Speaky Notes

Learn languages with augmented reality

Fabio Sorrentino, Lucio Davide Spano, Riccardo Scateni
University of Cagliari
Department of Mathematics and Computer Science
Cagliari, Italy
fabio.sorentino@unica.it, davide.spano@unica.it, riccardo@unica.it

***Abstract*—In recent years, mobile devices have become very popular within young people. Thanks to developments in mobile technologies, these devices can now do much more than just voice calls and texts. We envision mobile devices as tools for improving the young users' lifestyle, especially for learning. In this work we present a web authoring system that makes it possible to create a mobile application that supports children in learning a new language in a more pleasant and entertaining way by using Augmented Reality. This application allows pupils to improve their speaking skills turning the language acquisition into a game under the supervision of both teachers and parents. Our contribution is focused on understanding how digital technology can facilitate learning while keeping in mind that it is a wide and interdisciplinary issue.**

Keywords—Learning, Child, Augmented Reality, Voice, Language

I. INTRODUCTION

Two of the most common questions among teachers of primary school are: *How can I engage students? How can we get kids to do their homework?*

Research [1] has proven that parental participation in the education process plays a major role in their scholastic capabilities and general development. Based on this observation, it is important to use an approach that encourages parents to help their children in doing their homework. We think that new technologies, especially mobile devices, are the mean through which it is possible to improve the students' engagement and their learning process. This paper presents Speaky Notes, a part of a bigger project named LEAF.

LEAF is a web system that allows users to create their own personal dictionaries (called *e-dictionary*). Each dataset record thus represents a single term object and contains the word's syntax, its translation (in one or more languages), its phonetic transcription, its audio pronunciation and a representative image. Every dataset record is validated by linguistic experts and, thanks to its API, it is possible to use this collection in a fast and easy way.

In fact, Speaky Notes is focused on children learning using new technologies, and its goal is to give teachers and parents a useful tool able to turn lessons and homework into more pleasant and fun activities.

Regarding these new technologies (e.g. smartphones and tablets) and their owners' age range, we can affirm that year after year, it is common to see kids using their parents' smartphones or even their own personal mobile devices.

In the same way children learn to speak in the first years of their lives, they also learn to interact with these mobile devices while still in the childhood.

At the beginning, they learn how to unlock the phone, then they tap randomly over the screen surface, and finally they start to explore the device features. It is impressive how fast children learn to use this kind of devices, and after a while they actually understand the correlation between icons and applications. Due to this, it is clear that in primary school we will see skilled smartphone users that use a tablet to improve their learning.

Fig. 1. Speaky Notes as it appears on an iPhone 6 using the marker 'Porta' (that means *Door* in english) before (a) and after (b) the image recognintion.

Having such skilled users makes it possible to use these devices for learning. In our case study, we focused on language

learning, and, more precisely, our tool is oriented to the acquisition of the language vocabulary and its pronunciation.

In detail, the presented system allows teachers and parents to easily create an application for mobile devices that uses AR. This tool becomes really useful in children's hands because they learn through playing. The main reason that motivates our case study is explained in [2], in fact, if we consider the English native speakers and second language speakers who use this language for their day-to-day needs, it is possible to cover around the 15% of the world's population.

Finally, this work tries to contribute to the improvement of children education pursuing the following objectives:

1) Promote educational innovation by providing educators with a novel tool for teaching;
2) Allow a self-regulated learning at home with the participation of parents;
3) Analyse the possibilities that augmented reality techniques can have on children education.

II. Related Work

Augmented Reality, abbreviated as AR, can be defined as a type of virtual reality where digitally rendered 2D/3D objects that are generated by the computer are superimposed onto the real word. Indeed, the final result is the combination of real scene enriched with the virtual one. The main goal of these techniques is to give users the illusion of perceive both scenes as a single one, without notice where ends the real scene and starts the virtual one.

Even if the most significance in AR has been since the middle of nineties, it has its origins in the fifties.

Augmented reality is marked as a hot topic during these years. Existing devices that use it, such as smartphones and tablets, or that are being developed, like special glasses, allow the enrichment of our real environment with virtual information. This information is presented in a way that makes it much more fun, useful and accessible. This approach, if applied to the education field, means the creation of new incredible scenarios which would otherwise be impossible. For example, using augmented reality, we can hold something as small as an atom or as big as a star in our hands.

In 2010, augmented reality reached number four in Time magazine's 10 Tech Trends list [10] and then BBC reported that it "*looks set to become a serious commercial tool*" (BBC News, 2011).

If augmented reality techniques offer new learning opportunities, it is clear that they also create new challenges. As discussed in [3] the AR should be considered as a concept rather than a technology. We analysed works focused on learning (in any field) using an augmented approach, especially the ones regarding primary school pupils.

Another aspect that motivates us to pursue our goal is the impact of augmented systems on students' enthusiasm; in fact, several studies have noticed the improvement of students' motivation towards learning with this approach [3] [4].

In [5] we can find an augmented reality approach used for geometry teaching while in [6] a comparison between two 3D astronomical tangible model is shown. The first one is built using physical models while the second one uses an augmented reality approach. These tangible models show augmented views of the celestial bodies and support the students' investigation using spatial visual guides. Built through an exploratory experiment with 39 primary class students, they investigated the potential of the augmented scenario comparing the learning results with those achieved with the traditional physical model. The results show that this augmented learning environment significantly enhances astronomical learning. Moreover the model allowed users to concentrate on their tasks also enhancing the task controllability.

Among augmented reality applications that are focused on children learning, we have analysed ZooBurst [11] that is a "*digital storytelling tool that lets anyone easily create his or her own 3D pop-up books. As an educational tool, ZooBurst gives students new ways to tell stories, deliver presentations, write reports and express complex ideas*". This tool is mentioned as one of those with most potential for language teaching and learning case studies in the Salmon and colleagues' study [9] where an evaluative framework has established a potentially useful baseline for making decisions about the use of AR applications in the classroom. Even if ZooBurst has not been specifically designed for language teaching and learning, it is a flexible tool that could be used for this purpose. This project highlights how children can learn through playing, that is our own way of thinking.

Cascales and colleagues in [7] report an experiment where a sample of 36 preschoolers, having the same curriculum, were split in two groups (with/without an AR approach): even if the learning outcomes do not present significant statistical difference, they affirm that all participants considered the use of augment reality technique a good approach in the teaching/learning process.

In their conclusions we can find some interesting points, in particular they say that "*AR also promotes communication skills, promoting all kinds of interactions in the classroom between teacher and students, students and students, students and families, families and families and teachers and teachers*", therefore considering it a learning tool fostering social aggregation.

The potential of an augmented reality approach in education is clear, and it is easy to understand that such software may offer many exciting features to children in their learning process. Even if these aspects are interesting for the community, little research has been done into the teaching and learning field using such kind of methodologies as explained in [9].

III. Game Scenario

As we explained earlier, educators have a set of tracking cards and they have to place them over real objects, avoiding those that are placed in high or dangerous areas.

When all cards are well positioned the mobile device can be given to the child/pupil.

After that, the exploration game can start. Firstly, educators give the mobile device to children and they can assist them by giving some information or suggestions. For example they can ask them to find a specific item or by giving directions necessary to reach the next item (*go right*, *go left* and more).

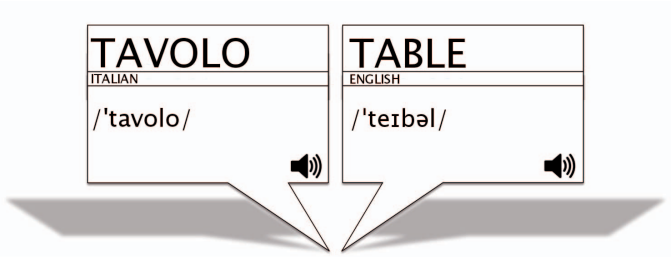

Fig. 2. Augmented reality content that shows the same word (and phonetic transcription) in different languages and allows to listen to an audio file tapping over.

During the game, educators can even ask them to repeat the word or to say the correct spelling.

This game could be conducted in a collaborative way, giving a single device to a group of pupils, thus fostering social interaction between them under the supervision of the educator.

All the elements, including the tracking information, their behaviour and the interaction functionalities, are generated by our system. A video that shows such interaction is available at https://goo.gl/bWFwzA

In addition, we can analyse a possible scenario of our approach:

Bob is a primary school educator that teaches English in an Italian school. He usually trains his pupils with new technologies like tablets and touchable surfaces in general. He is preparing the next lesson that is about new English terms. These words are connected to the house environment such as *door*, *window*, *table*, *chair* and more.

He uses the Speaky Notes web system by choosing among the available categories thus creating his own set of words (see Figure 2). Then he prints the PDF file and cuts the markers out. The day after Bob places them in the classroom explaining the game to his pupils. The school where Bob works has five mobile devices for each class, therefore he splits his pupils in five groups.

He asks to the first group (Alessia, Carlo, Sara, Luca, Paolo) to look for the "*item with a flat top and one or more legs, providing a level surface for eating, writing, or working*", immediately the first group's pupils see the table and go towards it. Then, they frame the card with the smartphone and the relative information is shown over the card. Pupils can now interact with the device by tapping over the augmented content listening to the pronunciation of the word in both Italian and English. Bob asks Alessia and Paolo to slowly repeat the word in English, then he asks Luca and Carlo to spell the word.

Finally he says a sentence to Sara along the lines of "*The table is red.*" asking her to translate it in Italian.

The game ends when all groups have framed all the placed cards.

IV. Speaky Notes System

Children have a critical or sensitive period for language acquisition that lasts until puberty, and during these years, certain parts of the brain are more developed than others. These brain areas are responsible for the unconscious learning such as riding a bike or dancing and this happens for the language learning as well [8]. Thanks to this we can use this "golden period" to learn more than a single language, stimulating children with new approaches involving mobile devices and AR.

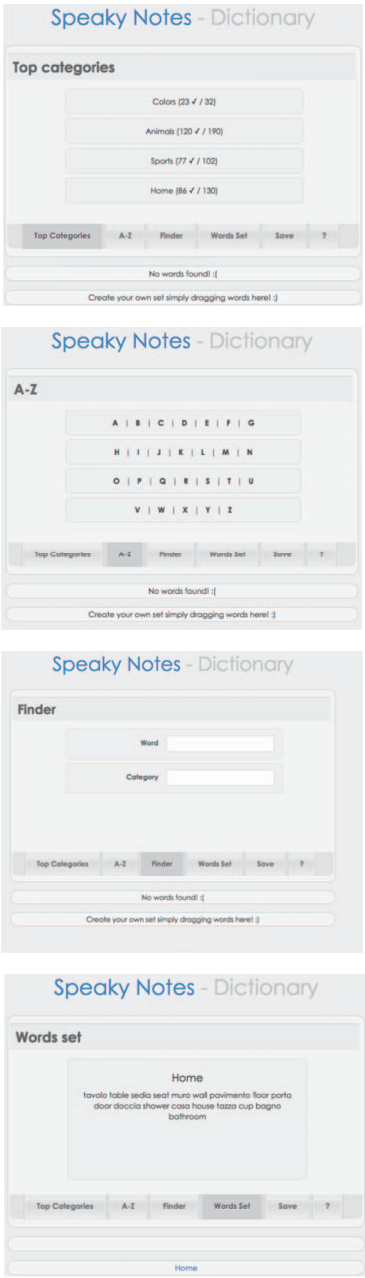

Fig. 3. Speaky Notes web interface. From top to bottom: top categories, first word letter search, term search, e-dictionary summary.

For some people learning a language requires more dedication than many other subjects even though it is not really difficult per se, but it certainly is time-consuming. Speaking a language fluently is made up of three main aspects: know the grammar rules; use a wide vocabulary; know the right pronunciation avoiding misspellings. Surely, there are a lot of correlated aspects that we have not mentioned, but in general these three ones are the most important.

We offer teachers and parents a tool for their children, able to improve their vocabulary and pronunciation of a new language, leaving the acquisition of the grammar rules to standard methodologies.

Our approach does not aim to replace traditional learning methodologies, but would be a complementary tool for teachers to use during the training stage, oriented to the language vocabulary and its pronunciation. Children can easily interact with these devices, in fact they already read e-books on tablets and they do homework directly on them through some sort of web-based platforms.

As we said in the introduction, this work is part of the LEAF project, which is a web system able to create personal dictionaries (called *e-dictionary*). For each word in the collection we can find its syntax, its phonetic transcription, its pronunciation (as an mp3 audio file) and a representative image.

The system allows for terms categorisation; we can, for instance, have the **home** category that contains words like *table*, *door* and *window*. LEAF is still a work in progress; at the moment we count five hundred validated translations that are a good starting point for Speaky Notes. It is worth noting that in this work we do not analyse the LEAF project, but we discuss how we used its dataset and why it is useful and suitable for the Speaky Notes system.

In our case study we implemented a tool for Italian students willing to learn English and also for the English students who want to learn Italian, but the entire system supports any other language pairing. In general we call the content relative to the native language FL (First Language), and SL (Second Language) the other one.

Our approach combines real world and virtual reality by using augmented reality. To achieve this we adopted a card set that represents the words the educators want to teach in the lesson. Both LEAF and Speaky Notes are web-based software. We envision them as freely available systems where teachers and parents can create their own augmented reality experiences and share their e-dictionaries.

These experiences depend on which words they want to teach. Usually, children learn vocabulary terms day by day, and often by categories. Some examples could be categories like **colours** (*red*, *blue*, *black*), **house items** (*table*, *chair*, *door*, *window*), **school supplies** (*pen*, *pencil*, *marker*, *eraser*).

Teachers, browsing among the available categories in the system, as shown in figure 2, can select which of them are suitable for the lesson, and, if necessary, they can create a set of words combining more categories by simply removing or adding single terms.

The search of a word can be accomplished by using a category browser (Figure 2a), by the word's first letter (Figure 2b) or even by using a common search input box (Figure 2c). Then, teachers can drag items into a specific box, building their own card set (Figure 2d). After this step, the personal e-dictionary is used to automatically generate the Speaky Notes mobile application just by clicking on the 'Save' button. This process is fairly immediate and does not require any user interaction. Framing just one QR Code (Quick Response Code), see Figure 3, the generated augmented reality application can be downloaded at a specific link through the Junaio (*www.junaio.com*) channel servers.

In our prototype we used this approach and, thanks to the specifications available on the Junaio framework, it has been possible to programmatically create the entire channel starting from a root project that includes the required AREL (Augmented Reality Experience Language) libraries and some base content.
A PDF containing the Speaky Notes card is available to teachers, as well as the QR Code. This document contains all the words saved in the e-dictionary. At this point the users have to print out and cut out the cards, then they can start the Speaky Notes application by framing the QR Code.

We designed a really simple layout, representing the FL syntax (Italian in our case study). Its layout is showed in Figure 3. We envision each card as a piece of heavy paper similar in dimensions to those used for common card games (60mm x 90mm). Once the QR Code shown in Figure 3 has been framed, and the application launched, the augmented reality experience can start.

All the Speaky Notes cards are *readable* by smartphones too, since we use them as tracking images for the augmented reality experience by analysing them with a pattern recognition algorithm. This way children can interact with the Speaky Notes just pointing at the cards with the mobile device and, thanks to augmented reality techniques, the word's information are overimposed on the screen.

Fig. 4. Card layout and QR Code needed to identify an AR channel. Junaio is an AR browser with an augmented reality client application that runs on smartphones and tablets. Developers can create their stand-alone augmented experiences (called channels) allowing them to have a platform independent application that requires Junaio to be installed on the user's device.

In fact, when the system generates the cards and the PDF file, it also retrieves the necessary content for the augmented reality experience through the LEAF API. This content consists in the word syntax, its phonetic transcription and an mp3 audio files that contains the pronunciation in both languages (FL and SL).

In detail, the system creates all the virtual content that will be shown over the tracking marker such as syntax, phonetic transcription and language name as illustrated in Figure [1][4]. Pupils can tap on the virtual objects and listen to the audio file that reproduces the right pronunciation.

V. HAVING FUN WITH THE E-BOOKS

We have discussed how to use the AR application under the supervision of an educator at school, but we think that a lot of work can be done at home.

For this reason our system generates a summary eBook that contains all the words chosen by the author/educator and their related information.

Fig. 5. Augmented sample pages of the generated eBook. In this case we can read the word in the native language (also used in the marker card), in the second language, its phonetic transcription and definition.

Using an eBook reader (or a similar device) students can improve their study at home, rehearsing the words learnt at school. Each eBook page contains all the information about a single word and its marker image. The image let students and parents to replicate the augmented game at home, transforming the student's house as a learning environment.

VI. CONCLUSION AND FUTURE WORK

The main objective of Speaky Notes is to give educators a system that uses a dataset of validated words that allows the creation of personal dictionaries, easy to share among colleagues.

Furthermore, we envision this system as a tool to engage students during the learning activity. Even if we use as case study the language acquisition process, the whole system could also be applied to other learning fields.

The next step for the Speaky Notes tool is user testing. We are planning a first test with a school in Monza under the supervision of an expert in pedagogy in order to get feedback and suggestions. At this moment the application is ready to use and the beta version will be available as open source. Advancements in technologies are a good chance to improve the way children learn, we need these innovative ways to engage students, to assist them and to improve their preparation in any field, from the language to the mathematical, historical or geographical ones.

In the education path, speaking a second language properly, cannot be a secondary goal. Children have to be motivated and enthusiastic in language learning and we see our approach as a good way to give them the tool to reach these feelings.

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REFERENCES

[1] Emerson, L., Fear, J., Fox, S., Sanders, E.: Parental engagement in learning and schooling: Lessons from research. Family-School and Community Partnerships Bureau (2012)

[2] Broughton, G., Brumfit, C., Pincas, A., Wilde, R.D.: Teaching English as a foreign language. Routledge (2002)

[3] Di Serio, A., Ibàñez, M.B., Kloos, C.D.: Impact of an augmented reality system on students' motivation for a visual art course. Computers & Education 68 (2013)

[4] Martín-Gutíerrez, J., Contero, M.: Improving academic performance and motivation in engineering education with augmented reality. In: HCI International 2011{Posters Extended Abstracts. Springer (2011)

[5] Purnama, J., Andrew, D., Galinium, M.: Geometry learning tool for elementary school using augmented reality. IAICT, 2014 International Conference on, IEEE (2014)

[6] Fleck, S., Simon, G.: An augmented reality environment for astronomy learning in elementary grades: An exploratory study. In: 25ième conférence francophone on l'Interaction Homme-Machine, ACM (2013)

[7] Cascales, A., Laguna, I., Pèrez-Lòpez, D., Perona, P., Contero, M.: An experience on natural sciences augmented reality contents for preschoolers. In: Virtual, Augmented and Mixed Reality. Systems and Applications. Springer (2013)

[8] Asher, J.J., Garcia, R.: The optimal age to learn a foreign language. The Modern Language Journal 53(5) (1969)

[9] Salmon, Jessica, and Julianne Nyhan. "Augmented reality potential and hype: towards an evaluative framework." The Journal of Language Teaching and Learning 3.1 (2013): 54-68.

[10] Fletcher, D. (2010, March). 10 Tech Trends for 2010, Time. Retrieved from: http://www.time.com/time/specials/packages/article/0,28804,1973759_1973760_1973797,00.html (Accessed 04/05/2012)

[11] Anon. ZooBurst. (n.d.). Retrieved from: http://www.zooburst.com/index.php (Accessed 04/05/2012)