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FONAPP: AN APPLICATION TO HELP SPEECH THERAPY IN PATIENTS WITH CLEFT LIP AND PALATINE

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Abstract: Among the birth defects commonly found in babies, cleft lip and palate, in general, is present in 1 in every 600 live births in the world. Individuals who are born with this condition deal in their daily lives with problems related to eating, speaking, listening, as well as psychological stresses in addition to problems with their social life, linked to aesthetic deformation. Treatment is performed through surgery followed by speech therapy sessions to correct speech. In this context, a mobile application was developed to assist speech therapy in patients with cleft lip and palate entitled FonApp. The use of this application as a tool during the speech therapy process can provide patients who have complications related to mobility or difficult access, the follow-up assisted by the speech therapist and allowing these patients to continue their care in a practical and efficient way at a distance. Among the features of the FonApp application, we can mention: creation of a record for the patient and the speech therapist, separation of complete and incomplete activities, recording of lessons by the speech therapist, exchange of support messages between the patient and the speech therapist, as well as an identity visual.
Keywords: Mobile Application; Cleft lip and palate; speech therapy.

INTRODUCTION

Cleft lip and palate is the fourth most common birth defect found in babies. Its prevalence has been estimated at 1 in 600 children born in the United States. The study presented by Kummer (2018) demonstrates a ratio of 1 in 1000 for cleft lip and 1 in 1500 for both clefts (labial and palate). In Brazil, from January 1975 to December 1994, 16,853 new cases of oral cleft were registered, with the Southeast region presenting 61% of these cases. Among the 16,853 registered cases, 4,413 were related to cleft palate alone. In addition, the highest proportion of cases related to cleft lip and palate, around 74%, was also evidenced in countries such as Japan, Sweden, Iceland and Nigeria (LOFFREDO; FREITAS; GRIGOLLI, 2010). Individuals born with this condition deal in their daily lives with problems related to eating, speaking, listening, as well as psychological stresses in addition to problems with their social life, linked to aesthetic deformation (RODMAN; TATUM, 2016).

The initial treatment to alleviate the problems in everyday life caused by cleft palate is surgery, then therapy. The surgical process corrects the negative effects of the cleft, such as the aesthetics of the lip and palate. However, it is necessary to provide therapeutic follow-up by speech-language therapists for speech correction, allowing the patient to be included in daily and social activities (DHAKY; SETHNA; BULSARA, 2011).

Mobile devices have been increasingly used to support the ongoing therapy of these patients. One approach currently used is remote therapy using mobile devices such as smartphones. In this context, an application was developed to assist speech therapy in patients with cleft lip and palate entitled FonApp. This application, developed for the Android operating system, has both a module for the patient and for the speech therapist and uses AWS services (Amazon Web Service) to store data in the cloud. FonApp has the following features: creating a record for the patient and the speech therapist; separation of complete and incomplete activities; recording of lessons established by the speech therapist; exchange of support messages between the patient and the speech therapist.

This article is organized as follows: Section 2 contains the theoretical foundation and description of related works; then, in Section 3,

the functionalities of the FonApp application are described; and finally, Section 4 presents the conclusion of the work, with the results derived from the developed solution.

THEORETICAL FOUNDATION

Before explaining the features of the FonApp application, some concepts related to cleft lip and palate are introduced, as well as some related works.

CLEFT LIP

The types of cleft palates vary according to the structure affected and their severity. These fissures occur due to delayed migration of neural crest cells in the first trimester of pregnancy. This delay can result in a cleft, reported in Figure 1, which can be: a) of the first palate; b) of the second palate; or in a fissure of both (KUMMER, 2018).

a) **Fissure of the First Palate:** It is also called prepalate clefts, they are clefts of the lip and alveoli and are formed from the seventh week of gestation. It is anterior to the incisive foramen and can be:

b) • Complete: travels through the labrum and alveolus to the incisive foramen

c) • Incomplete: only covers the lip

d) • Unilateral or Bilateral: they can be complete or incomplete, as the fissures follow the lines of the philtral crests and the lines of the incisive sutures.

e) **Fissure of the Second Palate:** They are clefts of the hard palate and soft palate (also known as veil) that form from the ninth week of pregnancy, posterior to the incisive foramen and can be:

f) • Complete: includes the uvula, soft palate and hard palate to the incisive foramen

g) • Incomplete: may include a portion of the soft palate or submucosal (beneath the mucosa)

h) • Midline: they are this way because they follow the midline of the suture of the palate.

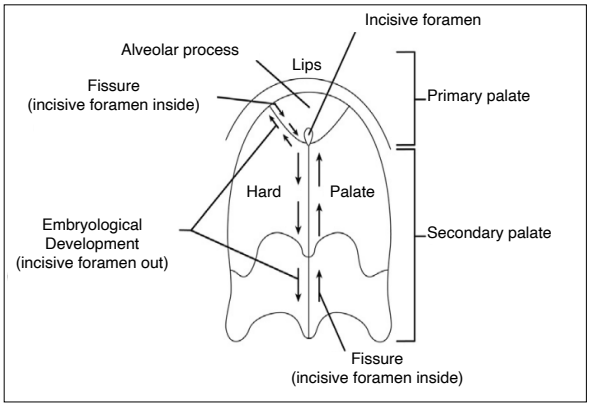


Figure 1: Embryological development and patterns of clefts (KUMMER, 2018).

The embryological development of clefts proceeds from the incisive foramen to the periphery of the palate, whereas cleft patterns start from the peripheral part and follow the steps of a normal embryological fusion towards the incisive foramen to the point of disruption. The classification of clefts that affect the first or second palate is based on embryological development, with the incisive foramen as the dividing point between the two (KUMMER, 2018).

The negative effects from fissures affect different areas, as previously mentioned by Rodman and Tatum (2018), and range from communication, hearing, eating, to psychological stresses in conjunction with social well-being problems caused by facial deformity.

In the study proposed by Maier et al (2006), where speech assessments of individuals with cleft lip and palate are made through a speech recognition device, it is said that such effects end up not only affecting the individual's intelligibility, but also the ability to for social interactions (Social competence) and their emotional development. This emphasizes the use of both a direct approach,

through the surgical process, and an indirect approach, through follow-ups and therapeutic treatments.

As for hearing, patients who present such problems are at great risk for middle ear disorder, with consequent hearing loss. Middle ear disorder is almost universal in children suffering from cleft lip and palate, with up to 90% of cases reported (GOH et al, 2018).

However, still according to Goh et al (2018), problems of this type are usually resolved after the surgical approach, or provide a great positive effect when performed before the age of one year. As for older patients, there is a greater presence of behavioral disorders, especially in relation to their peers. However, no correlation was found between such behavioral problems and the patients' hearing ability.

As for communication, some of the negative effects are presented in the form of disorders that end up affecting the speech of individuals, either through the sound emitted by the patient or in the inability to pronounce certain phonemes, among these disorders are: Speech delay, Disturbance from the sound of Speech (Articulation), Voice Disorder (Dysphonia) and Resonance Disorders, which are divided into: a) Hypernasality; b) Hyponasality; c) Cul-de-sac and d) Mixed or hybrid nasality.

a) **Hypernasality:** A lot of sound resonating in the nasal cavity, it is noticeable in vowels and consonants as (m/b, n/d, ng/g, n/s);

b) **Hyponasality:** Lack of resonance in nasal sounds, causes nasal phonemes to sound similar to oral cognates (b/m, d/n, g/ng);

c) **Cul-de-sac:** (It occurs when there is sound in the oral, pharyngeal or nasal cavity, but it is not released due to some obstruction, makes the sound muffled and low);

d) **Mixed nasality:** Both cases of Hyper and Hyponasality occur due to pharyngeal obstruction or velopharyngeal insufficiency.

e) In his study, Sakamoto (2007) states that carriers of this congenital defect have certain weaknesses regarding the production of certain phonetic segments, in the point and mode of articulation as well as in velopharyngeal closure, and to compensate for this malfunction, these people develop joints that compensate for the production of these phonemes.

f) With or without sound, the flow of air released by the lung is necessary for the production of pressure-sensitive consonants, such as plosives or stops (p, b, t, d, k, g) fricatives (f, v, s, z, sh, zh, th) and the affricates (ch, j). Velopharyngeal insufficiency causes this air to leak through the velopharyngeal valve during consonant production, generating audible nasal emission, particularly in voiceless consonants (p, t, k, f, s, sh, ch) that affect speech clarity (KUMMER, 2018).

g) This effect varies according to the extent of the velopharyngeal opening, with the possibility of being small or large, as described:

a) **Small:** causes a form of loud and distracting nasal emission called nasal turbulence. The sound is caused due to bubbling secretions when air is forced through the small cavity, this increases nasal pressure, which is then released with high velocity on the nasal surface of the veil;

b) **Big:** causes barely audible or inaudible nasal emission due to minimal.

RELATED WORKS

This section presents some research related to the work developed.

Based on Rose et al (2017), some applications can offer external help in several ways, one of which is to facilitate disease management through control for the patient in the use of their medications, with step-by-step instructions or through the interaction with other patients in a similar situation, thus providing greater encouragement or support in order to keep the patient engaged with their treatment.

According to Ferreira et al (2018), Smile Train (an international children's charity focused on cleft lip and palate) has developed some applications that act as support by recording patients' speech before and after the therapeutic intervention, and AmigoFono, which It is a Brazilian application whose objective is to monitor patients undergoing speech therapy. (HUBLI; NOORDHOFF, 2013).

Use mobile technology to provide basic speech exercise sessions for patients, and make collaboration and communication possible with a language therapist. It allows patients to receive the appropriate therapy, at their convenience, without impairing their activities (DHAKY; SETHNA; BULSARA, 2011).

The application proposed by Ferreira et al (2018) is a solution with a similar intent to the one produced in this article. Its objective is to assist in the therapeutic treatment of the speech of patients who suffer from cleft lip and palate, through features that allow the patient to improve their speech, and be accompanied by the therapist.

These functionalities, in general, involve the registration of activities authored by the therapist to be performed by the patient, determined during face-to-face therapy and also including the amount of weekly (eight days) or daily (six times a day) repetitions of each activity. In addition, the patient is notified when the time to perform each activity is approaching, thus allowing him to remain attentive and engaged with the treatment. After the accomplishments and heading to the next appointment, the therapist will then have access to data regarding the patient's performance regarding the activity performed. (FERREIRA et al, 2018).

A detail involved in this application is that its operation does not make use of an internet connection, as the speech therapist must perform the first access to the application by registering login and password (FERREIRA et al, 2018), this can become an obstacle in certain situations. situations, forcing both the patient and the therapist to use the same device to register and carry out activities at certain times, in addition to monitoring and evaluating the results.

Therefore, even if the developed application is able to meet most of the needs encountered in performing speech therapy, it becomes evident that there will be improvements capable of making the treatment more practical and viable.

FONAPP FEATURES

APPLICATION DESIGN PROCESS

Typically, the design process involves: investigation of user needs; similar search; information architecture design; creation of the logo and visual identity; elaboration of the navigable prototype.

Figures 2 and 3, they show the result of creating the logo. The process came from the analogy of the mouth, with its sounds and speech, composing an image referring to the dandelion, a flower that usually dissolves with the blow, with parts in the wind similar to those of the symbols that represent the sound in visual productions. In the union, figure was structured in a way that refers to the flower and its sounds, bringing strength, hope and confidence.

Figure 2: Visual identity, mouth, puff and dandelion.

Figure 3: app logo.

APPLICATION DEVELOPMENT PROCESS

DDuring the development of this application, periodic meetings were held with a speech therapist from Instituto de Medicina Integral Prof. Fernando Figueira – IMIP, with interest, work and research in speech therapy in patients with cleft lip and palate.

Figure 4 presents the technologies used in the development of the application. The *frontend* has two (2) modules, namely: doctor (used by the speech therapist) and patient (used by the individual who will perform speech therapy). For data storage, the MySQL database was used. With regard to the *backend*, development through Springboot was chosen, whose function is to access the database to change or retrieve the information to be presented in the *frontend*. It was decided to build the application for mobile devices with the Android operating system, since they are more accessible and common devices for end users.

Where specifically the RDS services (*Amazon Web Service*), where specifically the RDS services (*Relational Database Service*) used for the provision of a database in the cloud and the:*Elastic Beanstalk* (Machine virtualization service), which allowed the backend of applications to be accessed in the cloud at any time.

USAGE FLOW

In the application module used by the speech therapist, the functionalities present are the monitoring of the activities of the patients who are in the process of completion, registration of new activities and the performance of their respective evaluations.

To start using the application, the internet connection must be verified to enable access to patient data. Once the connection is confirmed, the speech therapist then has access

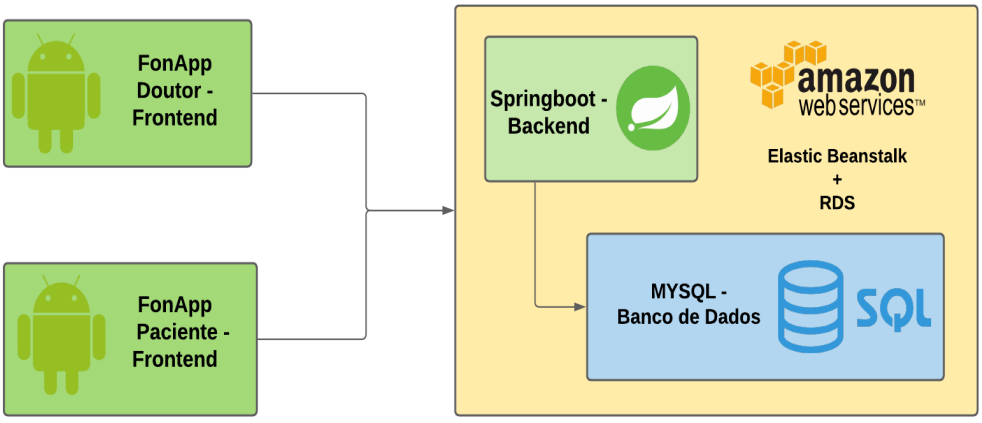


Figure 4: Diagram of technologies used in application development.

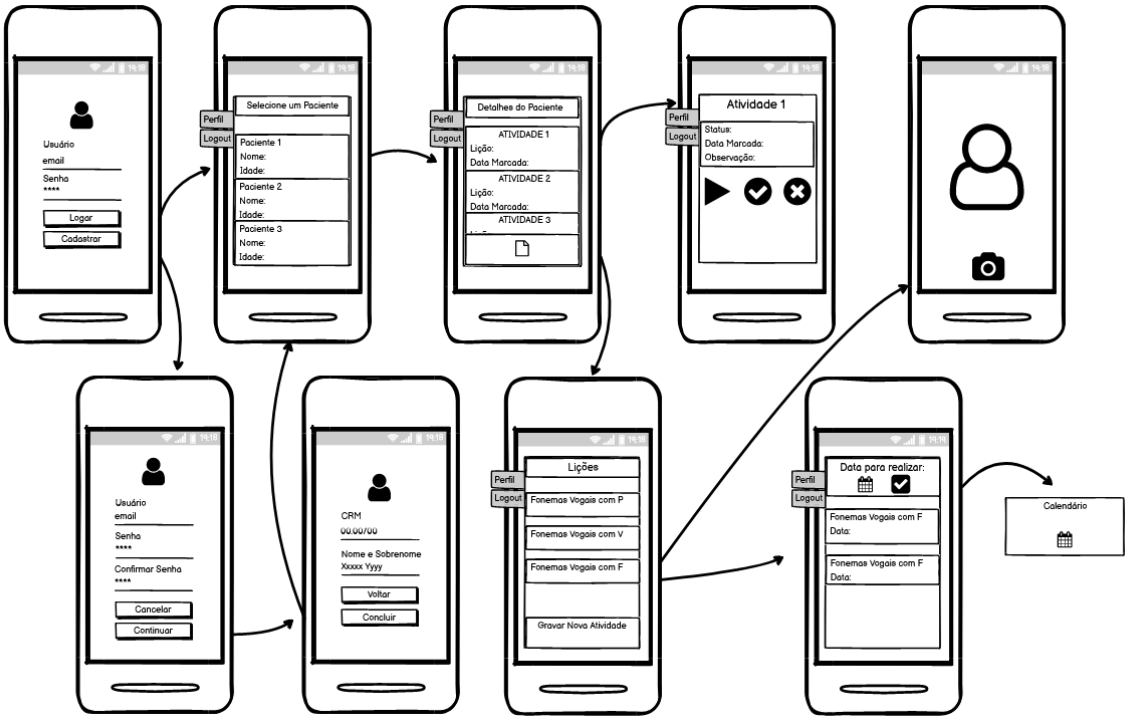


Figure 5: FonApp application usage flow diagram (Doctor module).

to the registration screen, acquiring a login with e-mail and password. After registering, it is possible to view the list of patients, giving access to their data, namely: name, age and status of patient activities. By selecting one of the patients, you can see in more detail which activities are in process, and which have been completed. From this point, the speech therapist can choose between registering new activities for the patient, by pressing the button located below the list of activities, or selecting one of the activities from the list to carry out an evaluation.

If you select to register a new activity, the flow is diverted to a new screen, where you have access to a list of pre-registered lessons. There is also the option to record a video of a new lesson. For each lesson, you can determine the number of repetitions and set a date for completing the exercise.

If he selects to evaluate an exercise performed, he will then see a new list of items, referring to the number of repetitions previously registered on that particular activity, with the possibility of listening to the audio and then evaluating the patient's speech.

For the patient module (see figure 6), the proposed functionality is the performance of an activity registered by the speech therapist in the doctor module of the application. Through an e-mail and password registration, name, surname and date of birth, the patient can then access the application and find the activities that must be carried out, which are arranged in a list. The patient will only receive their activities and screens when the audiologist sends an email notification.

After selecting an item from the list of activities, the patient has access to the details of the activity, such as: a video made by the speech therapist exemplifying the exercise proposed in that activity; a quick description; and a list of items, referring to the number of times this activity must be performed.

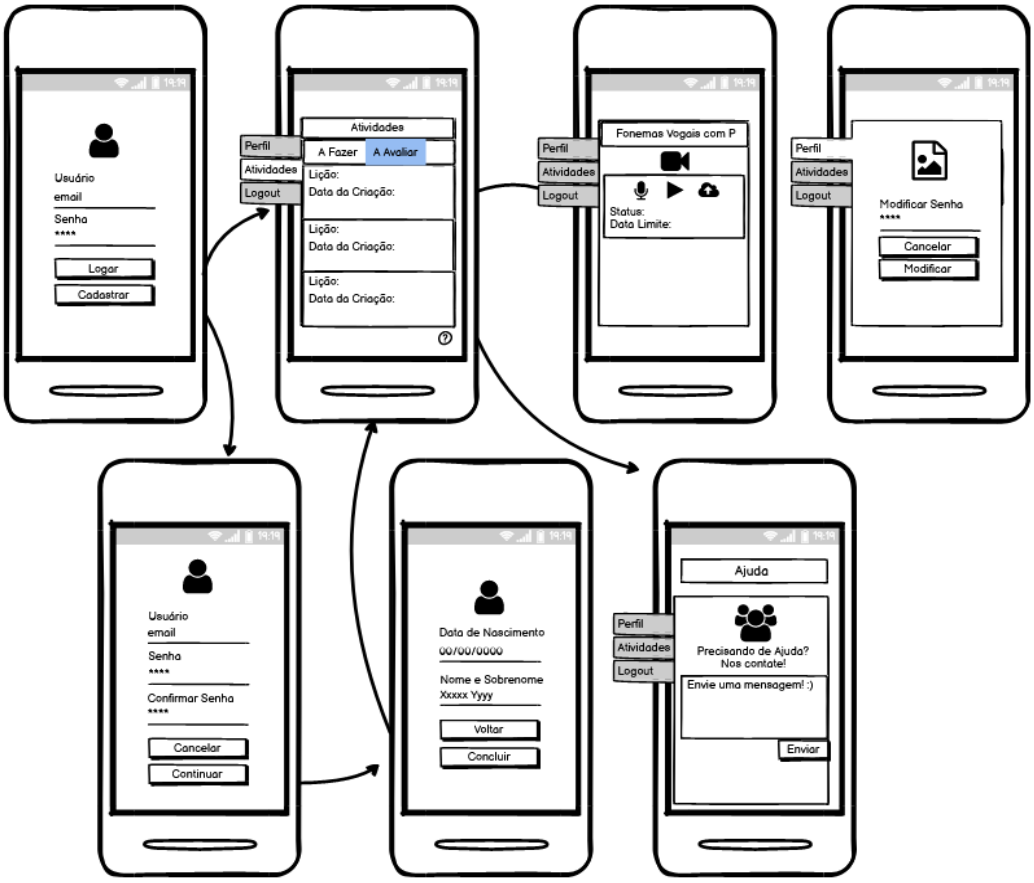
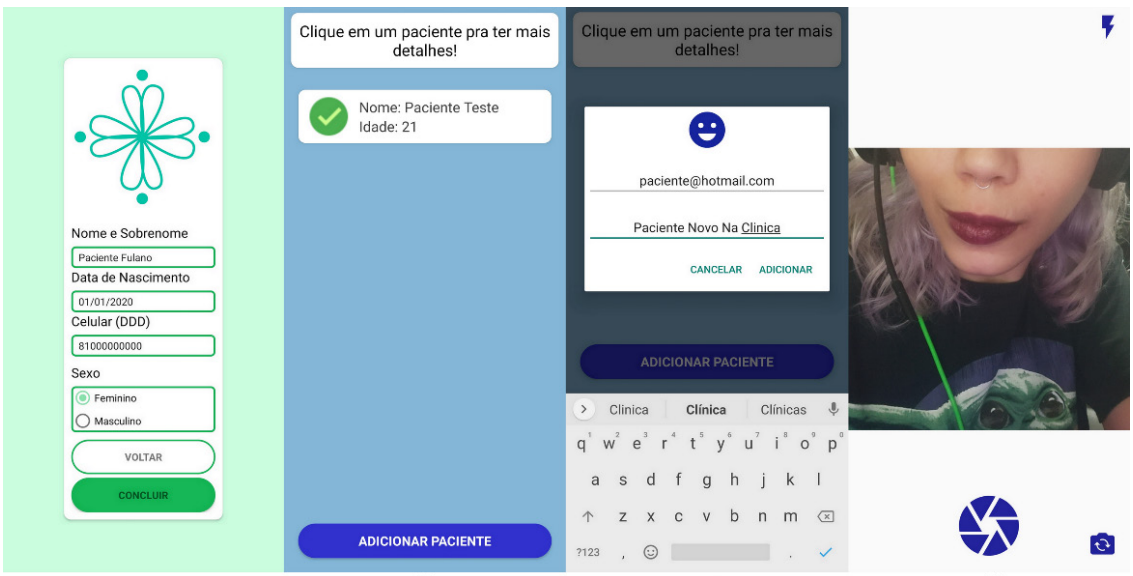


Figure 6: FonApp application usage flow diagram (Patient module).



(a) (b) (c) (d)

Figure 7: FonApp Screens.

Within the items, the patient will then be able to start recording the audio. If after listening to the audio, he will be able to check if it is to his liking, and if not, he will have the option to re-record the audio until he feels comfortable to carry out the final step of sending the audio.

At the end of these steps, the patient will notice the change in the status of each exercise performed, remembering that there is a possibility that an exercise needs to be performed again after sending it, which is evidenced by the progress bar on the previous screen, which contains the list of activities. The patient still has the option to ask his speech therapist for help by sending a message to his email.

Figures 7 (a), 7 (b), 7 (c) and 7 (d) present, respectively, the creation of the patient's record, with first and last name, date of birth, mobile number and gender, the list of patients, with the newly registered patient linked to the speech therapist, the addition of the patient in the speech therapist module with a brief description, and finally, the camera module, which records the activities in the database for the patients.

CONCLUSION

This work showed that mobile devices are a powerful tool to assist the speech therapy process in patients with cleft lip and palate. The following features were developed for the FonApp application: speech therapist registration, patient registration, video lesson recording, sending doubt messages, patient's name always on display, complete/ incomplete activity tabs for the patient. The perspectives for improvement are: presenting the application to a group of speech-language pathology professionals and applying a questionnaire based on use for validation, testing and observing with two distinct groups of patients: one who will undergo treatment without the application and the other with the application, for a period of 4 months, with the tests being carried out and supervised by a speech therapist from IMIP, who has been collaborating with the development of this work. It is understood that therapy through the application can present effective results, provided that aspects such as duration and frequency used during treatment are considered.

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