MMALL
Multilingual Mobile-assisted Language Learning

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Abstract: Learning multiple foreign languages has become a necessity in modern life since globalization is a phenomenon responsible for joining different cultures from all over the world. Computer-assisted language learning tools exist over the last decades and their assistance has been considered as quite beneficial in the area of education. However, the incorporation of mobile facilities in these tools offers the quite important facility of time and place independence for the users that are going to use them. Towards addressing the problem of providing mobile-assisted language learning, in this paper we present a sophisticated educational system called m-MALL. The m-MALL system has the additional advantage of providing multilingual support, a facility that is not yet investigated in the related scientific literature.

1 INTRODUCTION

Mobile-Assisted Language Learning (MALL) represents a very recent research field in the domain of language learning where the educational process is assisted or enhanced through the use of handheld mobile devices. As a result, MALL is a subset of both Mobile Learning (m-learning) and Computer-assisted language learning (CALL). MALL has evolved to support students' language learning with the increased use of mobile technologies such as mobile phones (cellphones), PDAs and devices known as smartphones. Through MALL, students have the ability to access language learning materials, test their knowledge, as well as to communicate with their teachers and peers at any time and at any place.

In our century, we have witnessed major improvements in the areas of transportation and telecommunications, permitting globalization by which regional economies, societies, and cultures have become integrated through a global network of people. As a result, personal, professional, social, and economic considerations all point to the advantages of learning foreign languages (Kurata, 2010). Considering the scientific area of Intelligent Tutoring Systems (ITSs), there is an increasing interest in the use of computer-assisted foreign language instruction. Especially, when these systems offer the possibility of multiple-language learning at the same time, the students may further benefit from this educational process (Virvou et al, 2000). The need for tutoring systems that may provide user interface friendliness and also individualized support to errors via a student model are even greater when students are taught more than one foreign languages simultaneously. Student modeling may include modeling of students' skills and declarative knowledge and can perform individualized error diagnosis of the student. However, in the recent scientific effort, it is not depicted the implementation of mobile-assisted language learning systems, which can support multilingual content in their domain of knowledge.

In view of the above, in this paper we propose a multilingual mobile-assisted language learning system which is the application of MALL in a multiple language learning environment. The prototype system combines an attractive multimedia interface and adaptivity to individual student needs in mobile learning. The communication between the system and its potential users as students is accomplished through the use of web services.

The paper is organized as follows. Firstly, we present the related work, concerning CALL systems, MALL systems and mobile learning in section 2. In section 3, we discuss our system's architecture. Following, in section 4, we present a description of

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our system, namely a general overview accompanied by screenshots of the system. Finally, in section 5, we come up with a discussion about the usability of the resulting system and we present our next plans.

2 RELATED WORK

Teaching languages through computer-assisted approaches is a quite significant field in language learning. A small number of researchers in the subject area have been further attracted by mobile-assisted language learning (MALL) over the last decade but this interest is rapidly growing. The majority of scientists, who are interested in these fields, have been attracted by computer-assisted language learning (CALL) or even mobile learning (m-learning). In this section, we try to imprint the speckle of the scientific progress in assisted language learning.

2.1 Computer-assisted Language Learning

AutoTutor is a CALL system, developed by Graesser et al (2005), which simulates a human tutor by promoting the conversation and provides feedback to the learner, pumps him/her for more information, gives hints, fills missing information with assertions, identifies and corrects bad answers, answers learner's questions and summarizes answers. Another CALL system is rEcho, which is developed by Zhou et al (2007), can give relevance feedbacks through anatomy animation and is based on deliberate data trained recognition to give error trend relevant feedbacks. SignMT was implemented by Ditcharoen et al (2010) to translate sentences/phrases from different sources in four steps, which are word transformation, word constraint, word addiction and word ordering. Another computer-based program on second language acquisition is Diglot Reader, which was developed by Christensen et al (2007) and is used in a way that students may read a native language text with second language vocabulary and grammatical structures increasingly embedded within the text. TAGARELA is an individualized instruction program, implemented by Amaral et al (2007), which analyzes student input for different activities and provides individual feedback. Finally, VIRGE, developed by Katsionis and Virvou (2008), works as an adventure virtual reality game but it has educational content as well and supports personalized learning based on a student modeling component.

2.2 Mobile Learning

Mobile learning is a general aspect of assited language learning and focuses on learning across contexts and learning with mobile devices. Jeng et al (2010) conducted an investigation of add-on impact of mobile applications in learning strategies. They surveyed recent researches including context awareness, pedagogical strategy-enhanced learning scenarios, as well as collaborative and socially networked mobile learning. Through their review study, essential characteristics of mobile learning were identified and discussed. Frohberg and Schwabe (2009) note in their critical analysis that mobile learning can best provide support for learning in context. There, learners are asked to apply knowledge and not just consume it. Furthermore, mobile learning should provide instruments to provoke deep reflection, communication and cooperation. Kuo and Huang (2009) propose an authoring tool named Mobile E-learning Authoring Tool (MEAT) to produce adaptable learning contents and test items. In addition, the visualized course organization tool has also been provided to teachers to organize their teaching courses. Moreover, Motiwalla (2005) proposes a project which explores the extension of e-learning into wireless/handheld (W/H) computing devices with the help of a mobile learning (m-learning) framework. This framework provides the requirements to develop m-learning applications that can be used to complement classroom or distance learning. A prototype application was developed to link W/H devices to three course websites. Gu et al (2011) make an effort to provide learning in informal settings through mobile. In order to learn how to develop usable learning content for lifelong learners on the move, a set of design principles from both pedagogical and usability concerns was identified. Next, a pilot system, based on the design principles, was developed to implement two prototype lessons. Finally, Mobile Author is an authoring tool, which was implemented by Virvou and Alepis (2005) and allows instructors to create and administer data-bases, concerning characteristics of students, of the domain to be taught and of tests and homework, through any computer or mobile phone.

2.3 Mobile-assisted Language Learning

Mobile-assisted language learning has evolved to

support students' language learning with the increased use of mobile technologies such as mobile phones and other devices. With MALL, students are able to access language learning materials and communicate with their teachers and peers. Chang and Hsu (2011) introduce a computer-assisted language-learning system for use on PDAs, which integrates an instant translation mode, an instant translation annotation mode and an instant multi-users shared translation annotation function in order to support a synchronously intensive reading course in the normal classroom. Zervas and Sampson (2010) propose an IEEE Learning Object Metadata (LOM) Application Profile that can be used for tagging educational resources suitable for Language Learning and supported by mobile and wireless devices. Fotouhi-Ghazvini (2009) et al also occupied with mobile-assisted language learning. Their paper concludes that using m-learning within the informal framework of learning provides a ubiquitous tool that can powerfully help adult learners and students in Iran during their continuous lifelong learning. Uther et al (2005) present a mobile adaptive computer-assisted language learning (MAC) software aimed to help Japanese-English speakers in perceptually distinguishing the non-native /r/ vs. /l/ English phonemic contrast with a view to improving their own English pronunciation. Sandberg et al (2011) conducted a research concerning the way that mobile learning may affect learning performance. Three groups participated in their study on the added value of mobile technology for learning English as a second language for primary school students.

However, after a thorough investigation in the related scientific literature, we came up with the result that teaching multiple languages through an integrated tutoring system via mobile is an approach that was not investigated before. For this reason, we implemented a prototype system, which incorporates user modeling and error diagnosis components, while teaching multiple languages through mobile devices. Our system offers the possibilities of e-learning and distance education as it operates in mobile devises, but also it offers interactivity and adaptivity to individual students needs. The resulting system includes all the standard attributes of an ITS and complies with its architecture, which consists of the domain knowledge, the student modeler, the advice generator and the user interface (Virvou and Alepis, 2005). A novelty of the system lies in the multilingual component and in the error diagnosis process, which is carried out through the m-MALL. The system provides estimation of the learner's proficiency in the domain as well as his/her proneness to commit errors. The facility of individualized error diagnosis is particularly important for students, who can benefit from advice tailored to their problems.

3 GENERAL ARCHITECTURE OF THE SYSTEM

In this section, we describe the overall functionality and features of m-MALL. The architecture of m-MALL consists of the main educational application, a student modelling mechanism, a web service, a database and finally an educational application installed locally in each user's mobile device. The web service is responsible for transferring the available information from the main system's database to the mobile application. The database is divided in two logical partitions. One part of the database is used to store educational data and another part is used to store data related to user modelling, namely student profile information and error diagnosis data. Accordingly, the database is used to store user models and user personal profiles for each individual user that uses and interacts with the system, as well as stereotypic information about user profiles. Each user's initial profile is updated while s/he uses the educational system. The system's general 4-tier architecture is illustrated in figure 1.

Correspondingly, the student modelling mechanism consists of two sub-mechanisms. One mechanism that is responsible for each student's model and another mechanism that reasons about Multilanguage errors (figure 2). Each student's profile takes initial values by combining the student's personal information (such as age, gender and educational level) with pre-stored stereotypic information. Consequently, the student model is adapted according to the students' performance while using the educational application. The Multilanguage error diagnosis mechanism tries to find possible reasons about student errors in a Multilanguage domain of knowledge. As a next step, these errors are categorized in terms on five pre-defined categories of errors.

Error diagnosis in the student's domain of knowledge is accomplished by recognizing errors and trying to associate them with one of the following five categories of errors:

1. Article and pronoun mistakes

For example the user may have used "a" instead of "an" or "he" instead of "we".

2. Spelling mistakes

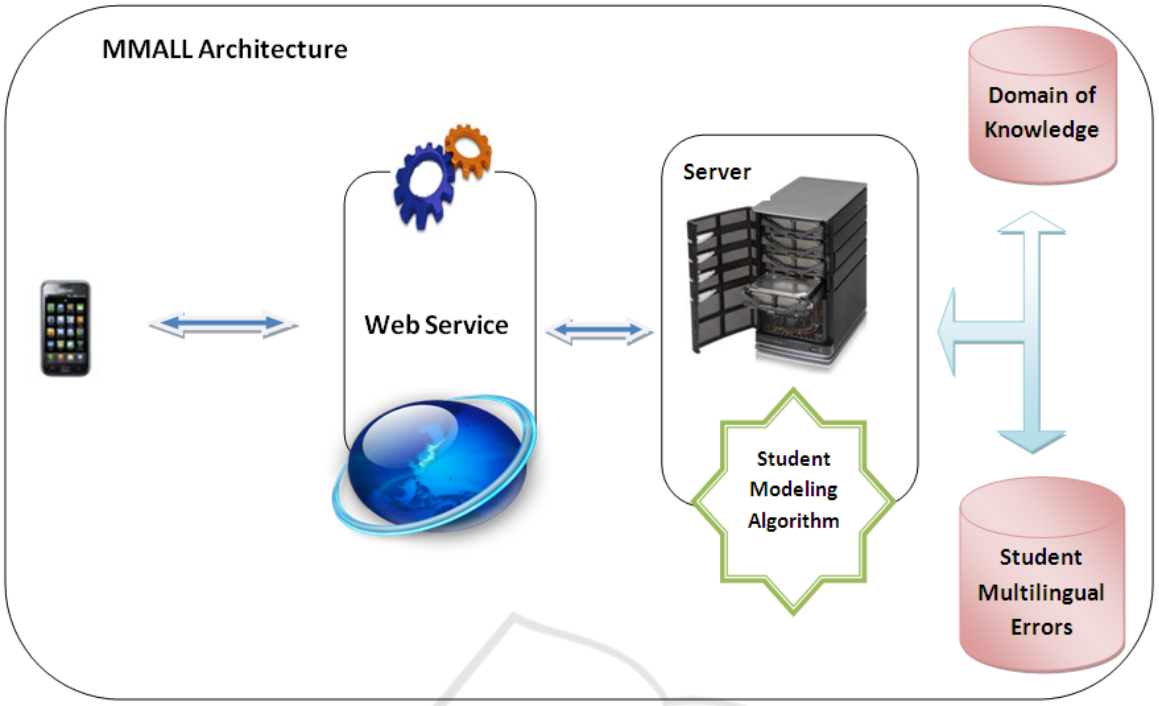

Figure 1: Architecture of m-MALL.

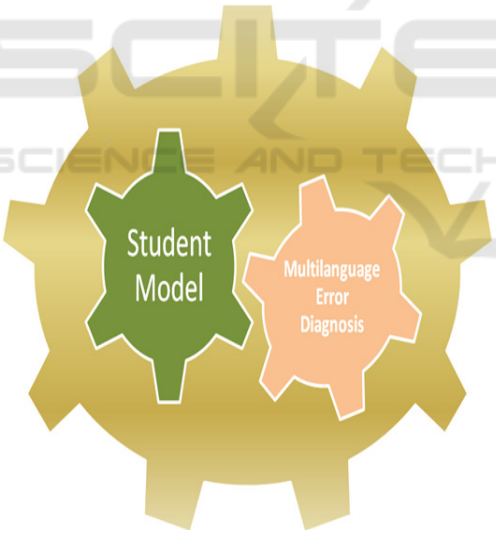

Figure 2: The Student modelling mechanism.

A spelling mistake is a result of letter redundancy, letter missing or interchange of two neighbouring letters.

3. Verb mistakes

Verb mistakes occur when the user has typed another person than the correct one, for example s/he may have typed "I has" instead of "I have".

4. Unanswered questions

The user may have no idea about what s/he should write and leave the question unanswered. That means that s/he has lack in theory.

5. Language Confusion

The resulting system is a multilingual learning system, which means that a student may learn two or more languages at the same time. However, there is the possibility of student's getting confused, concerning the proper use of an article or verb.

In order to successfully recognize one or more of the fore mentioned categories of errors, m-MALL incorporates two algorithmic approaches, as illustrated in figure 3. The first algorithm tries to find string similarities by matching a student's given "exact" wrong answer with the systems correct stored answer. If string matching occurs in a high percentage the system decides whether the mistake lies between categories 1-4. Correspondingly, using the second algorithm, the system also tries to find meaning similarities between the given and the correct answer by translating these two answers to the system's available supported languages. As an example, the student may have used "I am" instead of "Je suis", which is the French equivalent.

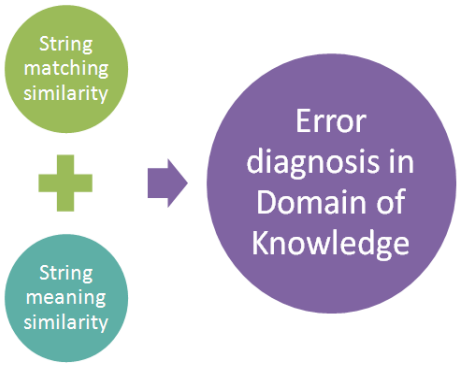

Figure 3: Error diagnosis mechanism.

A matter of great importance is the existence of a long term user model for each student. The system includes also a form, which keeps information about the student's progress in the three languages, the total grade in each one of the three languages and all the results of the tests. Students may benefit from viewing their own student models. For this reason, this form can be presented to students so that they stay aware of their advance of knowledge. M-MALL programs may promote noticing (focus on form) that will result in the improvement of students' existing grammatical knowledge. This can be accomplished by evaluating the students' performance through several tests.

The proposed architecture of the m-MALL prototype system gives great flexibility both to the students who are using the educational language learning application and to their instructors or supervisors, since the remote database can be easily updated and enriched with new knowledge domain data and user specific information. Furthermore, this is also the case of the student modelling mechanism since the algorithms may be independently modified or changed in order to provide more sophisticated feedback for the students

4 OVERVIEW OF THE SYSTEM

M-MALL has been developed to operate on the Android mobile operating system, while as for future work the authors are planning to provide implementations for other existing mobile phone platforms as well. Correspondingly, the system is programmed using JAVA as a programming language. This specific programming language is also compatible with the system's Object Oriented structure.

As we can see in figure 4, the m-MALL system is packaged and installed as an application in an Android operating smartphone. Each user can run or stop the educational application by using to start or to stop m- MALL through his/her mobile device. However, this mobile application relies on data stored in m-MALL's server and transferred to each interacting user through a web service.

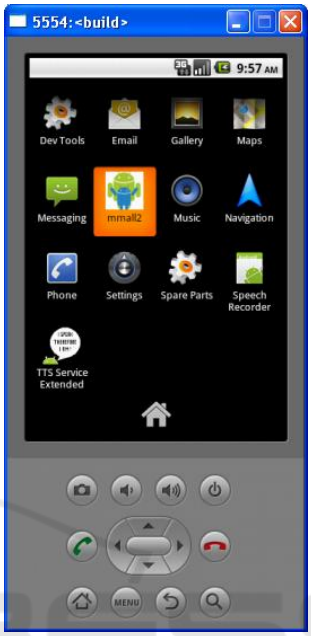

Figure 4: m-AWARE as an application in a smartphone.

Figure 5 illustrates a snapshot of the operating educational application where each student's personal profile may be updated. Personal student information is used for the student model to initialize using student stereotypic information which is stored in the system's database. According to each student's personal profile the system chooses which parts of the theory are appropriate for the student's learning level as well as the difficulty of each test.

Figures 6 and 7 illustrate snapshots of the operating educational application, where a student is completing a "fill in the gaps" exercise and taking the system's feedback. More specifically, in figure 6 we may see a student who has to fill in the gaps with the right word. The questions appear randomly and are adapted to each student model. It is quite important to note that the student must have acquired the knowledge offered by all the lessons as prerequisites.

Figure 7 illustrates a categorization to a student's specific errors. The student can be evaluated and check where s/he is wrong and what type of mistake s/he has made. The different colours indicate different type of errors:

- The red colour in the field means error in articles or pronouns.
- The green colour means a verb mistake.
- The yellow colour means a spelling mistake.
- The blue colour means confusion with the French language, while the purple means confusion with the English language.
- Finally, the grey colour indicates an unanswered question.

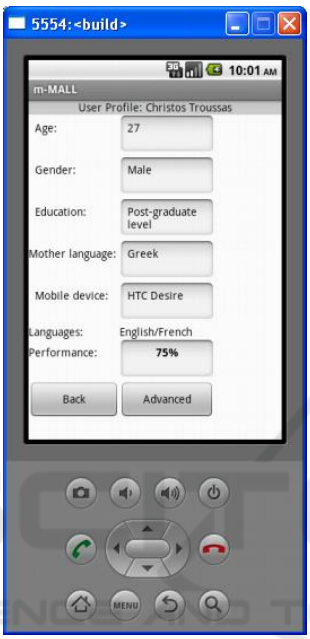

Figure 5: Snapshot of a user editing his/her profile.

Figure 6: A student is taking a test.

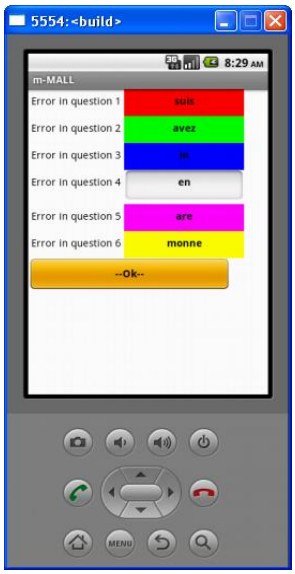

Figure 7: A student is viewing his/her errors.

At the same time, the system shows the grades of the students, along with the exact number of the errors in each category. The overall interaction through a mobile device is as much user friendly as possible in order to achieve high interactivity with regards to the limited functionalities and technical specifications of mobile devices in comparison with personal computers. To this end, part of the most "demanding" processing of data is carried through the system's main server and then transferred to the mobile device using web services.

5 CONCLUSIONS AND FUTURE WORK

M-MALL is a multilingual mobile educational application which combines attractiveness and user-friendliness that usual desktop applications provide with the well-known advantages of mobile learning. It is not only a post-desktop model of human-computer interaction in which students can "naturally" interact with the system in order to get used to electronically supported computer-based learning, but it promotes the m-mall in a platform where the student interacts with his/her mobile phone. In particular, the system incorporates the student modeling component for each user and performs error diagnosis. Moreover, the system keeps each student's error history in one language that is already taught and then provides advice in the tests of the other languages. In order to perform error diagnosis, the system bears a detailed

categorization of common student's mistakes. The error diagnosis process of the m-MALL system is especially focused on errors due to confusion of the other languages of the system, if the student learns more than one language at the same time. Furthermore, apart from the friendliness of the user interface, the system is oriented to offer adaptivity and dynamic individualization to each user that interacts with the educational application. All the available data that are used both for the domain of knowledge and for the student model are stored and processed in a server and transferred to each student's mobile device through the use of web services.

It is in our future plans to evaluate m-MALL in order to examine the degree of its usefulness as an educational tool for teachers, as well as the degree of usefulness and user-friendliness for the people who are going to use the educational system. We are also planning to extend the functionalities of our system by incorporating an authoring component into the m-MALL system in order to help teachers author their Multilanguage learning lessons. This incorporation will give the facility to teachers with limited computer skills to author important modules of the educational system in a short time and with less effort.

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