A system for adaptive platform-independent mobile learning

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Abstract

In this paper we present our work on the extension of a state-of-the-art e-learning system – the Intelligent Web Teacher (IWT) – to support multimodal mobile access in order to offer a complete set of learning experiences, services and models that are able to fit the complex and variegated mobile world. The extended platform can offer customised e-learning experiences depending on the type and capabilities of the user's mobile device. After a brief overview of the IWT e-learning platform, the paper describes how we approached the extension of IWT to provide browser-, SMS- and voice-based interactions. Some first experimental results are then given in the last section. The work described here was realised in the context of the EC-funded m-learning project.

Keywords
e-learning, ITS (Intelligent Transportation Systems), mobile technologies, SMS, IVR

1 Introduction

The spread of the use of mobile devices and technologies offers great opportunities for the e-learning community. New scenarios, didactical models, learning experiences and services have to be designed for this new category of user. Learning may now become, as never before, 'when you want'; but also, and this is the potential of mobile technologies, 'where you want' – in the street, on the underground train, when it is necessary or when there is enough time. Moreover, mobile technologies permit provision of continuing education/training to those users who are not taking part in traditional education, but have a mobile phone and use it every day.

The mobile users' community is a complex and variegated world, characterised by different devices and technologies which are constantly changing. Technologies range from highly diffused SMS (Short Message Service) to MMS (Multimedia Messaging Service); from WAP (Wireless Application Protocol) to HTTP (Hyper Text Transfer Protocol); and from GSM (Global System for Mobile Communication) through GPRS (General Packet Radio Services) to UMTS (Universal Mobile Telecommunications System). Devices vary from mobile phones to personal digital assistants (PDAs), from new-generation Smartphones to laptop computers.

Our aim is to extend an existing e-learning platform, the Intelligent Web Teacher (IWT), in order to allow the design and delivery of significant learning experiences via a huge set of mobile technologies. This was done in the context of the EC-funded m-learning project.

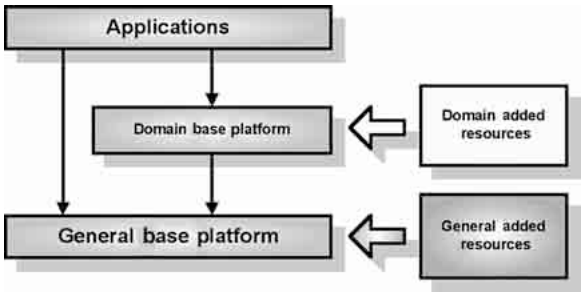
2 The IWT e-learning platform

Every didactic/formative context requires its own specific e-learning solution: not only with regard to the content, but also the didactical model, formative modules, applications and tools. These necessities usually imply hard work for analysts, engineers and developers. IWT (Capuano, Gaeta and Micarelli 2003) solves the problem, thanks to an extensible solution which can become the foundation of a virtually infinite set of applications for either traditional or innovative e-learning.

Conceptual and technical choices in design and development have brought about an architecture that can be extended both in terms of services and learning object typologies through the installation of added components. Indeed, IWT allows the user to add to the platform new services written *ad hoc* for the system by previous implementations of suitable plug-in software that is compliant with system specifications.

As illustrated in **Figure 1**, the general IWT platform offers a set of generic management services for content, courses, collaboration and administration. Some of those services are fixed (general base platform) while others are optional (general added resources).

Figure 1
General IWT architecture



IWT allows the user to manage contents like learning objects, tests, business games, etc. Furthermore, given the extensibility of the platform, it is possible to add new typologies of resource at any time, without altering the system. IWT also allows the users to manage courses. Two kinds of courses are supported: simple and intelligent. The intelligent course (Capuano *et al.* 2002) can be customised according to the real needs and preferences of the students and fully applies the principles of student-centred learning.

Given a set of didactic objectives chosen by the teacher on the domain ontology, the intelligent course is able to generate the best learning path for each student starting from its student model, based on acquired knowledge about the student and his/her learning preferences. Different students with the same didactic objective will thus have different courses generated by the system.

IWT also allows the users to collaborate and communicate with each other via messages, discussion forums, chat, content sharing, videoconferencing, etc. IWT applies three different models: the knowledge model, the student model, and the didactical model and is paradigm-based on a pattern adapter to allow extensibility. IWT is built completely using Microsoft .NET technology.

3 Browser-based interaction

Users who have HTML-enabled mobile devices may access a subset of IWT functionalities. Content and layout (see **Figure 2**) are automatically adapted by the IWT engine which recognises what kind of device users are employing for the connection. This was achieved by adopting the Microsoft Mobile Internet Toolkit (Lee 2002) which extends the Microsoft .NET Framework with server-side technology, allowing the delivery of content to a wide variety of mobile devices including mobile phones supporting Wireless Markup Language (WML) and compact HTML (cHTML), HTML pagers and PDAs like the Pocket PC.

Figure 2
IWT interfaces for mobile devices

Supported IWT functionalities on the mobile browser include course subscription, course delivery and basic collaboration features (like chat, forums and messaging). Such functionalities are synchronised with those available on the PC web browser. It means that people are able to communicate with each other even if they are using different kinds of device.

4 SMS-based interaction

SMS is the most common and frequently used mobile service: it is present in every kind of mobile device and offers the possibility of reaching all mobile users. Our idea was to build courses composed of SMS 'pills' – short textual learning objects – together with multiple-choice tests delivered by SMS. The learner can answer tests by simply replying to the test SMS question with an SMS containing the answer. The system tracks the answer received from every single learner, verifies the results and sends him or her a new SMS containing the test results and suggesting improvements.

Figure 3 Extended IWT architecture for SMS support

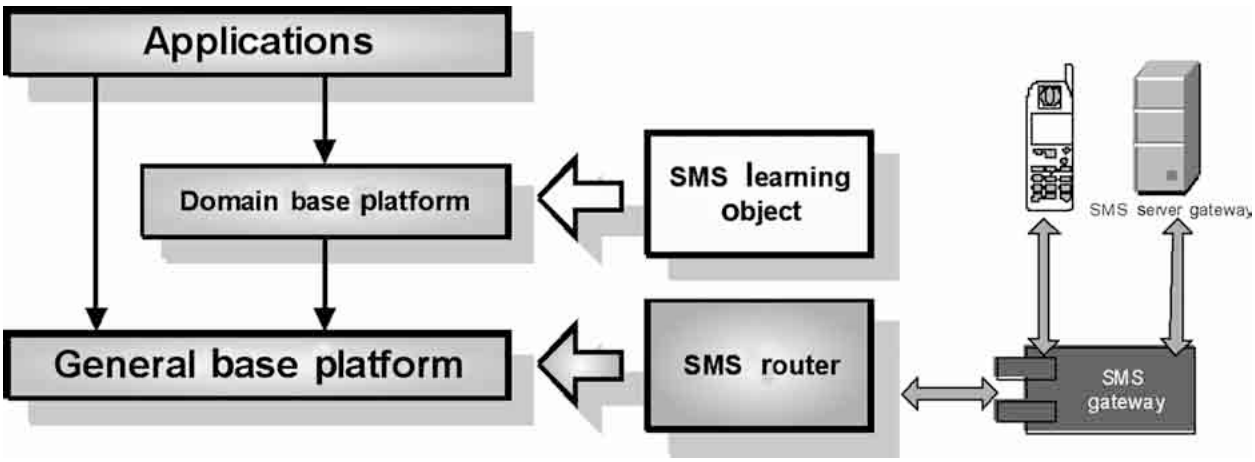
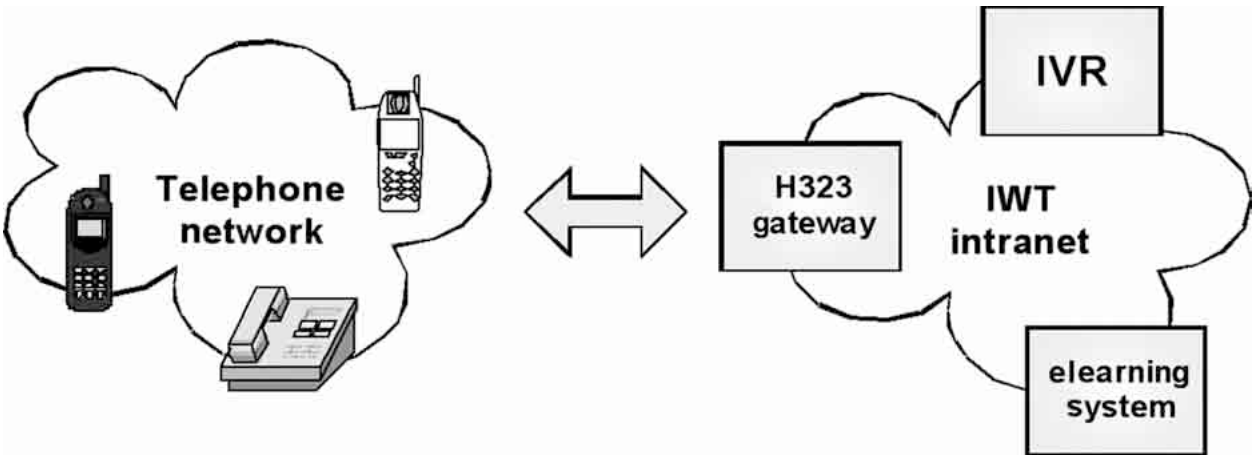


Figure 4 Adoption of voice-based interaction in IWT



To allow the management of these new types of learning object, we created several new IWT resources (see **Figure 3**): SMS Test, SMS Textual and SMS Course. To allow the learner to send/receive SMS, we have extended the IWT services with an SMS router module that interacts with an SMS gateway. An SMS gateway is a simple SMS-enabled mobile phone or an SMS server accessible as a web service.

5 Voice-based interaction

Last but not least, the system is also able to provide voice-based interaction. The learner can access the system with a normal phone call and can navigate the IWT portal using IVR (Interactive Voice Response). A synthesised human voice reads a simplified version of the portal content and the user can browse by dialling on the phone keyboard.

This access method was achieved by connecting to the IWT general base platform a software-based IVR facility linked to the telephone network through an H323 gateway (see **Figure 4**). A new version of the IWT portal was then provided in the form of a navigation tree. Each node of such a tree represents the current position of the learner, while each branch is a possible choice at that point. Some information features (bulletin and news reading, course lists) and collaboration features (messaging, voice chat with a tutor) were then implemented using voice-based interaction.

6 Preliminary experimentation results

The mobile browser-based interaction described in section 3 is under trial, with around 200 users from the UK, Italy and Sweden taking a set of courses on literacy and numeracy.

In collaboration with Albatros, an organisation from South Italy that works for the social integration of foreign and dialect-speaking people, we are currently starting a new trial based on an SMS first-level Italian language course, again using voice-based interaction for collaboration activities.

The final results of both trials are not available yet. The first impression is that users are generally highly motivated when using mobile technologies for learning, with a particular emphasis on SMS technology, which seems to be more effective and simple than browser-based interaction which still presents connection problems.

References

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