Seamless-based infomobility applications to support the needs of all travellers

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1. Introduction

Mobility often depends on the possibility of getting access to information both in terms of planning before travel and orientation during travel. The population in Europe with problems using information and communication technology is estimated to be 22.25% (Gill, 2004). Over 30% of the population can't use emerging mainstream web services and benefit from the eSociety and ICT applications, as unfortunately, little consideration has been given to the accessibility of these services by people suffering from motor, communication (illiteracy, dyslexia), hearing or visual limitations, which have an imminent negative effect to their mobility. The main reasons are the inappropriate interfaces and the lack of adequate integrated services and content that covers holistically an application area, leading to the need to visit various web-places from different service providers to collect the relevant info; which is neither practical nor economical.

2. The ASK-IT project – an overview

ASK-IT IP (co-financed by the eInclusion initiative of the IST Program of EC), developed a novel application consisting of prototypes and systems which automatically interfaces services from different service providers, in a transparent to the users way. Thus, ASK-IT manages to take everybody everywhere with a good level of comfort, providing pre-trip and on-trip information and support by telematic services; seamlessly throughout the trip, in a personalised way, according to individual user needs and preferences. In specific, ASK-IT developed a set of new, fully accessible tools, to support key functionalities for all, including travelers with functional limitations, among which are accurate indoors and outdoors localization, accessible route planning and guidance for car drivers, PT users and pedestrians.

ASK-IT is thus a universal system for all, which however takes specific care to satisfy the needs of ALL citizens, including mobility impaired (MI) users, such as:

- blind and partially sighted people;
- deaf and people with hearing problems;
- people unable to walk, i.e. wheelchair users;

- people who have difficulty in walking and bending limbs;
- people with medical problems affecting balance and stamina;
- people with cognitive impairment;
- people who are illiterate.

2.1 The Ontological framework used

In order to realise its vision, ASK-IT developed, among others, an open ontological framework, covering the contents that correspond to the above fields. For each type of content and each element within it, all accessibility attributes have been incorporated into the ontology. For example, the height and width of doors at a hotel, the existence or not and the width and height of steps at entrances or stairs, the existence or not and the inclination of ramps, etc. These ontologies are public and any new service provider can use them to develop ASK-IT compatible services. Thus, services are based upon a common ontological scheme, which can interface existing services through an online service alignment tool and a multi-agent system for service delivery, including personalized agents at the user's device and Web-based agents for service discovery.

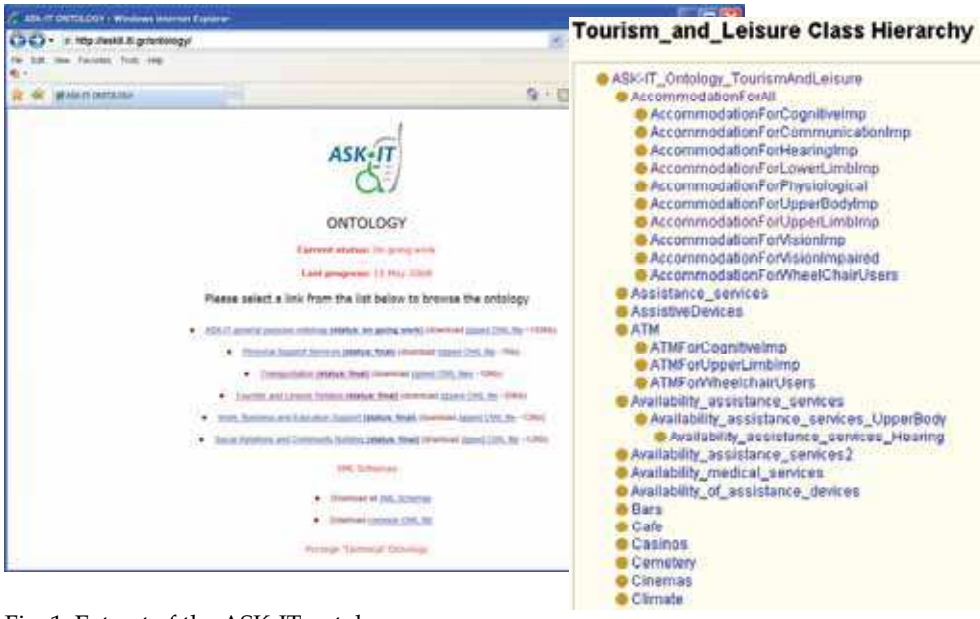

Fig. 1. Extract of the ASK-IT ontology.

Ambient Intelligence has been achieved by introducing personalisation to the content management (intuitive semantics), search functionality (intelligent agents for service provision), as well as the usability (self configured UI). The relevant GUI is self-configurable to the user type, as well as the device used, thus allowing users to get ASK-IT services through PC, tablet PC, mobile PC, PDA, mobile phone, automotive screen or even specialised domotic devices. The UI is adaptable to each device properties and capabilities. It tailors the service to the user's preferences, needs and habits as well as to the context of

use. It then introduces this intelligence to the body, personal, local and wide area networks, and the integrated, secure service platform. Thus, the intelligence is diffused on all aspects of service provision; else the unintelligent parts (i.e. content, functionality or interface) would cancel and limit the benefits of the intelligent ones. On the other hand, intelligent sensors were not developed, but interfaced from other research initiatives (such as SENSATION IP), to limit the work to the required for the service provision and result to a low-cost, modular, s/w-based system.

3. Applications and services in the Greek pilot site

Substantial developments were realised in the Greek pilot, resulting in a total of 10 connected services to the ASK-IT platform. A number of services already existed, including traffic and travel information services, demand responsive transport services, personal assistance in the airport, etc. Besides the existing services and infrastructure, many more services were created, in order to cover the ASK-IT application areas. For existing web services and applications, the existing content was updated and connected to the ASK-IT ontologies. The list of the available services follows below:

1. Accessible POIs (Athens & Thessaloniki), with transportation means info
2. Accessible multimodal routing
3. Personal support services
4. Social services
5. E-learning & e-working services
6. Domotics
7. In-vehicle services

A short description follows below for each of the above service types.

3.1 Accessible POIs and routes between POIs/stations

Accessibility data gathering was realised with the on-site visit of a specialized team, that stored the data electronically, according to specific evaluation forms (loaded on a PDA). Thus, accessibility information was stored on a PDA. Then, locally stored data was transferred to the ASK-IT SQL database and populated the corresponding Web services. Detailed info has been gathered for the accessibility of the POIs (hotels, restaurants/cafes, entertainment centers/venues, theatres/ cinemas, cultural facilities, sport venues, parks, bank ATM, shopping centers), the accessibility of the transportation means and stations, nearby the POIs as well as main public transport terminals (main bus, train and metro stations, airport). In total, 234 POIs were evaluated in Athens (including the Athens International Airport). The accessibility of 111 POIs from Thessaloniki city centre was included in the system by connecting already available content from a local project of the University of Macedonia to the ASK-IT platform.

Also, the most accessible pedestrian route, from the nearest stop/station to the selected POIs or from a POI (e.g. hotel) to another nearby (e.g. restaurant) is proposed, per ASK-IT user group. Over 50 pedestrian routes were evaluated in Athens and more than 20 in Thessaloniki.

A 3-level accessibility scheme is used, with a colour coding, distinguishing between the accessibility level of each POI/route. The results are shown according to the following table:

ASK-IT accessibility level	ASK-IT colour coding
0. Not checked	Black or grey
1. Not accessible	Red
2. Semi-accessible	Orange or yellow
3. Fully accessible	Green

Table 1. ASK-IT accessibility levels and corresponding colour coding used.

3.2 Accessible multimodal routing

A new mode of route guidance was developed, namely accessible route guidance. The system knows the user's particular problems (i.e. use of walking stick, wheelchair, or blind, or …) and the accessibility attributes of the routes and matches them (by semantic search), resulting to the proposition to each user of a route that is accessible for him/her (i.e. without stairs or with ramp/lifts, etc.).

Fig. 2. Routing application on the mobile phone.

In addition to it, multimodal route planning is supported (including rerouting during trip in case of need, i.e. service disruption or change of plans by traveller), again taking into account the user abilities, as well as preferences (i.e. maximum number if transportation mean choices he/she usually accepts) for selecting the multimodal trip as well as for selecting the suggested POIs to visit (i.e. type of restaurants he/she prefers, type of hotel he/she usually books). The personalisation of information is according to the parameters defined in Panou, 2008 (PhD Dissertation).

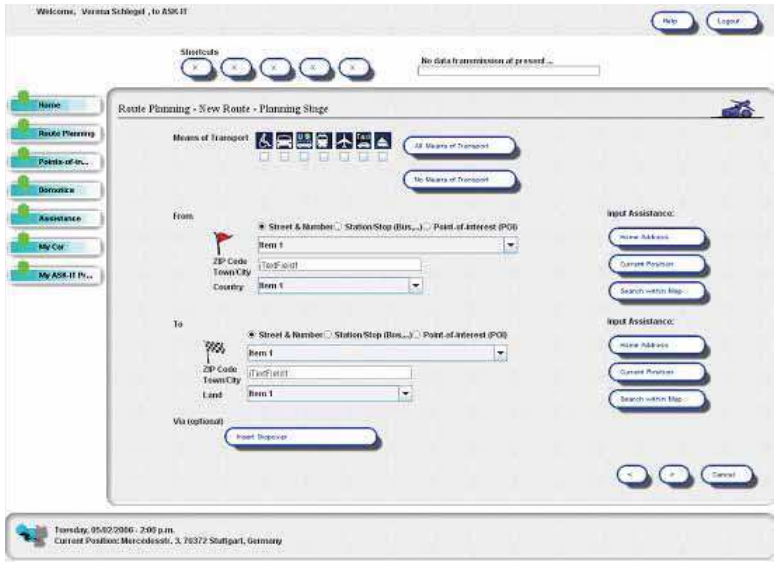

Fig. 3. Personalised multimodal route planning within ASK-IT.

3.3 Personal support

This service allows the users to rent special equipment before their arrival at the airport or a hotel. Such equipment are wheelchairs and Braille maps. For the purpose of the tests, Braille maps were prepared for the centre of Thessaloniki.

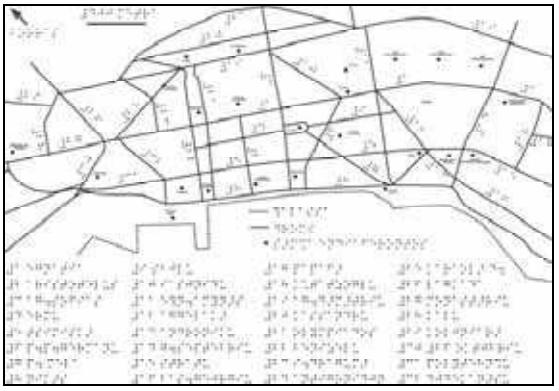

Fig. 4. Braille map of the city of Thessaloniki.

3.4 Social Events

CERTH/HIT developed the ASK-IT Social Events application. It is a web-based dynamic application that allows storing events in ASK-IT database (e.g. events not provided by Web service providers). The editing, deleting or adding of a new entry is allowed only to registered users.

Fig. 5. Social events application user interface snapshots.

Information is included on past and forthcoming events for people with disabilities. Search is possible by disability type, event type (athletic, musical, conference, etc.) and date. The application can run on the mobile phones and PDAs. Below, the way that the application appears on the mobile phone is shown:

Fig. 6. Social events application on the mobile phone.

3.5 E-learning & e-working services

With the e-learning applications, the MI user is able to follow specific e-learning programs (e.g. Open University, national institutes, foreign languages lessons through internet, etc.). Also, a number of tasks can be performed with the e-working service, i.e. (Zabulica V., 2008):

- Receive / send e-mails, multimedia files.
- Download application from a website (i.e. company web site).

- Connection to a teleconferencing session.
- Participation in a collaborative work session.

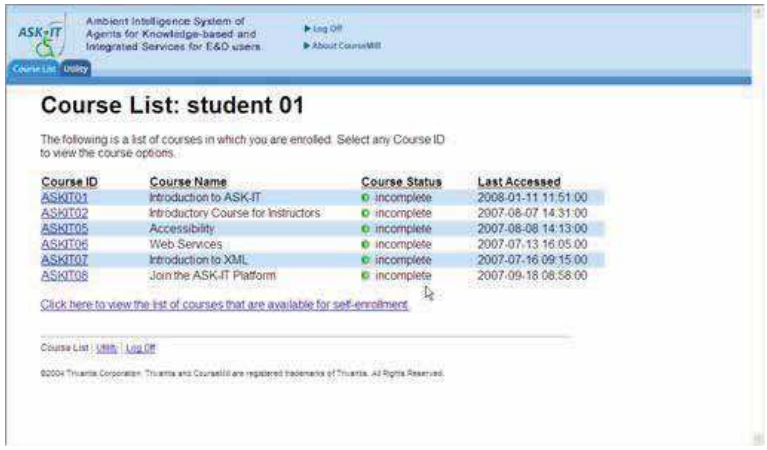

Fig. 7. Screenshot from the eLearning service of ASK-IT.

3.6 Domotics application

The Greek domotic pilot site has been designed and implemented from scratch for the purpose of ASK-IT and employs a wide variety of communication technologies and standards. From a top level point of view it makes use of both wired and wireless network communication mediums and the core of the system is based on OSGi middleware technology to form a Service Oriented Architecture. The domotic modules are integrated to the ASK-IT project by providing a User Interface under the common ASK-IT client software, and thus providing a centralised place for accessing all ASK-IT services (route planning, e-learning, etc.).

The general concept was to provide a safer, more secure and comfort environment for elderly and mobile impaired users (MI users) and to improve their overall wellbeing (Genoux et al., 2007). Taking this into consideration, the Greek demonstration site has been designed having a typical environment of a mobile impaired user in mind.


Fig. 8. Greek pilot site domotics room (at CERTH/HIT)

The UI developed for controlling the domotics in the Thessaloniki pilot site is integrated into the main ASK-IT services client UI and is designed with the same "look and feel". There are two versions available, one for large screen displays (desktop PC, laptop, media centre) and one smaller for mobile devices (PDA, mobile). Both UIs have been designed separating the business logic and functionality from the presentation and thus a more modular approach has been utilized. This is very important since it makes possible for other domotic sites to integrate with less development the ASK-IT services and domotics UI with their current infrastructure. The following screenshots present the two different UIs for both the mobile devices and large screen displays.

Fig. 9. UI of the domotics application at the mobile devices (PDA, mobile phone).

The laptop, desktop and media centre computers share the same application and size constraints. The following screenshots are from the UI of these devices.

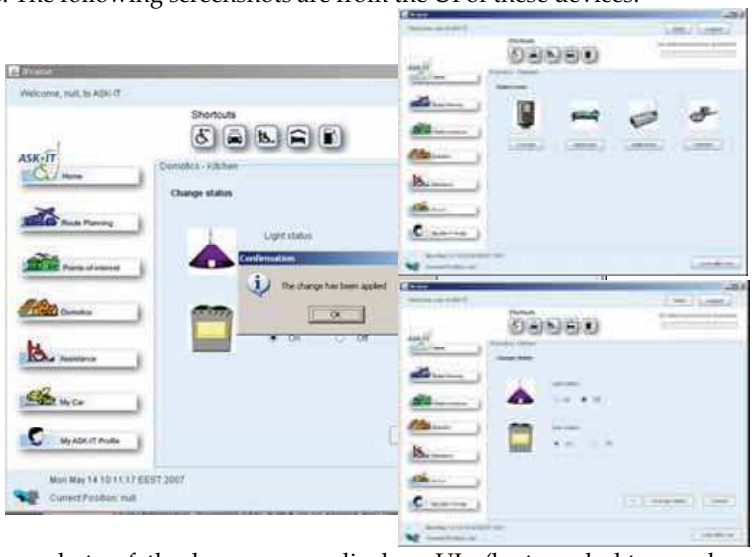

Fig. 10. Screenshots of the large screen displays UIs (laptop, desktop and media centre computers).

The pilot-site in Thessaloniki uses a touch-panel based User Interface device. In general, this device has been customized to the special needs of elderly & disabled users. Furthermore, it is appropriate for dyslexic persons, because the UI concept is based on images instead of text.

3.7 In-vehicle application

To secure safe operation of ASK-IT services while driving, a specific context-aware system for in-vehicle ASK-IT services provision has been built. The UI of the services is thus adapted when the vehicle is travelling with a speed over 15km/h (i.e. visual elements are minimised, technical interactions are frozen, …) and also ASK-IT info is delayed or cancelled when other info/warning comes from Advanced Driver Assistance Systems (ADAS). The in-vehicle system has been also adapted for specific user types categories, i.e. people with hearing impairment, colour blindness, illiterate /dyslectic, upper limbs impairment and neck problems (Visintainer et al., 2007). The ADAS that have been selected, implemented and integrated to the CERTH/HIT test vehicle to demonstrate the proposed algorithms and UI adaptation are:

- Adaptive Cruise Control (ACC) and Collision Avoidance System (CAS).
- Lane Departure Warning (LDW).

The driver keeps receiving the ASK-IT info from his/her ASK-IT nomad device. No transfer to an in-vehicle system takes place. The ASK-IT nomad device is connected to the car through a Bluetooth gateway. Thus, the ASK-IT services HMI adaptation for the MI users is according to the one developed for ASK-IT. Only the related ADAS HMI is thus adapted, when needed. ADAS algorithms have been adapted in terms of timing, modality and intensity of warning.

As a general rule, ADAS warnings have priority over all ASK-IT UCs. Thus, when an ADAS message is given, the ASK-IT messages will be interrupted or delayed by 20 seconds. Exceptions are the ASK-IT use cases related to emergency issues, which have top priority and follow their functionality in parallel to ADAS operation. For example, if a lane departure warning comes when the driver has pushed the emergency button requesting help, then: the LDW warning is given to the driver, while at the same time the car is being braked and the alarms are being activated. When the Center sends the feedback that help is coming, the driver is being informed. Another exception is the relevant use cases where the user has to turn to the next junction, the ADAS warning will come first but then the indication to turn may come after it with less distance than 20sec, so as not to lose the junction. This distance may never be less than 3sec.

The in-car module consists of two components; the server and client modules. The server module resides at PDA device and the client module resides at car's PC.

Fig. 11. Server's application

Fig. 12. In-car client module, with speed > 15 km/h

4. System evaluation in the Greek pilot

ASK-IT services have been installed in 8 sites Europewide, where significant accessibility content and infrastructure existed beforehand (to minimise efforts) but with many different IST technologies and sociological characteristics (to demonstrate interoperability). The ASK-IT sites were: Athens-Thessaloniki (GR), Bucharest (RO), Genova (IT), Helsinki (FI), Madrid (ES), Newcastle (UK), Nuremberg (DE) and The Hague (NL) as satellite site. Roughly 50 users tested ASK-IT services per site. Several hundreds of POIs and PT hubs and routes, as well as pedestrian routes have been connected to ASK-IT in each site, including a total of roughly 50 different service and content providers integrated into ASK-IT platform. Furthermore, cross-site Pilots between these sites guaranteed the seamless service delivery across Europe.

The Greek pilot site is a combined site, taking place in the two largest cities of Greece, Athens and Thessaloniki. All the above described services were evaluated with users with motor disabilities, as well as hearing problems and dyslexia. Participants were recruited by three supportive, non-profit, non-Governmental organizations. Moreover, mobility-impaired individuals were referred by employment counseling services.

The ASK-IT services enjoyed high levels of user acceptance from participants of the Athens-Thessaloniki pilot site. The easiness of use is highly related to the HMI issues. 72% of participants found ASK-IT easy or very easy to use at the start, and 74% found it easy or very easy to learn.

The following graph provides a visual image of the users' feedback, where the percentage of users that provided positive replies can be distinguished. The results are very encouraging.

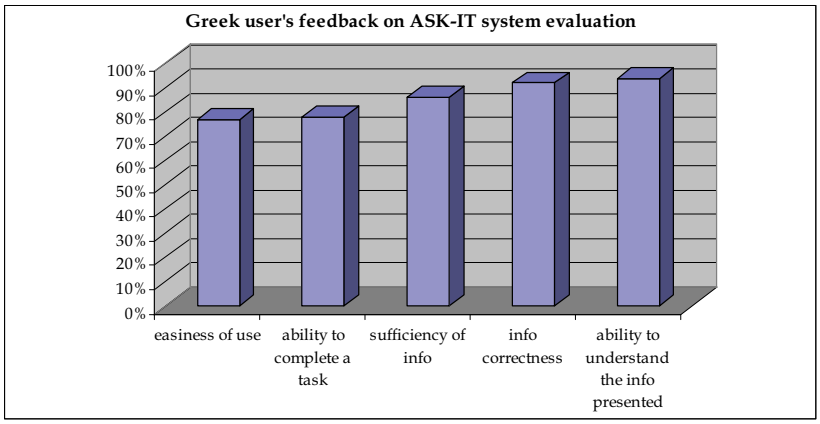

Fig. 13. Percentage of users with positive replies.

The personalisation service was accurate in terms of people's preferences for 89% of participants. Overall, 92% of people found ASK-IT met their needs. Security and privacy is seen as important or very important and all were satisfied or very satisfied with the perceived security of ASK-IT.

In terms of the graphical user interface, 84% of people found it easy or very easy to use it, of which 96% of participants found clear or very clear. 70% of participants found the text to be clear or very clear and 98% found the colour contrast to be clear or very clear. 71% of people suggested that the buttons and keypad are easy or very easy to use, although 65% would like additional buttons.

The responses regarding the ASK-IT services most cited as improving accessibility are shown below:

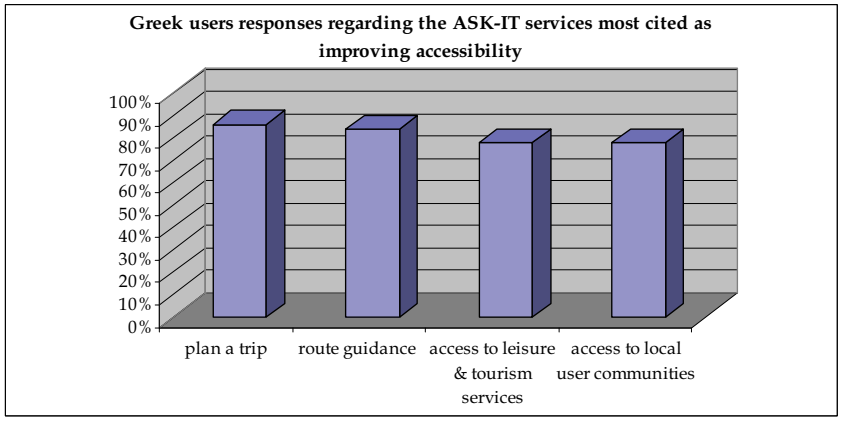

Fig. 14. Percentage of users suggesting the most important services for improving accessibility.

All participants would consider using ASK-IT in the future. The main factor that would influence their decision is the cost of equipment.

5. Conclusion

The findings from Athens-Thessaloniki are very positive in terms of user acceptance and usability. There appear to have been very few problems during the user trials. All the services are valued relatively highly.

ASK-IT research continues in OASIS IP (www.oasis-project.eu) which uptakes the ASK-IT ontology and further enhances it, within the scope of an open Hyperontological framework and further develops the alignment tool towards a semi-automatic version. Also, limitations of mobile devices reported by the users that obstruct them to use ASK-IT services intuitively, are dealt into AEGIS IP, that strives to make the next generation of mobile devices, desktop and rich internet applications fully accessible (www.aegis-project.eu).

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