



An approach for supporting distributed user interface orchestration over the Web



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ABSTRACT

Currently, a lot of the tasks engaged by users over the Web involve dealing with multiple Web sites. Moreover, whilst Web navigation was considered as a lonely activity in the past, a large proportion of users are nowadays engaged in collaborative activities over the Web. In this paper we argue that these two aspects of collaboration and tasks spanning over multiple Web sites call for a level of coordination that require Distributed User Interfaces (DUI). In this context, DUIs would play a major role by helping multiple users to coordinate their activities whilst working collaboratively to complete tasks at different Web sites. For that, we propose in this paper an approach to create distributed user interfaces featuring procedures that are aimed to orchestrate user tasks over multiple Web sites. Our approach supports flexible process modeling by allowing users to combine manual tasks and automated tasks from a repertoire of patterns of tasks performed over the Web. In our approach, whilst manual tasks can be regarded as simple instructions that tell users how to perform a task over a Web site, automated tasks correspond to tools built under the concept of *Web augmentation* (as it *augments* the repertoire of tasks users can perform over the Web) called *Web augmenters*. Both manual and automated tasks are usually supported by specific DOM elements available in different Web sites. Thus, by combining tasks and DOM elements distributed in diverse Web sites our approach supports the creation of procedures that allows seamless users interaction with diverse Web site. Moreover, such an approach is aimed at supporting the collaboration between users sharing procedures. The approach is duly illustrated by a case study describing a collaborative trip planning over the Web.

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1. Introduction

Currently, many tasks users engage over the Web involve dealing with different Web sites; for example, planning a simple trip would require the visit of a first Web site for booking a hotel, a second one for booking flights and many more for finding interesting sightseeing places at the destination... Despite the fact that users would consider such Web navigation as being part of the same task (i.e. planning a trip) most Web sites will run independently with little support to the actual users' concern (Firmenich et al., 2010). Moreover, although Web navigation was regarded in the past as a solitary activity, a large proportion of users are nowadays engaged in collaborative activities (Morris, 2008); for example sharing with colleagues the results of a search for cheap hotels, explaining to friends how to book a seat next to yours in a flight, outsourcing tasks such as asking the community to suggest nice sightseeing places at the destination... For a motivating

example, in Fig. 1 we illustrate a scenario for collaborative trip planning to attend a conference. For accomplishing this common goal, two users need to gather general information about a conference such as the conference dates and location, buy flights, book hotel, etc. Each user can perform the required tasks individually. However, if users want to travel together, some coordination and communication will be required for booking the same flights, hotels etc. Moreover, users might decide to share the work, for example one user can book for both participants. In the scenario presented by Fig. 1 it is possible to notice the many Web sites that will be visited by users. As we shall see, despite the fact that there is dependency between the information provided, Web sites are not integrated. While building service-based software such as mashups can be a solution for combining data and information from different providers, many times this approach might have limitations as they can hardly integrate all possible opportunistic tasks that users might have in mind; for example, checking the traffic situation on the way to the airport, booking the preference users' restaurant at the destination, etc.

We argue that there is a huge set of processes and tasks (such as planning a trip collaboratively) performed nowadays over the

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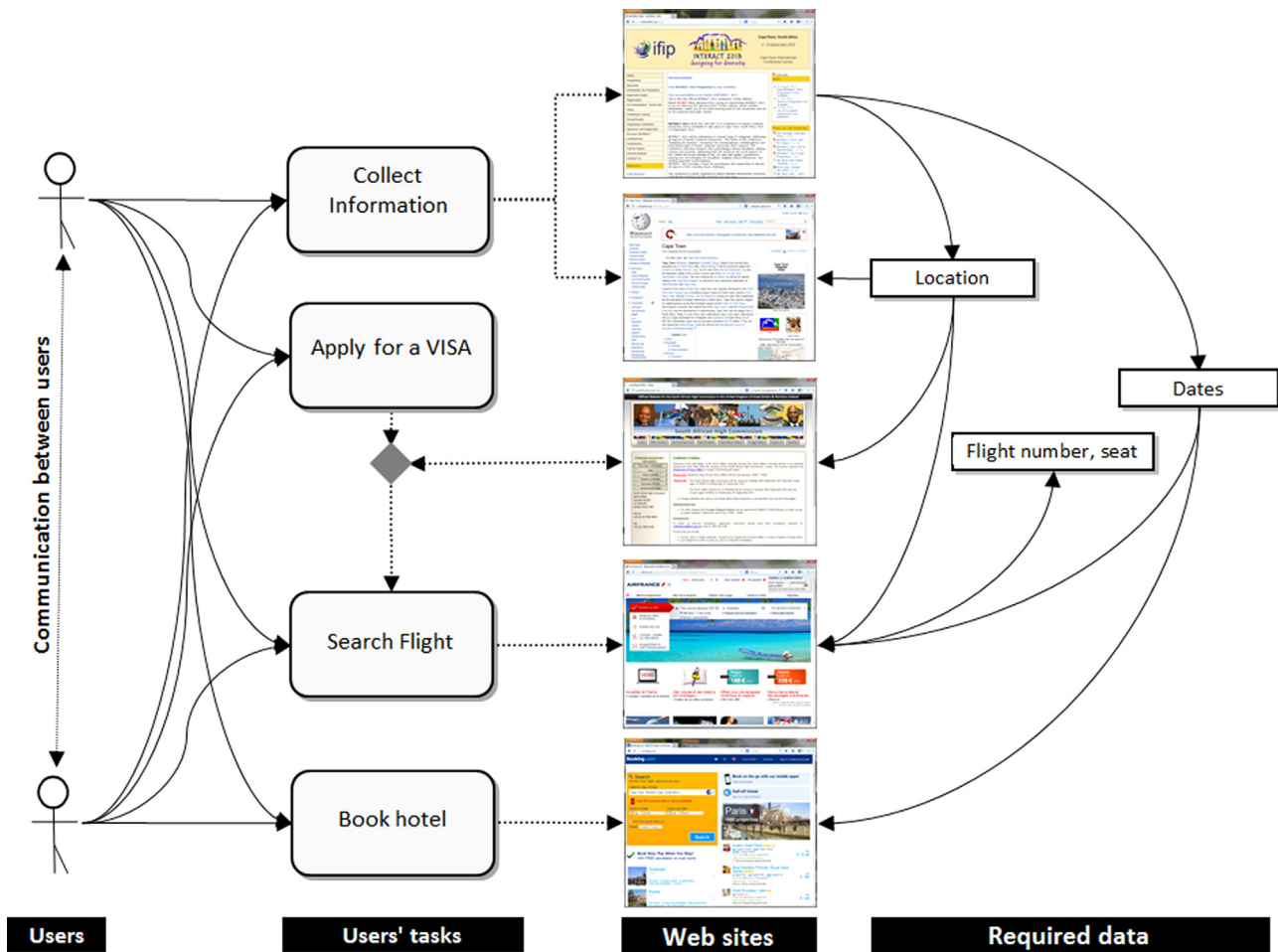


Fig. 1. Distributed user interaction for planning a trip including information sharing between users.

Web which requires a level of coordination that can only be achieved by Distributed User Interfaces (DUI). Distributed User Interfaces (DUI) has been recently defined as a "user interface whose components are distributed across one or more of the dimensions input, output, platform, space and time" (Gallud et al., 2011). The example shown by Fig. 1 highlights two important aspects of user activity over the Web that appeal for distributed user interfaces: (i) users tasks are distributed at multiple applications, i.e. Web sites, that are not directly connected to each other; (ii) users working collaboratively share information to accomplish a common goal (i.e. travel together).

In this paper we propose an approach to building distributed user interfaces that aim at ensuring a smoother user interaction whilst users are performing their tasks across multiple Web sites. Our approach combines individual user tasks to create procedures that seek to orchestrate user tasks over multiple Web sites. Such an approach is aimed at: (i) allowing flexible tasks modeling so that users can create ad-hoc processes for describing how to accomplish tasks in different Web sites; (ii) helping users to share such processes with friends and colleagues who might benefit of the guidance provided by prior task planning; (iii) support a seamlessly integration between data available over Web pages and the actual tasks performed by users across different Web sites; (iv) support the automation of user tasks by the means of Web augmentation tools that are aimed at helping users in their tasks; (v) mediate user interactions with the Web site via the execution of the so-called Web augmentation tools.

Our approach is built upon the concept of Web augmentation (Bouvin, 1999; Brusilovsky, 2007; Brusilovsky et al., 2007) that

defines strategies for implementing tools that can extend the set of elementary tasks users can do whilst navigating the Web. For that, we have developed a dedicated framework called Context Sensitive Navigation (CSN) (Firmenich et al., 2010) which implements a set of Web augmentation tools called *augmenters* (Firmenich et al., 2011). These augmenters are the basic building blocks for extracting information and DOM elements from diverse Web sites for creating distributed user interfaces. In Section 2 we revise the main concepts that are necessary to understand how our proposal is related to the state of the art on DUIs. Section 3 describes the CSN framework and individual augmenters. Later on in Section 4 we properly present an overview of our approach for building DUIs by composing individual augmenters and a Domain Specific Language (DSL) that formalizes the composition of procedures made of the assembly of individual tasks (Section 4.2). The section about the approach ends with the description of the corresponding tool support (Section 4.3). Section 4.4 presents a case study of a DUI for collaborative trip planning using the tool support that demonstrates the feasibility of our approach. Section 6 reports the preliminary results of a usability testing with 11 participants. In Section 2.4 we discuss the contributions of our approach to the research in distribute user interfaces (DUI). Finally, Section 7 presents conclusion, lessons learned and future work.

2. Related work

The field of Distributed User Interfaces is broad and spans over the development of Web applications. For the sake of conciseness

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