Development of Basic Learning and Communication System for School Children with Speech Disabilities using Mobile Platform

Anil Kumar
Department of Computer Science & Technology,
Kabarak University
Nakuru, Kenya

Nickson M. Karie
Department of Computer Science & Technology,
Kabarak University
Nakuru, Kenya

Abstract: The concept of community access to information using Information and Communication Technologies (ICT) has gained widespread attention as a strategically vital response to the perpetual lack of affordable access to information and ICT services in the developing world. Community access to information and ICT services is not in itself a new concept. Besides, it provides an encouraging policy approach to overcoming the wide disparities of access to information, particularly in the education sector. ICT services can provide opportunities for disabled students especially speechless students to participate in the newly emerging social and economic orders. A vast number of students have no obstacles to communicate or learn through the many technological educational tools that provide different functionalities and services. Even though the technology is becoming more incredible and sophisticated, there is not much of the development and improvement in the communication systems and learning or education application systems for speech disabled students.

This paper, therefore, presents a new concept aimed at developing a basic learning and communication system for school children with speech disabilities using mobile platforms in the developing world. Hopefully, the success of this developing project would become the much needed innovation that will bring the revolution for the society and more especially for the speech disabled students in the world. Basic learning and communication system for school children with speech disabilities using mobile platform constitutes the main contribution of this paper.

Keywords: Information and Communication Technology, learning, speech disabled students, mobile applications, mobile platform

I. INTRODUCTION

Disability is an issue of concern to many policymakers across the globe. In a report published by the United Nations, for example, at least one in ten people globally is a person with disability. Disability among different people is a serious problem that deprived many of the opportunities to participate in different social activities like any other person would do [1, 2]. In addition, the integration of disabled people to participate in different activities in the society has always encountered barriers [3]. However, with the help of today's technological evolution, disabled people can gradually take active roles in many of the social life activities.

The aim of this paper is to present a new concept aimed at developing a basic learning and communication system for school children with speech disabilities using mobile platform. Speech disorder is one type of disability having various challenges in one's daily life. Speech disability can, for example, prevent people from expressing themselves clearly. Moreover, it obstructs all the communicative activities in several fields of life like educational and commercial enterprises.

In this sense, the authors contend that, a basic learning and communication system for school children with speech disabilities need to be developed as a way to overcome the many different challenges posed by speech disorder. Such a system can for example lower the challenges posed by speech disabilities while in school or any learning environment. Hopefully, the success of the system proposed in this paper would bring the revolution needed by school children with speech disabilities as well as any other people with speech disabilities especially in the developing world.

As for the remaining part of this paper, section II introduces the background followed by a detailed description of the proposed system in section III. Section IV presents a critical evaluation of the proposed system. Finally, conclusions and future work are provided in section V.

II. BACKGROUND

Many people with speech disabilities and complex communication needs are more often than not excluded from full participation in their homes, schools, and community [4], [5]. The lack of access to speech may negatively impact on most aspects of their development, including cognitive, social, language, and literacy skills.

For this reason, [6] argue that, there is a need to provide children who have complex communication needs with access to the magic and power of communication at the earliest possible age to circumvent the negative effects of communication disabilities.

However, to be optimally effective, any communication system must be designed in such a way as to meet the needs and accommodate the skills of the young children and effective evidence-based intervention must be provided to support the children's development of the pragmatic, semantic, and syntactic skills required to achieve communicative competence [7].

According to a research by [8], Augmentative and Alternative Communication (AAC) interventions can also offer the potential to enhance communication and maximize language development. AAC as defined by the American Speech-Language-Hearing Association refers to communication used to express thoughts, needs, wants, and ideas. Although we all use AAC through gestures and facial

expressions, people with speech disabilities rely heavily on AAC to communicate.

It is for this reason that the authors present in this paper the development of basic learning and communication system for school children with speech disabilities using mobile Platforms. The authors also hope that with the availability of the open source community, more can be done in this area so as to arrive at a fully-functional AAC device for the speech disabled people using different mobile platforms. Such a system can, for example, help elementary aged children learn how to build grammatically correct sentences as well as communicate with easy. In the section that follows, we explain in more detail the design of the proposed basic learning and communication system.

III. DESIGN OF THE BASIC LEARNING AND COMMUNICATION SYSTEM

While many voice enabled AAC devices are currently available, they lack the important ability to generate customized speech that mimics aspects of the user's past or intermittently available speech [9]. In this section of the paper, therefore, the authors present a detailed explanation of the proposed basic learning and communication system design for school children with speech disabilities[1] using mobile Platform. Figure 1 shows the structure of the system interface design.
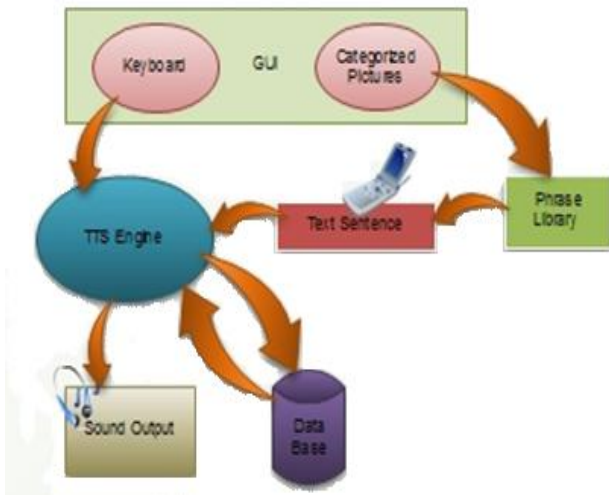

Figure 1:- System interface design

From top to bottom, the system consists of a Graphical User Interface (GUI) which includes the keyboard and categorised pictures as shown in Figure 1. The GUI enables the user to give input to the Text-to-Speech (TTS) engine. If the inputs are images, before sending it to TTS, the system sends it to a phrase library to convert the input to a suitable text. The TTS engine then processes the text and further produces the appropriate sound stream which is then sent to the related output device. To facilitate the generation of the sound output, the TTS engine interacts with a sound database which also communicates with the output device to produce the right sound stream as shown in Figure 1.

Note that, the system has preloaded images associated with some words and phrases about many situations that appear frequently in our daily life. Users, however, have the option to insert new appropriate pictures each corresponding to a meaningful word or phrase. In addition the users can

also type new meanings to any of the new uploaded picture using their keyboard. The entered input is then sent to the central part of the system namely the TTS engine for future use by other users. Figure 2 shows how a user interacts with the basic learning and communication system.
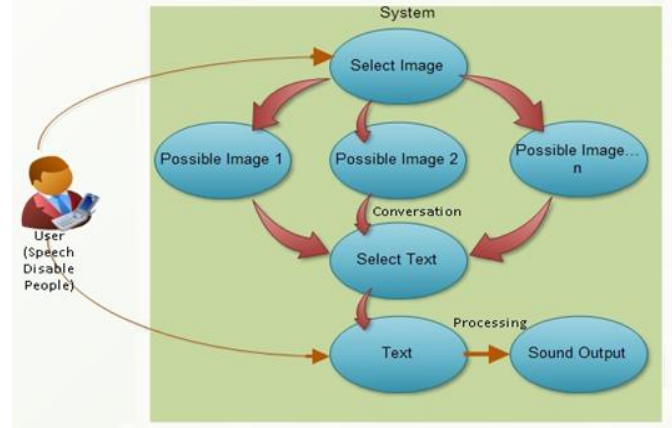

Figure 2:-The diagram of how the users interact with the system

Once the user selects an image the system generates related sentences. The user then chooses one of sentences generated and submits to the TTS to produce the vocal output as shown in Figure 2. The process of selecting the images and the generated sentences before the output is computed as shown in Figure 3 below. The system follows this path in forming statements and sentences with the associated images or pictures chosen by the user.
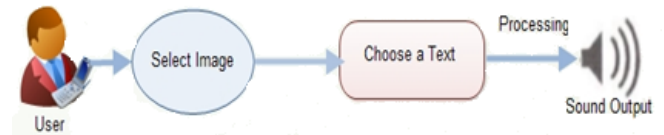

Figure 3:- Image selecting use case

The targeted users of the proposed system in this paper are speech disabled people [2]. Such people can either be at home, hospital or even at school. However the system can also be made available for general use by the public. The unique feature of this system is in its multimodal input/output design. Figure 4 shows the Data Flow Diagram (DFD) of the proposed system.
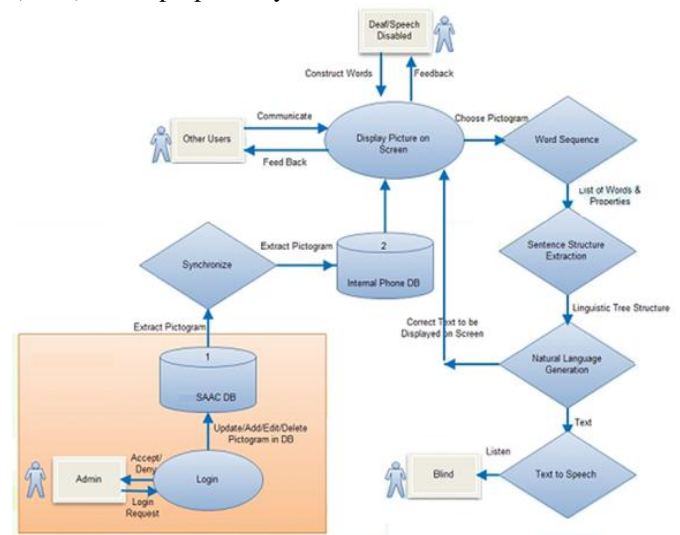

Figure 4:- Data Flow Diagram

The proposed system is a Java-based Android application for mobile devices, which is aimed at helping speech disabled people to communicate. The primary goal is to allow people to get sound stream output from the images or text given as input. Users can as well build sentences from the images they choose from the categorized pictures. In some cases users can upload more pictures and match them with existing words, phrases or even create new meanings to the images. However, the proposed system does not check for the correctness or meaningfulness of the input provided by the users. As of now all speech generated by the proposed system are handled in the English Language.

This requires the implementation of two main functions which will run on Android OS. The first one is a text-to-speech engine for English language, which will speak aloud any text inputted by the user. Second is a categorized and expandable phrase library with preloaded voices and pictures associated with several situations. As important as these functionalities is also the development of a graphical user interface suitable for use with mobile devices [10], particularly the Android platform as is the case of the proposed system. To help in understanding the usefulness of the system proposed in this paper, the next section provides a critical evaluation of the system.

IV. CRITICAL EVALUATION OF THE SYSTEM

The proposed system in this paper is a new contribution in the academic field. The scope of the system is defined by the steps and guidelines shown Figure 1, 2 and 3. The system is a new contribution which has the power of using text, graphics and sound system for basic learning and communication.

Furthermore, the system can assist speech disabled students to learn and communicate effectively with other persons in their daily lives. This also implies that, the system can as well help elementary aged children learn how to build grammatically correct sentences. In addition, the system can help elementary aged children learn how to have multi-exchange conversation with their peers in a variety of social settings.

Besides, the system provides real-time communication to its users by converting text to speech in less time. Because the system can be deployed on a mobile device, it means that the user could learn direct from their Individual mobile phone applications.

The specific details of the individual steps as identified in the system have also been explained in this paper. However, note that the steps as identified in Figure 1, 2 and 3 are meant to facilitate this study and primarily focus on the working of the proposed system. Such proposed steps or guidelines are by no means the final guaranteed steps to a perfect learning or communication between two individuals with speech disability. However, in the authors' opinion, organising the system into steps was necessary to simplify the understanding of the system as well as to present specific finer details of the system.

Some of the notable advantages of the proposed system include:

User-friendly: Speech Disabled persons can use the system with easy to communicate effectively due to its user-friendly interface deployed in mobile devices.

Reliability: The system is reliable because it does not depend on external database (has an inbuilt database).

Portability: The prototype of the proposed system is developed using standard open source software like java. Hence, can work both on Android phones as well as Tablets, thus, taking care of any portability issues that may arise.

Availability: The full systems once developed and complete can be made available via portals like the Google play for download.

Maintainability: The proposed system uses the 2-tier architecture hence making it easy to maintain.

Finally, the system presented in this paper has been designed in such a way as to allow for improvement or new contributions that may emerge as a result of technology evolution. To the best of the authors' knowledge, this is a novel contribution towards enhancing basic learning and communication to speech disabled school children. The next section concludes this paper.

V. CONCLUSION

The problem addressed in this paper was that of the lack of a basic learning and communication system for speech disabled school children using a mobile platform. This is backed up by the fact that many of the voice enabled AAC devices currently available lack the important ability to generate customized speech that mimics aspects of the user's past or intermittently available speech.

A system is then proposed in an attempt to provide a simplified way to offer basic learning and communication using mobile platforms. The requirement of such a system in the developing world is exceptionally important to any speech disable school child, especially for learning as well as communication. With such a system, school children will for example, be able to learn with easy as well as identify relevant patterns to be used during communication. Moreover, the system can also help the general public, for example, to learn how to communicate with speech disabled people. The ability to learn and communicate effectively can improve on the general participation and productivity of speech disabled people in any event in the society.

Finally, the authors believe that by using such a system, better learning and communication can be attained. However, more research needs to be conducted in order to improve on the proposed system in this paper. The system should also spark further discussion on the development of new techniques to support basic learning and communication to speech disabled children in schools as well as at home.

VI. ACKNOWLEDGMENT

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