

## Mobile application to aid people with speech disorders

Aplicativo Móvel para auxiliar pessoas com distúrbios de fala

Aplicaciones Mobiles para ayudar personas con problemas de habla

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### ABSTRACT

**Keywords:** Accessibility;  
Software design;  
Information technology;  
Speech disorders

Nowadays information and communication technologies have been used to solve many health issues. Because of this, new studies are necessary to develop innovative tools in order to solve problems related to accessibility. The purpose of this paper is the development of an application for mobile devices, targeted to the Android platform, aiming to help people with disabilities to communicate. It is assumed that these people don't have severe mobility issues, but have some of speech disorders. User interfaces and audiovisual features were created to improve the interaction between users and listeners with a total of 372 audiovisual features, considering 6 categories, 36 activities, 144 complementary phrases, along with 186 audio files. The result of this paper is the creation of new software to help people with speech disorders considering aspects of mobility and accessibility through the use of information and communication technologies.

### RESUMO

**Descritores:**  
Acessibilidade;  
Desenvolvimento de  
Software; Tecnologia da  
informação; Distúrbio de  
fala

Atualmente as tecnologias da informação e comunicação têm sido utilizadas para resolver problemas da área da saúde. Por estas razões novos estudos são necessários para o desenvolvimento de ferramentas inovadoras com o objetivo de resolver problemas relacionados a acessibilidade. A proposta desse trabalho é o desenvolvimento de um aplicativo para dispositivos móveis, direcionados para plataforma Android, com objetivo de ajudar pessoas com dificuldade de comunicar. Ao definir que essas pessoas não possuam dificuldade motora severa, mas que tenham distúrbios de fala. Telas do aplicativo e recursos audiovisuais foram criados para melhorar a interação entre usuários e ouvintes, com um total de 372 recursos de audiovisual, considerando 6 categorias, 36 atividades, 144 complementos de frases, com 186 arquivos de áudio. O resultado desse trabalho é a criação de um novo software para auxiliar pessoas com distúrbios de fala, ao considerar aspectos de mobilidade e acessibilidade através do uso de tecnologias da informação e comunicação.

### RESUMEN

**Descriptores:**  
Acessibilidad; Diseño de  
software; Tecnologías de  
la información;  
Problemas de habla

En la actualidad las tecnologías de la información y las comunicaciones han sido usadas para resolver muchos problemas de salud. A causa de esto, nuevos estudios son necesarios para desarrollar herramientas innovadoras que permitan resolver problemas relacionados con la accesibilidad. El proposito de este paper es el desarrollo de una aplicación para dispositivos móviles, orientado a la plataforma Android, con el fin de ayudar personas con discapacidades de comunicación. Se asume que estas personas no tengan problemas severos de movilidad, pero que tengan algunos problemas de habla. Intefaces de usuario y herramientas audiovisuales fueron creadas para mejorar la interacción entre los usuarios y los oyentes para un total de 372 herramientas audiovisuales, considerando 6 categorías, 36 actividades, 144 frases complementarias, junto con 186 archivos de audio. Los resultados de este paper es la creación de un nuevo software para ayudar gente con problemas de habla considerando aspectos de movilidad y accesibilidad mediante el uso de las tecnologías de la informacion y las comunicaciones.

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## INTRODUCTION

Information and communication technologies have been used to help people with disabilities, severe mobility issues and visual problems to communicate<sup>(1-2)</sup>. The DOSVOX project has computer systems to help blind people to use adaptive devices and desktop computers<sup>(3)</sup>. Nowadays computing resources have been used to aid people with severe mobility issues, through the use of computer games to improve the mobility of patients<sup>(4)</sup>, in the same way that the implementation of applications to the access of domestic devices by people with severe disabilities<sup>(5)</sup>.

The disabilities to communicate can be a hard obstacle to social inclusion, especially when people have some kind of other disabilities. Periodontal diseases, oral trauma, neurodegenerative diseases, multiple sclerosis, stroke, and surgery procedures as tracheotomy can cause disabilities and disrupt the communication process. People with disabilities to communicate have difficulty to express emotion and desires. The adoption of symbols, communication cards and concept Tablets can help people to express these feelings<sup>(6-7)</sup>. For these reasons we promoted the development of an application for mobile devices, targeted to the Android platform, aiming to help people with disabilities to communicate.

## MATERIAL AND METHODS

The software development process was used to create the application considering recommendations of software engineering. As a result, we applied software engineering steps to define, develop, test and keep this software product<sup>(8)</sup>. In this paper we summarize these steps considering five activities: requirements gathering, analysis and design, implementation, implantation, and tests.

### Requirements Gathering

First we defined functional and non-functional requirements of the application, in an effort to enable these requirements to be used in order to list all the needs

that must be answered. And in the future we can perform the validation of software through the comparison between all requirements and application functionalities.

#### Functional requirements

Functional requirements define clearly and objectively the functionalities of the application.

The user can choose one category to start the communication process through the application.

The application should allow the choice of activity related to category.

The user can choose complementary phrases related to activity.

The application should run audio features to establish the communication process considering elements such as: category, activity and complementary phrases.

#### Non-functional requirements

Whereas we used non-functional requirements to define characteristics related to quality of the software.

User interfaces will be created to prevent failures related to data inconsistency as a result of manual data entries by the implementation of buttons to all functionalities;

User interfaces will have intuitive buttons with fit size and suggestive images for easy visualization and access to all functionalities.

It is expected that the application could spend less than 1 second to screen transition about categories and activities elements;

It is expected that the application could spend less than 2 seconds for repetition of the same complementary phrase;

The application will be developed with open-source mobile platform in an effort to get more portability to different mobile devices.

### Analysis and Design

Secondly we did the analysis and design considering the requirements gathering. In this step, we created representations based on UML (Unified Modeling Language) patterns that are important to create the design

**Table 1** - Use Case details.

Elements of Use Case	Use Case 1	Use Case 2	Use case 3
Name	Choose Category	Choose Activity	Choose Complementary Phrase
Description	The user chooses one category.	The user chooses one activity.	The user chooses one complementary phrase.
Pre condition	The user is active in the application.	The Use case 1 has finished.	The Use case 2 has finished.
Main Flow	1) The user chooses one category. 2) The application makes a sound and shows activities related to the category and the use case is finished.	1) The user chooses one activity. 2) The application makes a sound and shows complementary phrases related to the activity and the use case is finished.	1) The user chooses one complementary phrase. 2) The application makes a sound related to the complementary phrase and the use case is finished.
Alternative Flow	The user cancels the choice of category and the application goes back to the previous screen.	The user cancels the choice of activity and the application goes back to the previous screen.	The user cancels the choice of complementary phrase and the application goes back to the previous screen
Post condition	The user has begun the communication process and now he can choose one activity.	The user has chosen one activity and now he can choose one complementary phrase.	The user finished the communication process.

of the application. The Use case context diagram was created like a representation to obtain an overall vision of the functionalities. Each use case represents a functionality of the application.

Considering the process of analysis and design of the application, we described the sequence of interactions between the user and the application by giving detailed information of each use case. This type of description can promote understanding about the functionalities of the application considering important elements such as: summary, preconditions, actors, main and alternative flows of interactions, and post conditions to describe each use case. In summary we described in some words what will happen in the interaction between the user and the application. The preconditions were defined considering the event that should have been performed before each use case. The actors were defined to identify who is acting with this functionality, besides the description of main and alternative flows that show interactions between the user and the application. Ultimately, we described post conditions of each use case. The Table 1 represents a description of all three use cases of this application.

### Implementation

After analysis and design, we did the implementation considering steps such as codification, compilation and execution of source code. Java and XML programming languages together with android libraries were used to develop this application. The Object Oriented programming was applied in this paper by the use of concepts of object oriented paradigm together with the codification using JAVA. User interfaces were created by the codification using XML programming language considering aspects of android libraries.

Moreover the software eclipse version Indigo was used as integrated development environment. This environment allows you not only to organize and build the structure of the application, but also to have easy access to all the tools of this software. The installation of Android Development Kit allowed the use of classes and functionalities to build, test, and verify errors in the creation of application to mobile devices on the android platform considering the software development process.

#### *Implementation details*

Components of XML programming language together with android libraries properties were used to create user interfaces. TextView, ImageButton, and LinearLayout are examples of these components that define the main structure of user interfaces using properties of android library such as: android:id, android:layout\_width, android:layout\_height and android:src. Codification of functionalities was necessary for each structure created. In this context, we used Java programming language to control the action of each structure. The Object Oriented paradigm allows programmers to implement the use of objects to access functionalities and methods. In this application all functionalities are oriented to events, in other words, functionality only occurs if an event exists. And one event exists if the user touches one button. Thus we can state that

concepts of object oriented paradigm were used together with event oriented paradigm in this implementation.

### Deployment

The software deployment process occurs with the installation of an execuTable file on the mobile device. The new application was deployed on Tablet PC which allows the use of faster audiovisual features with high image quality due to screen size and advanced resources. In doing so, we recommend the following hardware: Tablet PC – Dual-core processor, 1GByte RAM memory, 32 GBytes Hard Disk, Screen size of 10 inches, Wi-fi connection, and android platform version Ice Cream Sandwich 4. We did the transmission of an execuTable file from a desktop computer (where we developed the application) to a mobile device through Bluetooth connection. After that, we installed the application on the context of the android Ice cream Sandwich, especially because it is an ideal computing environment with portability to mobile devices with different configurations<sup>(9)</sup>.

### Tests

Functional tests, called Black Box Tests, were performed to validate the application<sup>(10)</sup>. Through Black Box Tests it is possible to verify if the features described on the software development process are actually working. Functional Tests were performed considering the following functionalities: Choose Category, Choose Activity and Choose Complementary Phrases, particularly tests related to button touch event, screen transition, playing sounds of categories, activities and complementary phrases. Moreover functional tests were carried out for aspects about performance related to response time of screen transition, and repetition of button touch event to access the same complementary phrase.

## RESULTS

We created a new application for mobile devices on the android platform to aid people with speaking difficulties as a result of software development process. Through this process we defined, developed and validated the application through functional tests.

As shown in Table 2, we describe results of functional tests related to functionalities such as Choose Category, Choose Activity and Choose Complementary Phrase.

Audiovisual features were created to promote an effective communication process between the user and their listener. Visual features were defined by icons representing categories, activities and complementary phrases, besides audio files in mp3 format for a total of 372 audiovisual features for the application, considering 6 categories, 36 activities, and 144 complementary phrases, including 186 audio files in mp3 format.

Each category was established as main directory for a set of activities. The categories created for this application are: house, work, school, family, sport and entertainment. We considered the following aspects to create the activities: creation of general activities, primary assistance to people with speaking difficulties, and activities related to daily

Table 2 - Functional tests details.

Test Name	Choose Category	Choose Activity	Choose Complementary Phrase
Event related to button touch	It worked	It worked	It worked
Sound related to button touch event	It worked	It worked	It worked
Visualization of screen after Button touch event	It worked	It worked	It worked
Response time of screen transition less than 1 second	It worked	It worked	It worked
Response time to repeat the button touch event for the complementary phrase less than 2 seconds	No test for this functionality	No test for this functionality	It worked

life. Ultimately, we created complementary phrases to specific needs related to the choice of activity.

User Interfaces were designed including large icons and labels for easy access to users.

Figure 1 shows the main screen of the application developed. Once the user has access to the application, he can choose one category to start the communication process. As shown in Figure 2, the user can choose one category. After that, the application shows one screen with all the activities related to the subject of that category (See Figure 3). Finally, the application will show the list of options with complementary phrases based on the choice of the user to finish the communication process (See Figure 4).

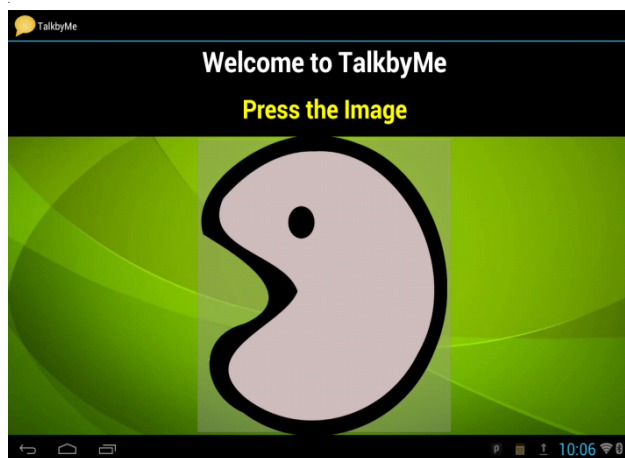


Figure 1 - Main Screen of the mobile application Talkbyme.



Figure 2 - Screen to choose one category to start the communication process. This screen has icons representing house, work, sports, entertainment, school and family.



Figure 3 - Screen to choose activity based on Category House. This screen has activities related to take a shower, lunch, dinner, watch TV, conversation, and sleep.



Figure 4 - Screen of Complementary Phrases referred to the Activity Lunch.

### DISCUSSION

We developed a new mobile application to aid people with speaking difficulties considering the growing use of information and communication technologies in the healthcare area<sup>(1-2)</sup> including aspects such as mobility and accessibility<sup>(7)</sup>, which are very important when compared to the use of applications on desktop computers<sup>(3)</sup>.

The software development process was fundamental not only to define, design and test<sup>(8-10)</sup> but also to organize, maintain, and validate the mobile application. We used functionality tests to validate the application considering software engineering tests. Additionally, knowledge about simple communication features such as symbols, communication cards and concepts Tables<sup>(6)</sup> was



fundamental for the creation of the new audiovisual features of the application. The aspects related to interface buttons and texts are very important to build computer interfaces to interaction human and computer. For example: the text size, font type, uppercase letters location and color can affect the accessibility of the end user<sup>(11)</sup>. Therefore, TalkbyMe has larger buttons and texts associated with the audio to simplify the access to features on three levels: class, activity and complement.

Software applications as Dynavox, Jive, Proloquo2Go, Alexicom AAC, AAC Speech Buddy and Voice4u are built for people with speech disorders. All these mobile apps are paid, some associated with hardware devices like the Dynavox and Jive! And others like Proloquo2Go, Alexicom AAC, AAC Speech Buddy and Voice4u works on Windows XP platforms (desktop computers) or iOS and Android (mobile devices)<sup>(12)</sup>.

The TalkbyMe will be freely distributed and made available on Google Play repository for use in mobile devices with Android platform. All applications presented above may be used in English language, with Dynavox also be used in Spanish, French and German, and AAC Alexicom software with Spanish and German, and Voice4u in Japanese<sup>(12)</sup>. The TalkbyMe mobile application was designed to interoperate in three languages: Portuguese, English, and Spanish. In the Latin America the Talkbyme can be used in Spanish with audio and typical expressions from these countries. In Brazil, the TalkbyMe is being distributed to the university centers in order to encourage the use of students, teachers and health professionals interested in new research in the area of speech disorders. The mobile application TALKBYME is presented in this paper in English, because this language is the most spoken language in the world today, and we would like to distribute this application soon in sporting events to be held over the next two years in Brazil.

In the period 2005 until 2010 were analyzed 156

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## CONCLUSION

The new application for mobile devices on android platform was developed to help people with disabilities to communicate, through a software development process that considers the best practices of software engineering to define, design, implement, implant and test the application, besides the creation of new audiovisual features together with the use of new information and communication technologies in the healthcare area.

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