Android based Receptive Language Tracking Tool for Toddlers

Sadia Firdous[1], Madhia Wahid[2], Amad Ud Din[3], Khush Bakht[4], Muhammad Yousuf Ali Khan[5], Rehna Batool[6], Misbah Noreen[7]

Department of Computer Science, Fatima Jinnah Women University (FJWU), Rawalpindi, Pakistan[1, 2, 6, 7]
Department of Physics, Fatima Jinnah Women University, Rawalpindi, Pakistan[3]
Department of Electronic Engineering, Fatima Jinnah Women University, Rawalpindi, Pakistan[4]
Department of Electrical Engineering, Gomal University, D I Khan, Pakistan[5]

***Abstract*—Today's Android-based applications are gaining more popularity among users, especially among kids. Many Android-based applications are available related to speech therapy of a child but these have left some loopholes. Talking kids is the solution to those applications. It is an Android-based receptive language tracking tool for toddlers that emphasis to improve child's hearing capability and helps to learn, understand and develop receptive language vocabulary. It includes the colourful images of the daily routine things with their sound in a native accent so that child can learn the daily routine items. Child assessment is also included in this application for monitoring child performance. On the basis of child assessment, the activity log is maintained for keeping track of the child performance. The collected results are showing the successful development of receptive language vocabulary in toddlers with the help of 'Talking kids'.**

Keywords*—Receptive language; mobile application; hearing impairment

I. Introduction

As the Android operating system is getting more popular the application based on Android interests more attention [1]. Today's many Android-based applications are available related to speech therapy of a kid but all these have some limitations. In this paper, we will look at Android-based mobile application development that is Talking Kids. It is an Android-based receptive language tracking tool for toddlers that focuses to enhance child's hearing ability and helps him to learn and understand language. It does not require an internet connection but only for installation. It is a comprehensive application which consists of different scenarios and categories in which children practice different words and daily life things. Colourful pictures of daily life items along with their pre-recorded sounds in a native accent are presented to the child to increase his hearing ability and to help him in learning communication skills. This application has one relationship category in which parents can add their own pictures and record their own sound. The application has a 'Monitoring' scenario to check a receptive vocabulary of the kid. The application has an 'Activity Log' feature to maintain a record of the child according to his performance in Monitoring.

A. Background Study

Receptive language is the ability of an individual to understand information. It includes getting the words, sentences, and meaning of what others are talking about [2]. It has great importance for better understanding and effective communication. Children who find difficulty in understanding things are to follow guidelines at school or at home. Difficulties in understanding language may lead to listening problems and behavioural issues [3].

B. Receptive Language Disorder

Receptive language disorder includes difficulty in understanding what others are talking. An individual shows receptive language disorder due to any neurological illness or injury. In some cases, it is developmental which is common in kids. Kids start speaking with the delay in developmental disorder. According to research, about 5% of school-age children have a language disorder. About more than 1.1 million children of 6.1 million got a special education under IDEA (Individuals with Disabilities Education Act) in public schools. In the 2005–2006 school years, these children were aided under the class of language impairment [4].

1) Speech and language development track: Speech and language development indicators for normal children are given in Table I. These tables show the normal speech development track of a kid. This table is showing that normal speech development chart usually starts with birth and at the age of 3-4 year toddler has a significant vocabulary to recognize things as well as to understand instructions. If a kid is not following this normal speech development track, management is required.

C. Causes of Delayed Speech and Language Development

There are different causes that make kids incapable to understand speech and language clearly. Some possible causes are:

1) Hearing impairment: Hearing impairment is the inability to hear. It can either be total or partial. Speech development delays due to condensed revelation to language in hearing-impaired children [5].

2) Learning disability: Learning disability is a neurological disorder. Children with learning disabilities may have difficulty in reading, writing, spelling, reasoning, and recalling and/or recognizing information [5].

3) Autism: Autism is a disorder that affects communication skills of a kid. It includes a range of conditions categorized by challenges with repetitive behaviours, social skills, speech and nonverbal communication. Speech Communication problems are an early sign of autism [5].

4) Neurological problems: Neurological problems are disorders of the nervous system that affect the muscles required for speaking. It includes cerebral palsy, muscular dystrophy and traumatic brain injury c.

5) Other conditions: Down syndrome, intellectual disabilities and premature birth of a child are some other reasons for speech delay [4]. Moreover extreme environmental dispossession can also cause speech delay. If a child is neglected and involved in other activities like using mobiles and other electronic gadgets unreasonably than he/she will not learn how to speak. These neglected children have less interaction with their parents. They do not hear their parents and in the result, they are unable to develop language and speaking skills [5].

TABLE I. NORMAL SPEECH DEVELOPMENT [5]

Age	**Language level**
Birth	**Cries**
2-3 months	Cries differently in different circumstances
3-4 months	Babbles randomly
5-6 months	Babbles rhythmically
6-11 months	Babbles in imitation of real speech, with expression
12 months	Says 1-2 words; recognizes the name; imitates familiar sounds; understands simple instructions
18 months	Uses 5-20 words, including names
1 & 2 years	Says 2-word sentences; vocabulary is growing; waves goodbye; makes "sounds" of familiar animals; uses words (like "more") to make wants to be known; understands "no"
2 & 3 years	Identifies body parts; calls self "me" instead of a name; combines nouns and verbs; has a 450-word vocabulary; uses short sentences; matches 3-4 colours, knows big and little; likes to hear the same story repeated; forms some plurals.
3 & 4 years	Can tell a story; sentence length of 4-5 words; the vocabulary of about 1000 words; knows last name, the name of the street.
4 & 5 years	Sentence length of 4-5 words; uses past tense; the vocabulary of about 1500 words; identifies colours, shapes; asks many questions like "why?" and "who?"
5 & 6 years	Sentence length of 5-6 words; the vocabulary of about 2000 words; can tell you what objects are made of; knows spatial relations (like "on top" and "far"); knows address; understands same and different; counts ten things; knows right and left hand; uses all types of sentences

D. Management

By using the following areas of cure effected individuals can get the benefit.

1) Augmentative and alternative communication (AAC): This is a helping method involves gestures, storyboards, or computers that say words out loud. These things act as a therapy material in order to make the person familiar with specific or general things [6].

2) Speech therapy: To improve speech and language skills, a rehabilitation platform called speech therapy is used. With the help of speech therapy children who cannot speak clearly can improve their speaking skills. Speech therapy builds language skills of kids by making them aware of new words, sentences, and instructions. It also improves their listening and communication skills [7, 25].

3) Other treatments: amilies can be trained so that they become able to provide language development to their child. Special education classes can be provided at school. In case of severe impairment, preschool education can be provided [8].

II. RECENT TRENDS IN RESEARCH WITH RESPECT TO INFORMATION TECHNOLOGY (IT)

IT researchers have proposed different speech therapy tools and system for hearing impaired children. Pentiuc et al. proposed a system known as Computer-Based Speech Training (CBTS). This system helps children with hearing deficits and pronunciation complications. CBTS is basically a medical tool that helps in the diagnosis of the problem and used to perform the repetitive task automatically. This system also manages important records and provides a timely response. CBTS system was designed in Logomon, Romanian language. Fuzzy expert system and semantic rules were used to design the basic architecture of CBTS. 1000 plus exercises were added in its database that is regularly updated on the basis of child performance. According to testing criteria, CBTS is an assisted therapy scheme with good system validation [8].

Hearing impairment is the major hurdle in developing communication language. It can be treated by using a different type of hearing assistance like a Cochlear implant. But these treatments can only improve hearing abilities, not speaking abilities. Brennan-Jones et al. conversed an application approach Auditory-verbal therapy (AVT). The main objective of AVT is to provide basic communication skills for a specific age group (birth to 18 years). It is an advanced application methodology including different sessions that involve a child's family. With the proper use of technology, improvements can be made in speaking abilities [9].

Children with a speech disorder and hearing impairment face difficulties in understanding their native language. Lee and Gibbon discussed an application approach known as Non-Speech Oral Motor Treatment (NSOMT). It is used by pathologists to enhance child's learning capabilities. The main objective of this application methodology is to deal with specific errors of speech and to improve the speaking abilities of hearing-impaired children. NSOMT is the non-speech action involves some exercises such as chewing, smiling, lips movement, swallowing and many others that are a helpful

parameter to generate sound. But the effectiveness of this application approach is dubious and requires more studies [10].

Hearing loss is one of the major health problems that affect the quality of life severely. Kids with hearing impairment have poor communication skills and social interaction. Rabelo and Melo examined treatment procedures achieved in public rehabilitation centre. The key factor in counselling activities is that the family is involved in the whole process. Electronic devices, used in counselling comprise of a broad range of information about daily life activities. Rehabilitation centres provide appropriate assistance to children, to make them able to persist in society successfully [11].

The act of communication is the basic feature of mental and behavioural development, learning and gaining knowledge. Rabelo et al studied the orofacial and cervical regions that include drinking, swallowing, eating, inhalation and speech processes. There can be learning delays during childhood that leads to unwanted results. Four speech therapists are involved in this research. They considered noise factor and different morphological features like lips, face, cheeks, tongue and smile movements. This study concludes that the occurrence of speech disorder is high and needs more research to tackle this problem [12].

Cognitive abilities of hearing-impaired children may lose due to auditory faults. Hearing impairment is a key reason for language disorder. Shojaei et al. evaluate language development in Persian children with auditory failings. According to their study early identification effect syntax and semantic skills of hearing-impaired children. Moreover, in different age groups, these skills vary [13].

In addition to traditional education system learning applications are helpful to educate children. These practice applications are based on the lesson, demonstration, gaming and presentation, finding, problem solving and recreation. Some practical applications are used to structure the mind maps by using images, audio, and video. These practice applications almost replace old digital learning processes. Now learning material is available in the form of more handy digital tools which are friendlier and provide good interaction to children to understand and learn digital educational material [14].

A. Mobile Application

1) Speech therapy: Speech therapy is a wonderful application that helps children with hearing defects to learn different words with proper phonation. It contains images for better learning of impaired children. They hear words and speak them accordingly. An interesting feature of the application is that it writes the spoken word and praises children if it is right [15, 25].

2) Constant therapy: Constant Therapy is an application that aids people and children having speech disorders. It gives prizes to winners. This application contains different levels with different tasks that aid the impaired child to develop his learning and speaking skills. Children have to speak words which they hear and awards are given to them on the basis of spoken words [16].

3) Articulation speech therapy: It is used to condense speech and language disorders in children with auditory defects. It contains images for a better understanding of kids. This application is used by parents for management of their impaired children [17,18].

4) Talking mats: Talking mats is an advanced communication tool. It helps children with communication problems to understand and direct their thoughts. The application is developed in Java using Android studio plugin version 3.1.2 with gradle version 4.4. Android built-in database 'SQLite' is created. This application is only for a single user so there is no need to use the server database. Also, the data of two users is confidential from one another so the local database is enough for this application. The main flow of Talking Kids is given in the below figure. It is a multi-module application; the modules of this application are given in Fig. 1.

B. User Registration

For using this application first the user must be registered and the registration is done by the parents.

C. User Login

If the user is already registered the user has a login for this application. It requires a username and password to continue.

D. Scenario Selection

This application compromises two different scenarios learning and monitoring. When the learning scenario is selected the child will learn images related to different categories. In the monitoring scenario, different questions were asked to check developed receptive vocabulary of the child. The activity log is maintained for keeping track of user performance. It gives choice to the user to exit from application. This application uses distinguishing, specially designed symbols that are smart to all ages and skills [18-24].

There are many research and mobile applications in this field but each of them has some flaws. Mobile applications with good sound quality are not free at play store. 'Talking Kids' would be free of cost at play store, as it includes images with good quality sounds. The most important audio stimulus is pre-recorded in a native accent.

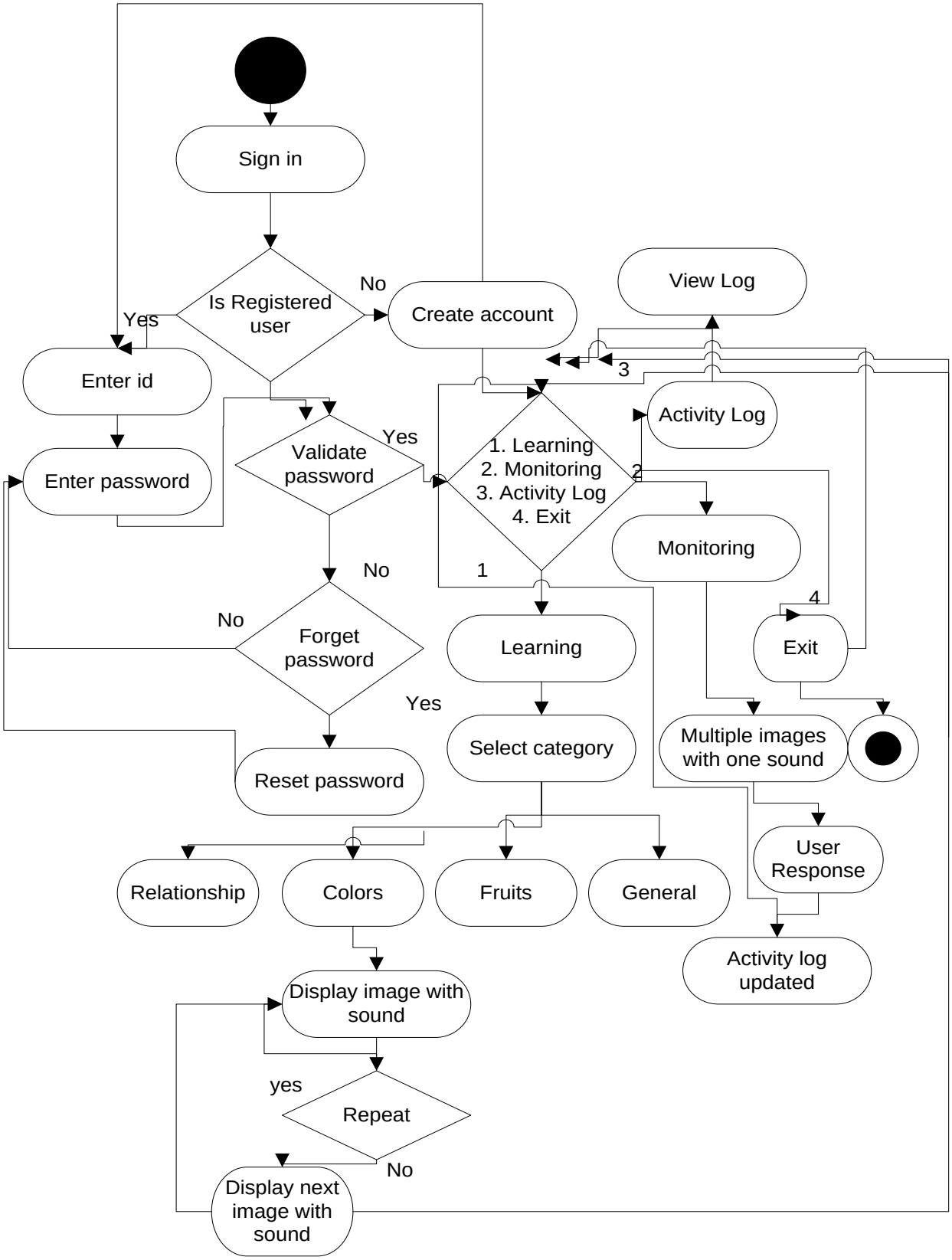

Fig. 1. Flow Diagram of 'Talking Kid's.

III. Design Methodology

Waterfall model is used for software development in the proposed application. This model is used because the requirements of this application are very well known as clear and fixed. Also, the technology used for implementing this application is understood, there is no ambiguity.

A. Category Selection

This module consists of different categories of animals/birds, vegetables/fruits, colours, relationship and the general. The choice is given to the user for selecting the category of his own choice.

B. Animals/Birds

This category includes images of animals and birds. The image displays corresponding to sound.

C. Vegetables/Fruits

It includes images of vegetables and fruits and corresponding pre-recorded audios.

D. Colour

It includes images of colours and corresponding pre-recorded audios.

E. Relationship

This category allows parents to add images of their own choice like child's immediate relations. The audio can also be recorded corresponding to the image.

F. General

This category includes the images of daily routine items with their pre-recorded audio, so that child is able to recognize these things. Screenshots of "Talking kids" are given in Fig. 2.

Fig. 2. Screenshots of 'Talking Kid's.

IV. Results and Discussion

'Talking Kids' helps kids to develop receptive language vocabulary and distinguish things. It assists them to cognize what is said to them, that is the main aim to make them able to cognize and react to given instructions.

It eases the burden of parents and gives compensation for expensive sessions of a speech-language pathologist. It does not require parents to remain stuck with a child, as they just start the application and choose the required scenario after this the kid can learn easily. Different classifications are added in this application in order to build the language of the child. Performance record helps parents to check the improvement of their kid. "Talking Kids" provides better outcomes as kids like to intermingle portable electronic gadgets.

Comparison of "Talking Kids" with other mobile applications is given in Table II. As compared to previously developed software/web and android based application "Talking Kids" is a multi-module application that permits parents to add images and record corresponding sounds. It includes colourful graphics, images, background music and audios in native accent to make a kid learn easily.

Five kids, of 2-6 year age who were suffering from hearing impairment, were taken to test the 'Talking kids'. This testing is done by a speech therapist. As shown in Fig. 3 "Talking kids" help these kids to learn, understand and develop receptive language vocabulary in a number of speech therapy sessions in the time period of seven weeks. Each sample (kid) has a different improvement speed. After doing sessions by the speech therapist with the help of "Talking kids" kids showed improved receptive vocabulary.

TABLE II. Comparison with the Previous Applications

Application Name	Modules in Applications		
	Learning	Child Assessment	Record Keeping
Speech Therapy[15]	***	-	-
Articulation Speech Therapy [17]	*****	***	***
Memory Game [19]	***	-	-
Speech Essentials Therapy app [20]	*****	*	*
This Work 'Talking Kids'	*****	***	*****
Perfect: ***** Average: *** Below Average: * Not included: -			

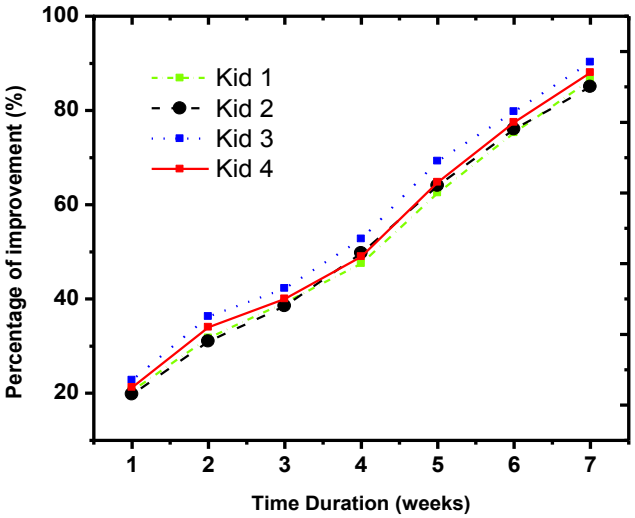

Fig. 3. Receptive Language Vocabulary Developing Pattern.

V. Conclusion

The main objective behind developing Talking Kids was to provide a rehabilitation platform to hearing-impaired children to develop receptive language vocabulary. The proposed application includes the different images and their pre-recorded audios in native accent. It also includes one category which allows parents to add the pictures of their own choice so that the child can learn his/her immediate relations. This application is beneficial to the child as they feel happy to interact with mobile gadgets, also it will save the expensive session of a speech-language pathologist.

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