Making Pre-Trip Services Context-Aware

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ABSTRACT
The process of selection, configuration and consumption of tourist information services is a complex task for the user. This is not least since existing tools most often focus on supporting either the pre- or post-trip phase or the on-trip phase itself by providing context-aware services. The goal of this thesis is to establish a framework that makes pre-trip services context-aware, thus reducing the gap between the pre-trip and on-trip phase by providing a single point of access. This is done by facilitating service selection and configuration in the pre-trip phase and context-aware service consumption in the on-trip phase. Its applicability and feasibility will be proved by a working prototype and evaluated through field studies.

Categories and Subject Descriptors
H4.m [**Information Systems Applications**]: Miscellaneous

General Terms
Algorithms, Design, Human Factors.

Keywords
tourist life cycle, customization, mobile tourist services, context-awareness

1. Introduction
Tourism is an information intensive business. Since tourism products are virtual products prior to consumption, travelers depend heavily on tourism information. In the ideal case, tourism services should support tourists with travel-related information during all phases (pre-trip, on-trip, post-trip phase) of the tourist life cycle [9] (cf. Figure 1).

Figure 1. Travel experience - tourist life cycle

In the *pre-trip phase*, tourists need information for planning purposes and decision making. *After their trip*, focus is on reminiscing about the journey and sharing the gained impressions and experiences with friends. In the *on-trip phase*, however, tourists are mobile and act in unknown environments where they would especially need personalized on-trip assistance in the form of information about accommodation, points of interest (POIs) (e.g., environmental and landscape attractions or gastronomy), weather forecasts, news or safety issues. Mobile services, i.e., services that can be used independently of temporal and spatial constraints and that are accessed through a mobile handset, may address these issues. They have the task to satisfy information requirements of tourists while being on the move by providing them with a broad range of up-to-date, situation-specific information. This information may be in addition adapted to the current situation of the user by exploiting user preferences, user location as well as mobile handset capabilities.

In the last years, research has been very active in each of the phases of the tourist life cycle. Research in the pre- and post-trip phase is closely linked to *online travel communities* [2], whereas the on-trip phase is targeted by research on *location-based, mobile tourist guides* [8].

The goal of *online tourism communities* is the provision of up-to-date, freely available tourism-related content, thereby enabling members to collect, view and exchange data items such as blog entries or pictures or to add own content and reviews. They provide good support for the pre- and post-trip phases but fail to support tourists sufficiently during the on-trip phase. A few communities such as the Tripadvisor[1] or the Yahoo Trip Planner[2] enable their users to download or print the personal trip plan, but do not provide support to access this information in a way suitable for mobile phones. Support for dynamic, on-the-move information is rare. Customization, i.e., adapting the information content towards the current context, is missing at all. As they only provide services which are useful before and after the trip and which are not interlinked to the on-trip phase, tourists have to use other sources to satisfy their information requirements while they are on vacation. Online tourism communities often provide personal trip planner tools (cf. e.g., [3]) that facilitate the time consuming planning process for tourists. They support tourists to select destinations of interest, to decide on activities and compose an itinerary.

Research with respect to the on-trip phase has resulted in a wide range of *mobile tourist guides*. Since one of the first famous prototypes [1], the sophistication of mobile guides has increased, and research in this field now specializes on features such as personalization, recommendation, context-awareness together with new forms of user interaction, collaborative usage and social integration. They may provide lots of useful information within

[1] http://www.tripadvisor.com/

[2] http://travel.yahoo.com/trip/

their field of application. The drawback is that they do not consider information generated by tourists in the pre-trip phase. In this way, they a) do not incorporate existing user profiles (e.g., profile of community member), b) do not exploit knowledge extracted from the personal trip plan and c) do not know the services the user is interested in and how these services should be delivered to fit the user's requirements and current situation.

In the current state, there is a perceptible gap between the respective phases of the tourist life cycle, resulting in the need for tourists to use different sources to satisfy the information requirements in each phase, ranging from travel communities, mobile applications, Internet websites, destination portals, meta-search & booking engines to traditional guide books. A single point of access that provides all the relevant services is still a preferable future state.

2. Goal & Use Case

The goal of this thesis is to make pre-trip services context-aware, thus reducing the gap between the pre-trip and on-trip phase by providing a single point of access for these two phases (cf. Figure 2).

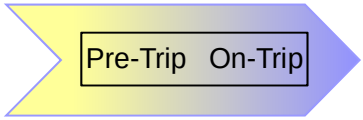

Figure 2. Integration of Pre- & On-Trip Phase

In the pre-trip phase, tourists should have the possibility to select and configure those tourist services that appear useful to them later in the on-trip phase. In the on-trip phase, the pre-configured services can then provide personal information that is tailored to the current situation and requirements of the tourist and presented on the mobile device of the user.

In the following, this visionary goal is presented by describing possible scenarios from a tourist's point of view. The vision might include many assumptions. We want to point out that it is not goal of this PhD to work on *all* these visionary service descriptions, but *some* of them will be realized within a working prototype. The envisioned system is called virtual tourist agent (VTA) since it should provide tourists the same comfort as if they would call their personal travel agent at home to satisfy their information requirements.

The show case gives some impression how the support of tourists in the pre-trip phase and during the vacation can be realized.

Pre-Trip Phase

In the pre-trip phase, tourists often do not plan all the activities they intend to undertake in advance, they rather follow an optimistic approach. For this, the VTA provides a trip-planner tool to establish a rough schedule that contains the cities/places they want to visit within a certain timeframe and the route between those places. Next, the tourists can *identify* and *select* all the tourist information services that they need later in the on-trip phase. Possible services include a flight information service, a tourist attraction service or a weather service. In [4], we showed a classification of these services and came up with a list of 12 generic tourist information services. Next, the tourist can *configure* those services with respect to delivery aspects that best fit personal requirements, thus resulting in value proposition and user satisfaction. For this, we proposed a framework in [4], comprising the three dimensions *service delivery*, *service customization* and *service initiation*. The *service delivery* dimension identifies different *consumer processes* how a user can satisfy her/his requirements. In the most simple form the user receives *information* about objects of interests. The *transaction* process allows the user to initiate transactional processes. The *community* process enhances the service with features enabling social integration. The *distribution* process enables the user to receive a digital product, such as maps or guides that can be downloaded to the device.

The *customisation* dimension expresses to which extent the information sent to the user is customized to fit the requirements of the respective user by taking into account various context factors.

Concerning the *initiation of delivery*, services can be classified into *pull* and *push services*. *Pull services* are characterized by a user-triggered search whereas *push services* deliver information to the user automatically.

For example, the user can select the weather service and configure it to push (service initiation) the up-to-date weather forecast (service delivery) every morning to the mobile device of the user, filtered to the destination of the user (customization).

Since a mobile device suffers from several limitations, e.g., small screen and network connection with low bandwidth, it is important to limit the amount of information that is presented to the tourist so that he or she can obtain the essential information in a non-intrusive way. After all, the mobile device should function as an assistive tool for the current task (e.g., sightseeing) and should not require full attention of the user. To fulfill this purpose, an automation of service delivery and decision making is required. This is done based on the definition and evaluation of rules that may partly be defined by the tourist. These rules are checked by the VTA in order to deliver only relevant information, leading to a more fulfilling user experience. For example, the tourist can define the rule that the VTA should contact him/her in security-related issues, e.g., he or she booked a flight to a country where an earthquake happened (security issue), so that he or she can decide to re-book the flight to another destination. In case of re-booking, the VTA may automatically cancel the accommodation booking on behalf of the user (if he defined another rule concerning this issue).

On-Trip Phase

During the on-trip phase, tourists receive support from the VTA based on the service selection and configuration done in the pre-trip phase. This means that they obtain information from all the services that have been configured to act in a push-based manner. Further, the situation of the tourist (comprising context factors such as location, time, user profile and travel schedule) is constantly checked by the VTA to detect reactive situations [6], thus requiring an action of the VTA. This can either be a change in context, such as an arrival at a new destination, or a new event fired by a service, such as the announcement of a delay received from the flight information service. Possible actions include pushing this information to the user or acting on behalf of the user based on rules defined in the pre-trip phase. For example the VTA might detect that tourists arrive at the booked hotel not in time and automatically informs the hotel about their late arrival.

Another example might be the case that tourists plan a bicycle tour on a specific day during their vacation. The VTA informs them that the weather forecast might be bad this day and instead suggest them indoor activities. Another case might be a planned mountain tour, e.g., on the vulcano Etna, situated on Sicily. The VTA can check whether it is allowed to go up on the Etna (it is still an active vulcano and dangerous eruptions may occur). In case that it is not, the VTA can suggest a tour on the vulcanos "Vulcano" or "Stromboli", being part of the Aeolian Islands in the north of Sicily by exploiting knowledge from a respective knowledge base. If a certain activity cannot be carried out at the destination, based on reasons such as bad weather, closing hours or long waiting lines, the VTA can look up the time frame planned for this activity in the trip schedule and suggest an equal activity instead. This shows that the travel schedule is an important source of knowledge next to traditional context factors such as location, time or user profile. The tourists may also pull for information, such as querying the VTA for a nice beach to go for swimming. The VTA can present a personalized list of nice beaches.

3. State of the Art

In the following, we report on state of the art in e-tourism by discussing research on online travel communities that focus mainly on the pre- and post trip phase and research in the field of mobile tourist guides, covering the on-trip phase.

Concerning online travel communities, we evaluated in [2] eight travel communities with respect to Web 2.0. This evaluation assesses services of travel communities within the context of the tourist life cycle. In the pre-trip phase, tourists have to cope with a large amount of unstructured information. Different search functionalities, e.g., destination browsing, are needed to support tourists during the information search. Some communities, e.g., Yahoo Trip Planner or the Virtualtourist platform[3] enable the aggregation of relevant trip information for later on-trip assistance by letting users create a personal trip plan. The relevant trip information, i.e., entries for travel location, may either stem from third party providers or from other community members. In most cases, the personal travel plan can only be printed or downloaded as PDF document to be used in the on-trip phase. Only a few communities provide access to mobile services. Travelpod[4], for example, supports travelers through a mobile blogging application. Lonely Planet[5] offers the functionality of downloading customized, targeted travel guides. In 2003, it launched CityPicks OTA downloadable travel guides together with Nokia. Recently, it launched, with Orange as partner, a WAP portal that provides chargeable travel information services.

In [4], we provided a classification of mobile tourist services that can be grouped into 13 service categories. Further, a conceptual framework is given that shows different design dimensions how those mobile services can be designed and delivered to tourists in order to generate value proposition and user satisfaction. This framework is then applied to mobile tourist guides that have been developed in the last few years, with focus on those systems that are used in real situations or that have been tested in the field. The evaluation results show that most of the services are provided by mobile tourist guides, while pointing out clearly that there is a large gap in the design of those services of the various tourist guides with respect to service delivery, service customization and service initiation.

Several surveys on mobile tourist guides have already been published that evaluate mobile tourist guides not in terms of provided services but focusing more on the technical side such as architecture, user interaction or context-awareness. In [8], we presented a comprehensive overview and comparison of mobile tourist guides. The comparison is based on an evaluation framework that focuses on context and adaptation criteria. In this way, this survey explores the capability of mobile tourist guides to provide customized services, i.e., services that can react to the context by adapting the information. The main statements are that most systems use their own content databases and do not exploit the potential of incorporating external content, e.g., through standardized interfaces such as web services. Most approaches only consider location and user profile as context factors, while neglecting other ones, such as time or network. Moreover, the potential of combining context properties to derive more valuable logical information is not exploited.

4. Methodology

As already mentioned, the goal of this work is to find a satisfactory solution for making pre-trip services context-aware. To reach this goal, an approach based on the design-science paradigm (cf. e.g., Hevner et al (2004)) is used. The design-science paradigm seeks to create knowledge and understanding of a problem domain and its solution through the building and application of innovative design artifacts. Thereby, artifacts are defined not only as the resulting instantiations (working prototype), but also comprise constructs (vocabulary), models (abstractions & representations) and methods (algorithms & practices) applied in the development as well. To demonstrate the applicability and feasibility of this work, the VTA system will be implemented as a working prototype. For its development, several other design artifacts are needed that will be outlined in detail in section 5. These artifacts further contribute to the knowledge in the field of e-tourism. The goal of design-science research is to address unsolved problems in innovative ways and to address solved problems in more effective and efficient ways. This goal is targeted by this thesis through an innovative approach that facilitates service selection, configuration and consumption through a single point of access. The effectiveness and utility of the VTA prototype will be assessed by a field study with tourists and compared to other systems that target the pre- or on-trip phase in isolation.

5. Research Contribution

The main contribution is the design of a conceptual framework and the prototypical implementation of the VTA system. Thereby, it is not the goal to implement each component from scratch, but to implement the whole system by heavily reusing and combining existing tools. Figure 3 illustrates the architecture of the VTA system. In the following, the architecture is explained by describing its components and listing research tasks that have to be addressed to develop the whole system.

[3] http://www.virtualtourist.com/

[4] http://www.travelpod.com/

[5] http://www.lonelyplanet.com/

In the pre-trip phase the user can select and configure all relevant *service types* and choose the adequate *service providers* from which the data is obtained during the on-trip phase. The *service instances* abstract from the different application programming interfaces (APIs) of the *service providers* and are linked over a standardized interface to the respective *service type*. For example, the *service type* "weather" can access *weather service providers* using different technologies, ranging from SOAP and restful web services to RSS feeds and finally to wrappers that extract the data from the provider's website if an API is not available. The different symbols of the service providers act as representatives for the different technologies that can be used to access the data. In the runtime phase, the *VTA system* exploits the situation of the tourist and manages the states of the *service providers* in order to detect changes that require an action on behalf of or sending some information to the user.

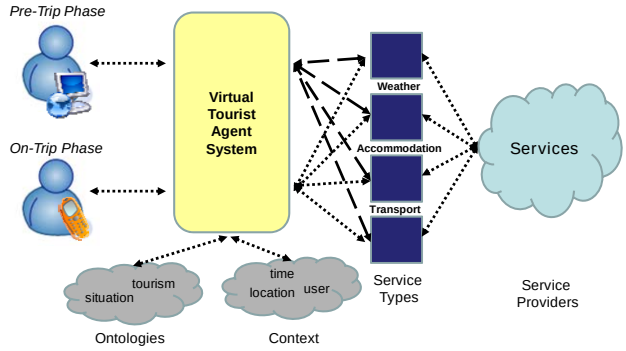

Figure 3. Outline of the VTA architecture

The main components of the VTA framework are described in the following. For this, Figure 4 shows a high-level view on the components of this framework. Context-aware information systems have to derive meaningful information based on the situation of the user. Ontologies are a promising technology to model the situation of the user since they can represent the knowledge in a semantically rich kind and are therefore a central part of the system.

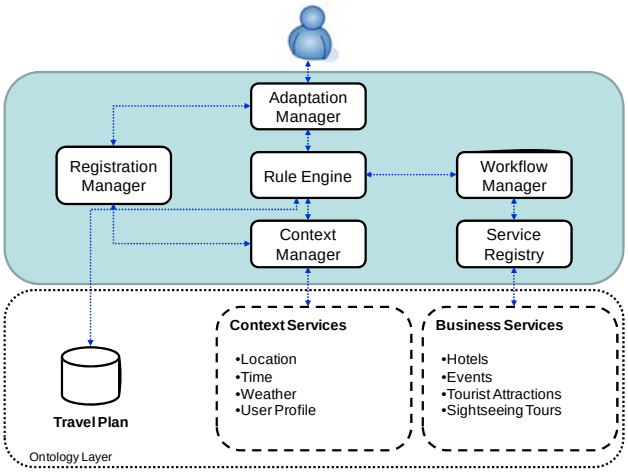

Figure 4. Components of the VTA system

Personal trip planner tool

In the pre-trip phase, the VTA needs to include a trip planner tool that assists in trip planning. A survey has to be done to select a promising trip planner tool that can be integrated within the VTA. The trip planner of the destination portal of New Zealand[6] seems to be a good starting point.

Business Services & Service Registry

In our previous work [4], we showed a classification of tourist services that are of high value to tourists being on the move. Of course not all of these service types can be addressed within our working prototype. We did an expert survey in [7], where we asked 40 international experts in the academic and industrial field, both with tourism and an 'e-tourism' background to rate the information services in terms of their relevance using a 6-point Likert-scale. Based on these results, we will implement promising service types and provide the necessary interfaces to service providers in order to access their data. All services are semantically described and registered within a service registry.

Context Services and Context Manager

The framework provides access to different context factors such as location time or profile of the user that are provided by the system or by the user or even external context factors such as weather information. As soon as a context change happens, either triggered by the user (e.g., location change), by the system (e.g., time) or by external providers (e.g., weather), the context manager forwards this event to the rule engine.

Rule Engine

The rule engine consists of an inference engine and a dependency checker. The inference engine takes the request from the user and the events from the context manager and matches them with the knowledge base that contains the situation of the user and his/her travel plan. In this way, the inference engine uses axiomatic knowledge in the knowledge base to derive new conclusions. For example, when the context manager sends a bad weather event for the next day, the rule engine checks all outdoor activities taking place next day and apply some actions on them based on predefined rules (such as canceling those actions). The activities in the travel plan show complex dependencies amongst each other. For example, if the user plans to stay at a certain destination for another day in order to attend a concert (new activity), this new activity might be dependent on the possibility to stay another night in the booked hotel. If the user already booked a hotel at another destination for this day, this has to be canceled as well. It is the task of the dependency checker to monitor coherent activities.

Workflow Manager

The workflow manager encapsulates all different services as workflow components. The workflow manager receives from the rule engine the information about those services that have to be called in order to perform the actions defined in the rule engine and composes the respective services to a workflow (e.g., cancel hotel, send confirmation in form of SMS to the user).

[6] http://www.newzealand.com/

6. Future Work

Future work concentrates on detailing the architecture and the necessary components. Based on the design decisions, e.g., heavy-weight vs. light-weight client, existing tools, middleware and frameworks have to be selected that facilitate the design of the conceptual architecture and the implementation of the resulting prototype. Surveys are needed to select the suitable tools and adapt them in a later step for our work. The system will be implemented based on a rapid prototypical approach, which allows testing the prototype in small, iterative steps in order to get fast feedback for further improving the prototype.

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