

# Speech development application

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## Motivation

Communication for people with hearing impairment can be challenging. Learning how to speak and pronounce words correctly without a voice feedback is, without any external help, close to impossible. For children, who want to play and communicate with their peers, and are unable to express themselves, is the situation even more alarming. Existing softwares addressing this issue are either outdated or very expensive. The goal of this diploma thesis was to develop a free to use mobile application that improves the hearing-impaired children's ability to speak.

## Our Approach

The application consists of four engaging animated games, each of which is designed to focus a different aspect of a children's voice control.

- The **Cloud Game**, as a first game of the application, introduces the application to the children by showing them that they will control it by their voice.
- The **Airplane Game** exercises lengthening of the expiratory flow and the ability to hold a constant vocal phonation.
- The **Dog Game** practices the articulation of monosyllabic words.
- The **Balloon Game** focuses on a control of the volume of their spoken word.



Figure 1: Initial layout of Cloud Game

## Implementation

The application is a combination of three major core parts — sound processing, gamification and event logging. Sound processing is handled by a powerful framework called **AudioKit**. AudioKit captures sound from the microphone of the device and enables inspection of its properties, such as frequency and amplitude. Game graphics, physics effects (such as adding force fields and collision detection) and animations are implemented by Apple's framework **SpriteKit**. Finally, the event logging part of the application logs sound events and sends them to an external storage. Analysis of events suggested future improvements based on past game-walkthroughs.

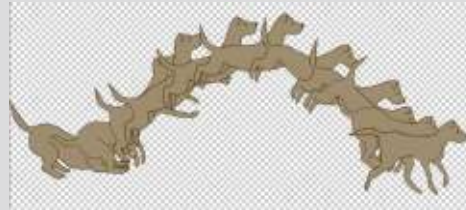


Figure 2: Texture animation of jumping dog in SpriteKit

The correct structure of the code and its extensibility and reusability is ensured by a mobile application architecture **VIPER**, reactive programming and dependency injection.

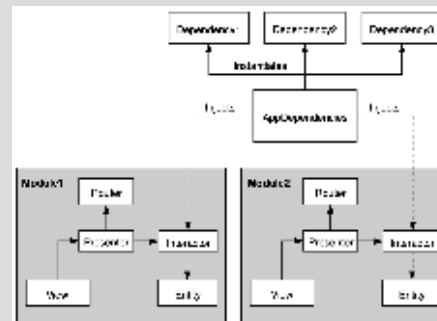


Figure 3: VIPER Architecture with dependency injection

## Testing of hearing-impaired children

Testing was performed in cooperation with the **Special Pedagogic Center** in Prague that is regularly visited by children with hearing impairment. On a daily basis, children were using the application and providing valuable feedback that helped improve the quality of each game.

Ten of these children were selected for more extensive testing. Their ability to complete game tasks and overall willingness to use their voice were tracked once every two weeks. The results were very positive. After one month, the majority of children was able to complete each game and reported improvements in focused tasks. More importantly, children were enjoying the game. The lack of any kind of feedback on speaking caused them to limit the usage of their voice to occasions when they have to use it. Visual feedback provided by the application entertained them and made them want to use the application more.



Figure 4: Testing in the Special Pedagogic Center

## Conclusion

Application for children with hearing-impairment was created and thoroughly tested. Testing provided valuable feedback that influenced numerous improvements.

- Application is in a stable state and ready to be deployed to the **AppStore**.
- Ideas for future development (adding more games, improving current games) are being discussed.
- Application proved to be able to help children with hearing-impairment with the development of their speech and also with the willingness to use their voice.