displacement time between places and this might be a problem because not all the people move at the same speed (e.g., consider a group of small children vs. young adults), or they might need a flexible number of breaks to restore. Moreover, FieldTripOrganizer builds an itinerary that is going to be the

Figure 4: Visualization of an itinerary on a mobile phone.

same for all the members of the tourist group that is going to participate in the tour. This is suitable for student classes up to secondary school and for families with young children. However, it might be limiting for adult tourist groups who might want to separate in some parts of the tour, e.g., to visit different places or carry out different activities, as supported by TourRec [16].

In our future work, we will investigate these aspects that involve both the design phase, during which the user builds the schedule, and the enactment one, to support the visitors' group while they travel and carry out the planned activities.

7 TECHNICAL DETAILS

The architecture of a mobile guide built using FieldTripOrganizer includes three main components:

(1) the FieldTripOrganizer shell that manages the interaction with the user;
(2) a content management system (Omeka-S[5]) storing the data presented by the mobile guide;
(3) the itinerary generation service supporting interactive scheduling.

During the interaction with the user, the shell queries the content management system through APIs to retrieve the information about places and activities to be shown in the user interface of the mobile guide. Moreover, it queries the itinerary generator to retrieve scheduling information.

As a building block for the design and development of FieldTripOrganizer, we specified the structure of items (PoIs and activities) and itineraries by developing an OWL-S [25] ontology defining the main concepts and the relations among them. We then used this ontology to configure the Omeka-S content management system on the itinerary generation domain. Omeka-S supports the authoring of information by offering a friendly user interface to input domain data. We thus avoided the development of an ad hoc user interface for this purpose.

[5]https://omeka.org/s/

8 CONCLUSIONS AND FUTURE WORK

We presented the FieldTripOrganizer application, which supports teachers and families or tourist groups in the design of cultural/scientific tour plans. In summary, this application empowers the user to design a tour by helping her/him select Points of Interest and activities that are relevant to her/his interests and, at the same time, comply with the overall time constraints to be respected. This is aimed at inducing the user to focus on the creative and relevant part of the tour organization, i.e., the selection of what to do, leveraging the system for the execution of possibly difficult and annoying consistency checks that might be a source of distraction and make the organization task long and heavy.

In our future work, we plan to organize a user study to evaluate the efficacy of the application in supporting tourist plan organization, as well as field trip organization for out-of-school learning. Specifically, we will organize a user test involving teachers of any level of school in the organization of field trips for their student classes. In our future work, we will also investigate the personalization issues discussed in Section 6 to improve the user experience with the application.

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REFERENCES

[1] Liliana Ardissono, Daniela Petrelli, and Tsvi Kuflik. 2012. Personalization in Cultural Heritage: The Road Travelled and the One Ahead. *User Modeling and User-Adapted Interaction. Special Issue on Coming of Age: Celebrating a Quarter Century of User Modeling and Personalization* 22, 1-2 (2012), 73–99. https://doi.org/10.1007/s11257-011-9104-x
[2] Matthias Braunhofer and Francesco Ricci. 2016. Contextual Information Elicitation in Travel Recommender Systems. In *Information and Communication Technologies in Tourism 2016*, Alessandro Inversini and Roland Schegg (Eds.). Springer International Publishing, Cham, 579–592. https://doi.org/10.1007/978-3-319-28231-2_42
[3] Matthias Braunhofer and Francesco Ricci. 2017. Selective contextual information acquisition in travel recommender systems. *Information Technology & Tourism* 17, 1 (01 Mar 2017), 5–29. https://doi.org/10.1007/s40558-017-0075-6
[4] Igo Ramalho Brilhante, Jose Antonio Macedo, Franco Maria Nardini, Raffaele Perego, and Chiara Renso. 2015. On planning sightseeing tours with TripBuilder. *Information Processing & Management* 51, 2 (2015), 1–15. https://doi.org/10.1016/j.ipm.2014.10.003
[5] Keith Cheverst, Nigel Davies, Keith Mitchell, and Paul Smith. 2000. Providing Tailored (Context-Aware) Information to City Visitors. In *Proceedings of the International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems.*

Springer-Verlag, London, UK, UK, 73–85. https://doi.org/10.1007/3-540-44595-1_8

[6] Amine Dadoun, Raphaël Troncy, Olivier Ratier, and Riccardo Petitti. 2019. Location Embeddings for Next Trip Recommendation. In *Companion Proceedings of The 2019 World Wide Web Conference* (San Francisco, USA) *(WWW '19)*. Association for Computing Machinery, New York, NY, USA, 896–903. https://doi.org/10.1145/3308560.3316535

[7] Berardina De Carolis, Cristina Gena, Tsvi Kuflik, and Joel Lanir. 2018. Special issue on advanced interfaces for cultural heritage. *International Journal of Human-Computer Studies* 114 (2018), 1–2. https://doi.org/10.1016/j.ijhcs.2018.02.007 Advanced User Interfaces for Cultural Heritage.

[8] Justin Dillon, Mark Rickinson, and Kelly Teamey. 2016. The value of outdoor learning: evidence from research in the UK and elsewhere. In *Towards a Convergence Between Science and Environmental Education*. Routledge, 193–200.

[9] Marilyn Fleer and Jill Robbins. 2003. "Hit and run research" with "hit and miss" results in early childhood science education. *Research in Science Education* 33, 4 (2003), 405–431.

[10] Lucia French. 2004. Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly* 19, 1 (2004), 138–149.

[11] D. Gavalas, M. Kenteris, C. Konstantopoulos, and G. Pantziou. 2011. Web application for recommending personalised mobile tourist routes. *IET Software* 6, 4 (2011), 313–322. https://doi.org/10.1049/iet-sen.2011.0156

[12] Rochel Gelman. 1990. First principles organize attention to and learning about relevant data: Number and the animate-inanimate distinction as examples. *Cognitive science* 14, 1 (1990), 79–106.

[13] Marco Giardino. 2012. PROGEO-Piemonte: a multidisciplinary research project for developing a proactive management of geological heritage in the Piemonte Region. *Geologia dell'Ambiente* 3 (2012), 196–197.

[14] Marco Giardino, Carlo Bertok, Alessandro Borghi, Francesca Gambino, Vincenzo Lombardo, Francesca Lozar, Luigi Perotti, and Fabrizio Piana. 2018. The GeoDIVE project for enhancing geodiversity of the Piemonte Region (Italy): "From rocks to stones, from landforms to landscapes". In *20th EGU General Assembly*.

[15] Raquel Heras, Rosa M. Medir, and Olga Salazar. 2020. Children's perceptions on the benefits of school nature field trips. *Education 3-13* 48, 4 (2020), 379–391. https://doi.org/10.1080/03004279.2019.1610024

[16] Daniel Herzog, Christopher Laß, and Wolfgang Wörndl. 2018. Tourrec: A Tourist Trip Recommender System for Individuals and Groups. In *Proceedings of the 12th ACM Conference on Recommender Systems* (Vancouver, British Columbia, Canada) *(RecSys '18)*. Association for Computing Machinery, New York, NY, USA, 496–497. https://doi.org/10.1145/3240323.3241612

[17] Rashmi Hti and Maunendra Sankar Desarkar. 2018. Personalized Tourist Package Recommendation Using Graph Based Approach. In *Adjunct Publication of the 26th Conference on User Modeling, Adaptation and Personalization* (Singapore, Singapore) *(UMAP '18)*. Association for Computing Machinery, New York, NY, USA, 257–262. https://doi.org/10.1145/3213586.3225233

[18] Chris King. 2008. Geoscience education: an overview. *Studies in Science Education* 44, 2 (2008), 187–222. https://doi.org/10.1080/03057260802264289

[19] Tsvi Kuflik, Oliviero Stock, Massimo Zancanaro, Ariel Gorfinkel, Sadek Jbara, Shahar Kats, Julia Sheidin, and Nadav Kashtan. 2011. A Visitor's Guide in an "Active Museum": Presentations, Communications, and Reflection. *ACM Journal of Computers and Cultural Heritage* 3, 3 (2011), 175–209. https://doi.org/10.1145/1921614.1921618

[20] Yohei Kurata and Tatsunori Hara. 2013. CT-Planner4: Toward a More User-Friendly Interactive Day-Tour Planner. In *Information and Communication Technologies in Tourism 2014*, Zheng Xiang and Iis Tussyadiah (Eds.). Springer International Publishing, Cham, 73–86. https://doi.org/10.1007/978-3-319-03973-2_6

[21] Kwan Hui Lim, Jeffrey Chan, Christopher Leckie, and Shanika Karunasekera. 2018. Personalized Trip Recommendation for Tourists Based on User Interests, Points of Interest Visit Durations and Visit Recency. *Knowl. Inf. Syst.* 54, 2 (feb 2018), 375–406. https://doi.org/10.1007/s10115-017-1056-y

[22] Mike Martin. 2006. Motivating teachers and students through a place-based experience. *AGRICULTURAL EDUCATION MAGAZINE* 78, 4 (2006), 25.

[23] Noemi Mauro, Gianmarco Izzi, Marco Pellegrino, Liliana Ardissono, Claudio Grandi, Maurizio Lucenteforte, and Marino Segnan. 2020. Faceted Exploration of Cultural Heritage. In *Adjunct Publication of the 28th ACM Conference on User Modeling, Adaptation and Personalization* (Genoa, Italy) *(UMAP '20 Adjunct)*. Association for Computing Machinery, New York, NY, USA, 340–346. https://doi.org/10.1145/3386392.3399279

[24] Pavel Merinov, David Massimo, and Francesco Ricci. 2022. Sustainability driven Recommender Systems. In *Proceedings of the 12th Italian Information Retrieval Workshop 2022, Milan, Italy, June 29-30, 2022 (CEUR Workshop Proceedings, Vol. 3177)*, Gabriella Pasi, Paolo Cremonesi, Salvatore Orlando, Markus Zanker, David Massimo, and Gloria Turati (Eds.). CEUR-WS.org. http://ceur-ws.org/Vol-3177/paper22.pdf

[25] OWL Services Coalition. 2004. OWL-S: Semantic Markup for Web Services. http://www.daml.org/services/owl-s/1.1B/owl-s/owl-s.html.

[26] Myra Pasquier and Paul J Narguizian. 2006. Using nature as a resource: Effectively planning an outdoor field trip. *Science Activities* 43, 2 (2006), 29–33.

[27] Frank Press. 2008. Earth science and society. *Nature* 451, 7176 (2008), 301–303. https://doi.org/10.1038/nature06595

[28] Pablo Sánchez and Alejandro Bellogín. 2022. Point-of-Interest Recommender Systems Based on Location-Based Social Networks: A Survey from an Experimental Perspective. *ACM Comput. Surv.* 54, 11s (2022), 223:1–223:37. https://doi.org/10.1145/3510409

[29] Ben Shneiderman. 1996. The eyes have it: a task by data type taxonomy for information visualizations. In *Proceedings 1996 IEEE Symposium on Visual Languages*. 336–343. https://doi.org/10.1109/VL.1996.545307

[30] Ornit Spektor-Levy, Yael Kesner Baruch, and Zemira Mevarech. 2013. Science and Scientific Curiosity in Pre-school—The teacher's point of view. *International Journal of Science Education* 35, 13 (2013), 2226–2253.

[31] Tali Tal and Orly Morag. 2009. Reflective Practice as a Means for Preparing to Teach Outdoors in an Ecological Garden. *Journal of Science Teacher Education* 20, 3 (2009), 245–262. https://doi.org/10.1007/s10972-009-9131-1

[32] Pieter Vansteenwegen, Wouter Souffriau, Greet Vanden Berghe, and Dirk Van Oudheusden. 2011. The City Trip Planner: An expert system for tourists. *Expert Systems with Applications* 38, 6 (2011), 6540–6546. https://doi.org/10.1016/j.eswa.2010.11.085

[33] VVAA. 1991. International declaration of the rights of the memory of the Earth. In *First International Symposium on the Conservation of our Geological Heritage*. Digne, France.

[34] Karen Worth and Sharon Grollman. 2003. *Worms, Shadows and Whirlpools: Science in the Early Childhood Classroom*. ERIC.