

# Super-Fon: Mobile Entertainment to Combat Phonological Disorders in Children

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## ABSTRACT

Therapies based on serious games is gaining a lot of interest by the healthcare community. The efficiency of this approach is demonstrated by several studies and many projects. This paper presents the project Super-Fon, which is focused on a serious game developed as a mobile application to support speech therapeutic intervention in the phonological development area. The game design follows the metaphon therapy approach, implementing its phases and levels, and it intends to motivate children between three and eight years old to execute activities to improve phonological competencies while having a fun experience. A first prototype was developed for Android-based tablets.

## Author Keywords

Mobile computing; speech language therapy; metaphon methodology; theragames; gamification; serious games.

## ACM Classification Keywords

K.8 [Personal Computing]: General – games. H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## INTRODUCTION

Gamification, which is essentially about learning from games, is an umbrella term for the use of game mechanics, game design techniques, aesthetics, and game-thinking to improve user experience and user engagement in non-game services and applications [1]. Moreover, serious games based therapy (theragames) is currently gaining a lot of interest by the healthcare community. The efficiency of this approach is demonstrated by several studies and many projects in diverse domains [2].

Using computer technologies in Speech Language Therapy (SLT) is increasingly common, and children are becoming more aware about Information and Communications

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Technology (ICT). In a study made by Larissa et al. [3], positive outcomes were found in the treatment of phonological disorders in children, by using a computer, which enabled faster recovery. Intervention with children is mainly based on games and fun activities, and the use of computers is common in recent years in order to accomplish the entertaining goal for an improved therapy process. On the other hand, Common Sense Media reported an explosion in the use of mobile technology among young children in the past three years [4].

Motivated by the aforementioned, the project Super-Fon grew out of a partnership between a College of Technology and a College of Healthcare to be a tool for intervention in phonological disorders in children with ages between 3 and 8 years old. Super-Fon is a mobile theragame that implements the metaphon therapy approach, following its phases and levels. Metaphon is a remediation procedure designed to facilitate change in phonological processing by developing and utilizing metalinguistic awareness [5]. Phonological disorders are part of the Speech Sound Disorders and are considered “a group of language disorders, whose cause is unclear, that affect children’s ability to develop easily understood speech by the time they are four years old” [6]. So, we present a novel approach where the therapist’s work is combined with a serious game solution that uses the ubiquity of mobile devices to help children surpass their speech disorders. Our initial prototype is directed to Android-based tablets and therapy in Portuguese, although we are in the process of preparing an English version.

## RELATED WORK

Even though we can find interesting related work, such as the Tiga Talk mobile app [7], or Vocaliza [8] and PreLingua [9], both directed to Spanish language, none of them uses the metaphon methodology to address phonological disorders in children. Moreover, we only found one solution directed to the European Portuguese that differs from Super-Fon in several aspects. It is Articula [10], a mobile app for iPad that has the goal of supporting the training of correct articulation of consonantal phonemes (sounds). The app’s design was developed so that it can be used by adults and children. Additionally, it uses some game dynamics, but it is not based on a story and clear gameplay scenarios.

## PRELIMINARY STUDY

This Section presents results from a preliminary user study conducted in the analysis phase of the project to verify its viability. A survey was conducted in order to assess the importance of this kind of applications for the therapy of phonological disorders, especially among young children. The survey was directed exclusively to Portuguese speech language therapists. All participants (12) were female with ages between 21 and 28 years old. It was inquired if they use mobile devices in therapy sessions, which kind of devices and if they know other digital games for speech language therapy, among other questions. The obtained results allow us to conclude that not only these potential end-users, but the community in general, are receptive to this kind of applications, and almost all of them are familiar with the use of recent mobile devices, such as smartphones and tablets. However, only a few use mobile devices as an aid to speech language therapy, which makes Super-Fon a novelty, at least, to the Portuguese SLT community. It should be noted that all participants agree with the use of the metaphon methodology, which supports our decision. Moreover, the main results are summarized in Table 1.

Question	Answer	Result
Do you use any mobile device (smartphone or tablet)?	Yes	60%
	No	40%
Which kind of mobile device do you use (After answering 'Yes' in previous question)?	Smartphone	67%
	Tablet	17%
	Both	16%
Do you often use mobile devices as an aid to speech language therapy?	Yes	17%
	No	83%
What is the reaction of your patients with regard to the use of mobile applications for therapeutic purposes?	Satisfied	100%
	Not Satisfied	0%
Do you agree with the use of the metaphon methodology to address this kind of problems?	Yes	100%
	No	0%
Do you consider advantageous that patients can practice the exercises at home through mobile devices?	Yes	100%
	No	0%
Do you know any other application/game that is used in speech therapy?	Yes	30%
	No	70%

**Table 1: Summary of the survey conducted for the preliminary study.**

## SUPER-FON IMPLEMENTATION

Since the primary goal of the project was to incorporate research from different areas, we have a research and

development team with expertise in several areas, such as speech therapy, game design, mobile computing and human computer interaction. We drew on our team of therapists' knowledge to evaluate the implemented prototype in terms of the: instructional objectives and strategies best suited for the target-rehabilitation; implementation of the metaphon methodology; design of adequate engaging and motivating game activities for the target-audience; and the evaluation of the overall effect of gameplay. The following subsections explain the result of this collaboration.

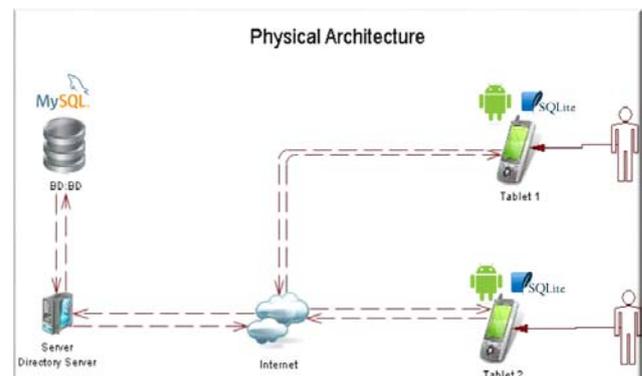
We decided to follow a metaphonological approach to the remediation of phonological disorders in children. This approach develops and uses children's phonological awareness to make changes in speech. Intervention is made around activities that make children think about sound, speech and structure of words. Therefore, Super-Fon is based on the metaphon methodology, which was a choice supported by literature review and taking into account that we did not find any related work following it. It was also important to know that all the participants in our study agreed with the use of this methodology.

Super-Fon intends to provide a mobile entertainment experience to motivate children throughout the therapy process.

## System Overview

The Super-Fon system consists of two main components (see Figure 1):

- A server, which manages a central database and all the requests from the diverse apps (clients). It is based on a MySQL central repository and uses PHP scripts for synchronization between the apps and itself.
- The mobile application as a client.



**Figure 1. Architecture overview.**

A first app prototype is fully functional, implemented in Java for the Android platform, taking into account the prospective market penetration. Market analysts envision the continuity of a wide spreading for Android-based

devices. It is not required to be connected to the Internet to use the app, but it will request periodical connections in order to synchronize with the server. It connects to the server to obtain app's updates and statistical data and to store user's game data. The local database in the mobile device was implemented in SQLite to obtain a lighter but reliable data management.

### Main Requirements and Rationale

This game is aimed to be used primarily in the scope of a speech therapy program with the supervision of a therapist, although it will be also available to the general public through Google Play. Therefore, the therapist plays an important role in this system, since she is the user who is responsible for configuring the game according to each patient's individual needs and for supervising patients' performance and progress.

The therapist is the second most important actor to the system and will always be dependent on the use of Super-Fon by her patients, only having access to her patients' data. Thus, the patient is the main actor of Super-Fon, effectively playing the game to complete all the activities and levels. The therapy is focused on the patient. The system presents a third actor, the administrator, which is responsible, for example, for validating users, for consolidating data, for executing general reports and for configuring diverse parameters of the gameplay.

Requirements were divided into four main modules: authentication and synchronization; game; game management; and reporting.

The first step the user must take to use the app is to register and create a profile. This requirement permits:

- The association of a therapist to the patient;
- The use of the same mobile device by several users;
- A user to login using different devices.

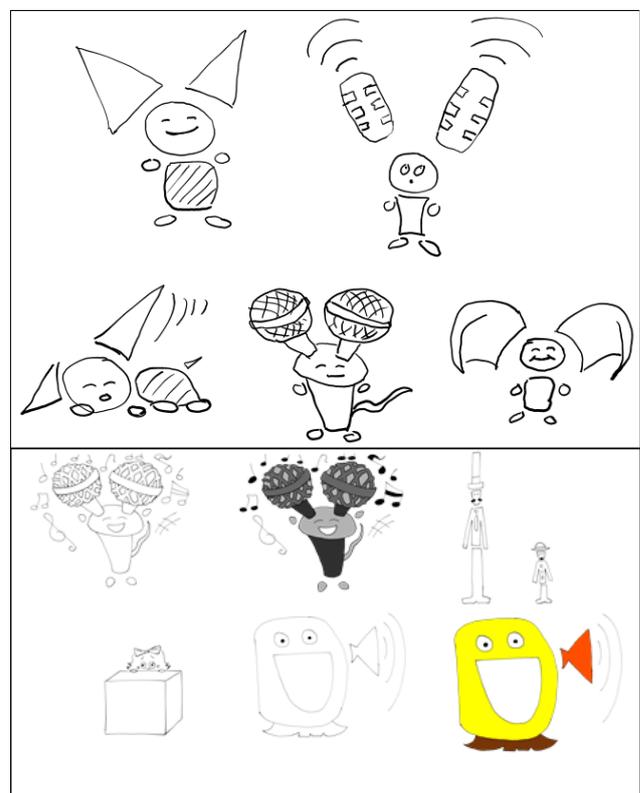
Therefore, a user that is a patient has the option to associate the therapist that will monitor her throughout the use of Super-Fon. The therapist will have to confirm the association, after receiving a notification related to that. After being associated to patients, the therapist will have access to a module in order to monitor the patients, seeing reports with charts in the app or receiving textual reports and notifications related to the priority cases.

The game itself was developed with the aim of providing a fluid gaming experience to children. The Super-Fon game activities are always supported by written text and audio. The system was developed in order to support game management facilities that provides the administrator with a mechanism to add new activities to the game through an online interface allowing a continuous improvement of the application.

### Story and Gameplay

The beginning: Super-Fon has been rather lonely and decides to throw a party. In order to be understood by others, Super-Fon will have to correctly pronounce the invitations. With the help of the player (patient), Super-Fon will be put through increasingly difficult tests to organize the best party people have ever heard of. As Super-Fon advances levels, several friends arrive at his home for the party. Super-Fon will keep pictures of all his dear friends in a photo album that the user will be able to consult and print.

Super-Fon was designed with two microphones atop the head to symbolize that he is paying attention to what the user is choosing and saying (see Figure 2).



**Figure 2. Sketches of the game's main characters: (top) Super-Fon design alternatives; (bottom) final sketches.**

In terms of gameplay, the activities are divided according to the four levels of phase 1 of the metaphon methodology: *concept*, *sound*, *phoneme*, and *word*. Each level is composed of several activities that must be executed sequentially. After responding to an activity, the child will hear a positive or a negative message along with a small animation according to her performance. In case of success with an activity then the user will earn a digital coin. Coins can be used to buy stickers, which represent characters of the game and other items that should appear in the Super-

Fon's party. Stickers can be printed to be colored. Every time a sticker is bought it will fill a gap in the stickers' booklet (see Figure 3), which was designed to stimulate the user to play the game, wanting to hit as many activities as possible, even after concluding a level. This way, the user will be motivated to repeat a level until all its activities are responded correctly. The gameplay requires a certain percentage of correct answers in order to allow the user to pass to the next level. For instance, Figure 4 shows a message that appears after the execution of all the activities in the *concept* level. The user is not able to move forward to the next level since her performance is below 75%. This percentage can be adjusted by the therapist.

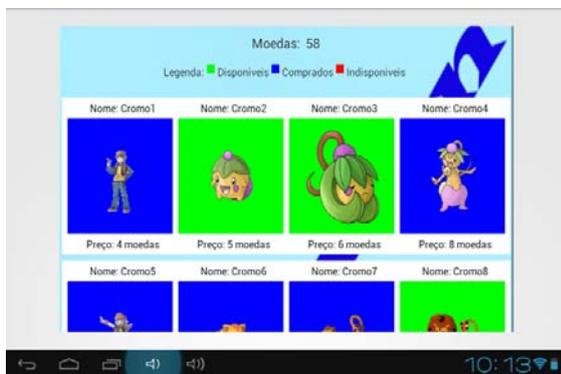


Figure 3. The stickers' booklet.



Figure 4. Message at the end of the concept level.

## CONCLUSIONS AND FURTHER WORK

This paper gives a new perspective for speech language therapy, which is the use of mobile theragames that follow the metaphon methodology. The combination of mobile devices, such as tablets, with serious games design can help motivate children in need of therapeutic treatment. In order to accomplish it, we chose to create a research team to combine expertise from areas such as speech therapy, game design, human computer interaction and mobile computing.

Firstly, we drew on the therapists' knowledge to evaluate the prototype along the different phases of development. We have the positive results extracted from the preliminary study. We have already conducted prototype tests with a set of therapists and we are now collecting and analyzing the results. Moreover, in the near future, we will conduct end-user tests and studies to evaluate Super-Fon in real contexts of use.

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