ENHANCED WISETRIP: Wide Scale Multimodal and Intelligent Journey Planning

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ABSTRACT

Enhanced-WISETRIP is the continuation of WISETRIP project and its goal is to build on WISETRIP to bring the current system new possibilities for planning and booking multimodal journeys adapted to all user needs, integrating costs and environmental impacts and allowing the management of unexpected scenarios.

WISETRIP objective was to develop and validate an innovative mobility service platform, which provides personalized multimodal travel information. This system combines several national and international Journey Planners and provides the user with real-time personalized information anytime anywhere.

The present paper will describe the system developed within WISETRIP project and how E-WISETRIP project will enhance the features of the WISETRIP platform.

Keywords: Journey planning, multimodal, personalized information, urban, interurban.

1. Introduction

ENHANCED WISETRIP is a collaborative project, lead by Forthnet and which consortium is formed by 14 participants from seven different countries, these countries are: Greece, Netherland, United Kingdom, Italy, Russian federation, china, Belgium, Brazil and Spain. Enhanced WISETRIP will build upon the results of the former WISETRIP project in order to bring new possibilities for planning, booking and travelling multimodal journeys adapted to all user needs, multiple trip criteria, environmental impact and personal preferences. To manage unexpected scenarios, the project will realise integration of real-time and non real-time data sources based upon efficient communications and decision management mechanism that will be considered for traveller alerting and trip redesign. It advances the state-of-the-art towards efficient and green planning of multimodal international trips, through its unique mixture of features, which are:
• Inclusion of a wide grid of criteria that form the basis of variant trip strategies and govern selection process either at planning or at trip redesign phase. Criteria include CO2 footprint, elderly and disabled preferences, typical factors (time, cost, hops) and various user-specific options.
• Acknowledging user requirements by genuinely addressing door-to-door journey planning; considering real-time event data and information on extraordinary conditions (strikes, disasters, extreme weather); and offering the possibility of integrated ticketing
• Use of the most advanced mobile interfaces (handheld and in-vehicle devices),
• Expansion of the geographical coverage and of the number of transport modes supported by the existing open platform for the interconnection of Journey Planners (www.wisetrip.travel); including international railway, car and cycle routing and more countries.
• Strong dissemination across European and non-European countries

The WISETRIP project developed and validated a common platform for planning personalised multi-modal journeys beyond the borders of European countries or regions by taking into account multiple criteria and complex scheduling constraints (i.e. time windows on departure or arrival) applied to a network of several journey planners. Such a system is accessible by the travellers through stationary devices anytime and anywhere before and during the trip.

An open system was built to which new Journey Planner (JP) can easily be connected and added to the system to cover new regions and expand the usability of the system. After a validation process this new Journey Planner may become an active member of a co-operative set of interconnected Journey planners that will serve global travellers wherever they are and wherever they want to travel. This flexibility on adding new journey planners to the system is possible due to the structure of the system based on events.

A generic view of the WISETRIP network of interconnected Journey Planners is shown below in Figure 1. At the top of the hierarchy of this diagram the core system of WISETRIP is represented. As can be seen in the following picture, the heterogeneous set of Journey Planners are connected to the WISETRIP core system, covering different or overlapping areas and at the same time having advanced control capabilities according to adaptations made to them.

Each of the Journey Planners connected to WISETRIP platform are controlled by different transport operator or content providers, but all of them are compliant with the WISETRIP adaptation guidelines so that they can operate and respond under the umbrella of WISETRIP wide-scale Journey Planner Platform. The Journey Planners integrated in WISETRIP platform can be either Urban Journey Planners, Long Distance Journey Planners or even national/regional Journey Planners, including both urban and long distance journey planning services.

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**Figure 1 – Network of Participating Journey Planners**
2. WISETRIP architecture

The architecture needed to develop the proposed platform includes several components, as illustrated in Figure 2, these components are responsible for:

- The personalization of the information.
- The interconnection between the core system and the different Journey Planners.
- The provision of travel-specific requests, based either on selected trip time stamp, location of the user, or other preferences.
- The presentation of the information through various stationary or mobile devices connected to broadband or narrowband infrastructure.

![WISETRIP main architecture](image)

Figure 2 – WISETRIP main architecture

As shown in the above figure, WISETRIP system consists of three main layers of modules. These layers are briefly described below (from bottom to top):

2.1. 1st Layer – Participating Services and Data

This layer consist of several systems (such as journey planners or booking systems), external information and services (such as time, user position, external alerts) and personal user data related to trip selection and user preferences.

2.2. 2nd Layer – WISETRIP Platform:

Three main modules can be identified within this platform, the journey planning (WISETRIP Core System), the personalization system and, the services. The final journey plan is produced by the Core System and is handed to the Services for delivery or to personalisation system for further processing. Other subsystems refer to interfaces with the other layers or data subsystems. WISETRIP Platform is interfacing to the 1st layer: a) The Core system interacts with the participating Journey Planners and b) the Personalisation System interfaces with external information, user data and profile through the real-time decision mechanism, which process all external...
& user data. The Services of the WISETRIP Platform communicate with the devices of WISETRIP (3rd layer) through an intermediate layer which is ‘Devices Interfaces Layer’ that takes care for the open & harmonised interconnection to various devices.

2.3. 3rd Layer – Distribution:

This layer contains the function of providing the information and service to multiple users through various technological devices. The main role here belongs to the devices and the user interfaces running on top of them.

3. PERSONALISATION SYSTEM

The WISETRIP Personalisation System performs journey planning functions and procedures according to the users profile and trips cycle criteria selected by the user. It detects the information that must be sent to each user, processes alerting messages and produces notifications, defines when and how to send a notification message, and utilizes the necessary mechanisms in order to distribute this information.

3.1. Trip-Life Cycle Model

The personalisation system takes into account the registered trips selected by the users, and specifically the different periods of a journey (trip – specific life cycle data) that constitute the Trip Life Cycle Model (Pre-trip phase, En-route phase and other phases of a journey). The trip life cycle model is defining the rules on which journey analysis is made into several phases, so that a specific user journey is translated to Trip Life Cycle data.

Figure 3 – Trip Life Cycle
The decision mechanism sets up a schedule of notifications into time for a specific trip, when relevant up-to-date information is ‘pushed’ to each user. Information is analysed and according to the trips cycle sets off one or more notifications for one or more users. The Trip Life Cycle manager is identified as a separate component, part of the real-time decision mechanism, and also includes functions related to the definition of personalised data (profile definition function, trip selection, etc.)

3.2. Real Time Decision Module

The main module in the Personalisation System is the Real-Time Decision Module. The RTDM is an internal module of the WISETRIP which mainly constitutes the Core of the personalisation system. It is an event listener which is continuously monitoring all the active trips and processes all real-time information on a permanent (or on per request) basis and then trigger decision mechanisms that define the information to be ‘pushed’ to interested users when needed. It communicates with the external data sources and receives information by them (information push). Every piece of information is analysed and according to the trip cycles that are in progress it triggers one or more events for one or more users.

One of the main functionalities of the RTDM is to manage and monitor all the active trips of WISETRIP. To do so, each trip has its own trip management process.

Every time an active trip is detected (at RTDM startup or when a new trip is created) a new TripManager object is created for managing the trip. This manager controls the whole life cycle of the trip, carrying out the following sequential actions:

- The trip is initialized and its state is set to Active. This means that it can process its scheduled events and receive and process unscheduled events.
- Taking into account the service subscriptions defined for the trip, the list of its scheduled trip events is generated. The list of events includes the service subscriptions events (chosen by the user when creating the trip) and other additional scheduled events used by the system (these events are transparent for the user), some examples of the system events are: NodePassEvents, generated to registering the pass of the traveler by each of the nodes in the trip segments; TripStateChangeEvents, generated for changing the state/phase/stage of a trip when needed. This event list is ordered by time of execution.
- Once the list of scheduled events for the trip is created, the system programs a timer for the first event of the list (the one with earlier execution time).
- While hibernating, the TripManager can be woken up by one of the two following possibilities:
  - The manager receives the timeout of the first scheduled. When this occurs, the event is removed from the list of scheduled events and is executed, depending on the kind of event it is (see Process Scheduled Trip Event for more details).
  - If the manager receives an external unscheduled event then the event is executed (see Process Unscheduled Trip Event).
- In any of both cases, once the event (scheduled or unscheduled) has been executed, the event is stored in the database as an historical event.
- The list of scheduled events is checked for remaining events.
  - If the list is not empty the manager sets up a new timer for the next scheduled event and the TripManager hibernates again awaiting for the time out or an unscheduled event.
  - If the list of events is empty it means that the trip has ended and that the corresponding TripManager must be deactivated and terminated.
Figure 4 – Real Time Decision Module (RTDM)
3.3. Process Scheduled Trip Event

The process or execution of a scheduled trip event depends on the type of event to execute. The following type of events can be received:

- NodePass: This is an internal system event that is used to register that the traveler has passed by a node of one of its scheduled trip segments. It needs no execution (only the storage of the event in the list of historical events).
- TripStateChange: This is an internal system event that is used to change the current state/phase/stage of the trip.
- ScheduledNotification: This event is used for sending a text message to a traveler using a phone number or an e-mail. The message is sent using the NotifyInformationToTraveler service, provided by the MOBILE interface. These events are generated by the service subscriptions of the trip.
- SegmentValidation: Segment validation is carried out by using the FindTrips CORE function for checking if a given trip segment is still scheduled by the JP that originally provided it. If the validated segment remains as originally scheduled, then no action is needed. In the case the validated segment is no longer scheduled as was originally provided, then it’s necessary to check the changes and disturbances produced in the trip. This is made using the Manage Trip Changes function, described later.

![Figure 5 – Scheduled events processing algorithm](image)

3.4. Process Unscheduled Trip Event

The process or execution of an unscheduled trip event depends on the type of event to execute. The following event types can be received:

- JPSegmentDisturbance, TripSegmentDisturbance, TripTravelerPosition: This three different types of events have in common that they notify a disturbance in one of the scheduled trip segments or in the expected traveler position. In this case an evaluation of the possible consequences of these events is needed. Onces
this is evaluated the necessary actions are tacked in consequence. This is carried out by the function Manage Trip Changes.

- **TripModified**: This event means that an existing trip has been modified or that a new trip has been created. It is also possible that the real-time options of the trip have been changed. In any of these cases the TripManager reloads the trip information from the DB and recalculates the list of scheduled trip events.

- **TripNotificationAnswer**: This event is the answer of the traveler to a previously received notification about the possible alternatives to a segment, scheduled in his trip, that has been disturbed. This answer specifies the alternative selected by the traveler. A new version of the trip is then created, substituting the disturbed segment with the selected alternative. Once the trip is recomposed, its list of scheduled events must be recalculated again.

![Unscheduled events processing algorithm](image)

**Figure 6 – Unscheduled events processing algorithm**

### 4. E-WISETRIP improvements

An ambitious attempt to integrate actively Journey Planning engines to form a unified intermodal Journey Planner for international journeys, has been performed by the WISETRIP FP7 research project. To certain extent, WISETRIP has addressed important needs of the international traveller including also the provision of personalized information before trip and during the trip under different usage scenarios. The proposed Enhanced WISETRIP project aims at building on the knowledge developed in the last FP7 project to bring the current system to new possibilities to create an open platform for planning, booking and travelling multimodal journeys adapted to all user needs, integrating costs and environmental impacts and allowing the management of unexpected scenarios.

Building on the same concept, and having identified additional innovative functions that can be included within the system, the objective of this new proposed project is to enhance WISETRIP capabilities. The established basis of achievements and the demonstrator of WISETRIP (www.wisetrip.travel), having proved its efficiency in terms of having a realistic and practical approach, offers the appropriate environment for inventing
innovative features, experimenting upon and demonstrating them. Apart from enriching the existing system with innovation, the proposed Enhanced WISETRIP project seeks to cover the gaps and overcome the following limitations encountered in currently running WISETRIP:

- The real-time alerting system implemented in the pilot system is based upon user generated alerts. This is an interesting point, as travellers are valuable sources of information in a well-organised and managed information eco-system;
- Real-time replanning is performed by manually replanning the remaining journey on the mobile application;
- Long computational time is sometimes encountered for trip requests requiring the collection of information from multiple journey planners;
- Use of private car, bicycle and parking space is not included in the trip solutions though it would improve efficiency within several scenarios as well as it could be within the strategies of the traveller and the trend towards greened solutions;
- Large numbers of answers to trip requests need the application of intelligent processing through representation of trip strategies and more criteria (including the environmental ones); and
- The requirements of elderly and disabled travellers are not considered adequately.

According to the above, the demonstration and evaluation task from existing WISETRIP reported the following findings that will be tackled by the new project Enhanced WISETRIP:

- Content and modal limitations: in order to become attractive to travellers and the tourism business market, WISETRIP has to extend its geographical coverage and multi-modality. Concerning content, what is requested is: the integration of Journey Planners from other fundamental European countries and/or regions; moreover the inclusion of international rail transport, car routing and low cost airlines were considered as a significant imperfection.
- Pricing and ticketing information: provision of an estimated price per trip segment has been foreseen within the WISETRIP platform and user interface; however the lack of the relative data was one of the users’ complaints. Besides pricing information, seats availability and ticketing service were also considered crucial. Users claimed that booking a trip identified from WISETRIP through other systems proved time consuming and difficult. Moreover, feedback from user trialshighlighted that ticketing restrictions related to travel choice must be known as in the event of disruptions it may be feasible to get another flight but your ticket may not be valid.
- Details on walking segments: Walking transfers between transport nodes often raise travellers’ anxiety, especially when travelling abroad. To this end more detailed information on walking routes was requested. Users mentioned that a more detailed map for the walking segments and the relative distance in meters would be appreciated. Information on stairs, lifts, escalators etc., is required particularly for disabled people and those carrying luggage.
- Alerts and re-planning options: Users mentioned that they would like to have detailed information about possible disruptions or other critical events (e.g. strikes, weather or other natural phenomena etc. The actual lack of real-time event data and information for extraordinary situations that could be communicated to the traveller en route reduces the usefulness of the relative alert services implemented and provided by the WISETRIP platform. Moreover, dynamic re-planning is considered as a significant added value service for a Journey Planning system but users would like a more flexible and advanced service than this provided currently by the WISETRIP system (e.g. taking into account ticketing restrictions based on the initial booked itinerary).
- Round trip and stop over functionality: those two services were considered as of great value for the end users. Most people when travelling depart and return to the same origin, so when planning their trip they would like to have full information for the round trip. Furthermore, a stopover service is also very useful if for example the travellers want to place a meeting or a cultural visit among different segments of their trip.
- Concern about elderly and disabled users: This is a major omission from most existing Journey Planners including WISETRIP. Users proposals include relative options in the profiles creation (e.g. wheelchair users) that would be taken into account and at the provided trip solutions (e.g. for disabled people time calculation for walking segments should be different), or even provision of taxis links and accessible transport availability.
- Concern about green routes: Another omission of WISETRIP in respect to the current trend is the inclusion of the CO2 footprint metric within the presentation and the criteria selection and filtering process. Moreover, the alternative of combining cycling and public transport will be an interesting approach for those really concerning about green routes.
Mobile applications for new generation devices: in order to penetrate to the mobile travel market a WISETRIP mobile application for smart iPhones and Android devices is essential. The user needs, efficiency versus associated cost (in particular when roaming) play also a dominant role.

References

WISETRIP Project: http://www.wisetrip-eu.org/
WISETRIP Multimodal Journey Planner: http://www.wisetrip.travel