Development assistive technology for students with hearing impairments

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Abstract. Lip reading is a technique of understanding speech by visually interpreting the movements of the lip when normal sound is not avalaible. Also as a primary method for individuals with hearing impairment to understand others speech. Lip reading requires constant attention to obtain complete information. The fact is that students with hearing impairments have difficulty to doing this in the class, because they have to do other activities such as writing or asking a friend. So it cause some of the information conveyed by the lecturer is not to be captured. Considering that technology plays an important role in clouded communication and information needs for individuals with hearing impairment. It is necessary to develop assistive technology that can help students with hearing impairment to more easily receive material delivered by lecturers by converting sound to text form in real time that can be accessed and stored by student cellphones. This research involved 2 programmers, 3 validators, 2 lecturers and 3 students with hearing impairment. Based on the results of validation and testing, it shows that this assistive technology can be used easily for lecturers and help students to understand the material more easily.

1. Introduction

Inclusive education is an educational approach that focuses on the needs of students to provide quality education for all students with a diversity of abilities, gender, social and cultural, by involving the active participation of all students [1]. Differences in inclusive education are seen as an advantage rather than as a problem [2]

In Indonesia, Inclusive education has been carried out at the level of primary and secondary education for years, but only a few years the principle of inclusive education has entered the university's agenda in both teaching and learning policies and practices[3] . Likewise in the Department of Special Education, Islam Nusatara University, the departments accepted students with a variety of conditions, one of which is students with hearing impairment.

Deaf is a condition where a person has difficulty or cannot hear at all because of limited or non-functioning of hearing. Deaf individuals have an increased risk of experiencing language problems including phonology, morphology and syntax [4]. This ability is influenced by many factors such as cognitive function, linguistic processing skills and understanding ability [5]

Individuals with hearing impairment have different experiences with other individuals who are able to hear,that consequences them to having the risk to interpret speech in different ways [6]. So, the students with hearing impairment having the risk of difficulty in attending lecture material that requires a lot of language comprehension skills. In addition, the impact of low language acquisition can have an impact on the decline in academic achievement[6]. Sound is an important source of

information. Communication that is often used in classroom learning is through voice signals in the form of speech. However, people who are deaf or hard of hearing may not be able to use voice signals to communicate effectively[7]. In understanding the explanatory material delivered by the lecturer, students with hearing impairment rely more heavily on their visual abilities

People with hearing impairment use lip reading as the main method for understanding what other people reveal[8]. Lip reading is a job where someone recognizes what is said by others through a visual examination of the speaker's face[8] when the speaker is seen. To get all the information from someone's conversation, individuals with hearing impairment must pay full attention during the conversation. So that when their attention is diverted, then there is a big possibility that there will be information that is not captured.

On the other hand writing is one of the most complex tasks for children with hearing impairment [9]. So at the same time students with hearing impairment have a dilemma when listening to the material delivered by the lecturer. When he focuses on listening to the material presented by the lecturer, children find it difficult to write the essence of the material, and when he focuses on writing, he will lose the information conveyed, thus inhibiting their active participation in class.

Considering that inclusive education is based on a social model, in which the community in this case the university must produce practices that can support active participation [10], the university has the responsibility to develop technology that can help students with hearing impairment to access information in learning process in the classroom. Considering technology plays an important role in clouded communication and information needs for individuals with hearing impairment [7], therefore researchers are interested in developing Android-based assistive technology that can help students with hearing impairment to obtain information explained by lecturers.

2. Methodology

Researchers in this study are interested in developing and validating an assistive technology in the form of android-based software that will be used in lectures. This technology is expected to help students with hearing impairment to have better process in captured material delivered by lecturers . To do this, we make it in four stages as follows:

2.1. Need Analysis

Needs analysis is done by conducting a survey of deaf students and lecturers who teach in classes where there are students with hearing impairment. This survey was conducted to obtain data on the needs and expectations of lecturers and students related to software that will be developed that can help the learning process, especially in helping students with hearing impairment to understand the lecturer's explanation.

2.2 Development Stage

The purpose of this stage is to develop assistive technology in the form of android-based software that can be used by lecturers and students in lectures according to the needs analysis. At this stage the researchers involved two skilled technicians in the field of software development

2.3 Validation Stage

The validation stage is intended to conduct a review of software that has been developed, in order to find advantages and disadvantages that might be corrected and refined. This stage involved two experts namely experts in the field of learning media and hali in the field of hearing impaired, and students with hearing impairment.

2.4 Refinement Stage

This stage is the refinement stage of the software that has been developed by including suggestions from the validator

2.5 Testing Stage

The test was carried out using software that had been refined in the classroom involving two lecturers and three students. This stage is done to see the ease of use of the enhanced software

3. Results

Based on the results of the needs analysis that has been done, there are several points expected by lecturers and deaf students to be able to help the learning process, namely: 1) Presentation material that contains a lot of visual information, 2) there are people who help explain the material delivered in sign language and 3) the existence of technology that can change the voice of lecturers when explaining into written form that can be accessed by mobile phones. Based on the results of the needs analysis, the researchers agreed to develop software that focuses on the development of the third point. This software can convert any material spoken by lecturers verbally into real-time text form which can simultaneously be accessed by all students with hearing impairment in that class.

Based on these needs, then software-based development was developed using devices with Android based via local area network with wireless communication using WIFI. The choice of WIFI technology is due to a wider range and higher frequency range when compared to bluetooth. In a simple working system of this application are as follows: 1) The lecturer speaks explaining the lecture material (in the form of voice messages);

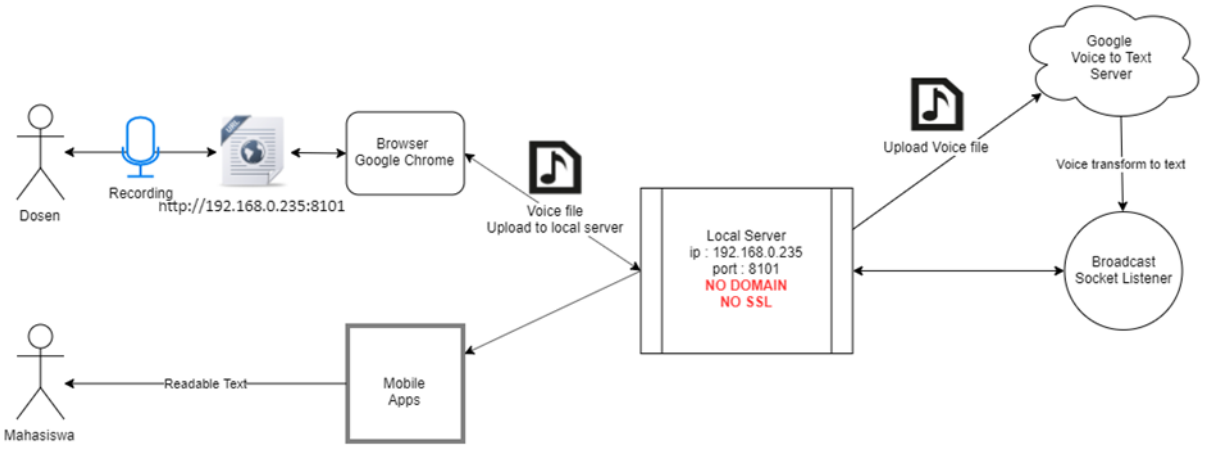


Figure 1. Technical Process

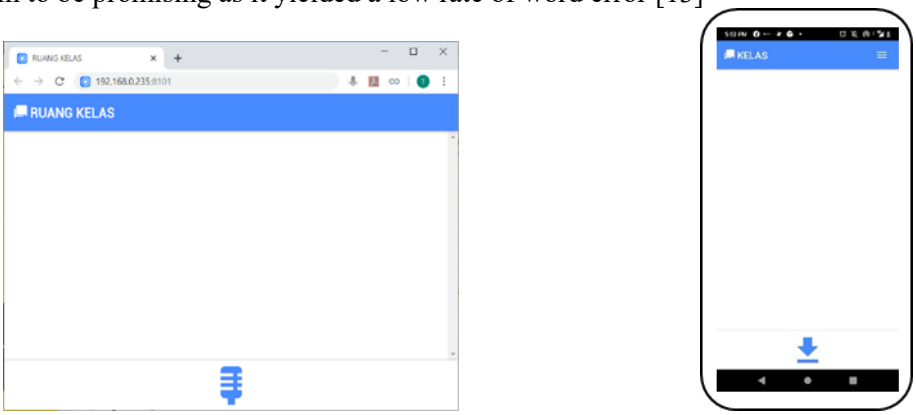
Voice messages are recorded through the Google Chrome browser, and then the file is uploaded to the server. On the server the file is uploaded to the google voice to text server and the voice is converted to writing sent to the student's cellphone that has the application installed

Students can read every word from lecturer's explanation that is delivered verbally in real time on the screen oh cellphones/smartphones/laptop.

Based on the results of validation, in general this software can assist students in receiving all auditory information submitted by lecturers when explaining the material verbally. However, there is no save menu so the material delivered can only be understood during the learning process. Based on the results of the validation, in the refinement stage, a save menu is added to save all the text from the lecturer's explanation into a file in document format. Additionally, technology ia valued for specific and unique types of learning activities[11] . So adjustments in some respects to suit needs are indeed needed.

The trial results show that this software can be used easily both for lecturers and students. Every explanation delivered by the lecturer can be transferred to each student's smartphones completely. Lecturers and students feel very helped by the application that has been developed. It's just that there

are still obstacles if the wifi signal is unstable there will be a delay in receiving text. Nevertheless, they still have benefits. However it was reported that the processing time took up to 10 second which indicates its unsuitability for realtime communication[12] And the perpformance of device speech to text seem to be promising as it yielded a low rate of word error [13]



Picture 2. Software Display

A person who experinced hearing loss, even in the best circumstances where the environment does provide a rich linguistic experience, they are at greater risk for missing out on some of learning opportunities [14]. The use of this application shows that assistive technology in the learning process is highly needed by deaf students. And also, the students explained about feeling comfortable and more confident when using these devices so they could participate in class activities. This is felt very differently when not using the device. The relationship between language and behavior is also stated by Orfanedes, there is a correlation between language and problem behaviour[15] Students who are missing to much information they lost in class discussion [16]

This process also appear the attitudes of university or faculty members towards students with dissabilities. They had more experience in how to respond to the needs of the students with dissabilities [17]. Improving the opportunities for disabled students to participate in fieldwork can be seen as amove to improve our teaching and the quality of th elearning experiences we provide [18]

4. Discussion

In the development of assistive technology, researchers do not only involved experts in the field of technology, but also users, namely students, thus developing the technology according to user needs. This is as explained that in the development of assistive technology it must involve the participation of users in three things: 1) decision making process, 2) testing prototypes and tools developed, and 3) involving users as well as research “subjects” [7].

The use of devices that can contain text for the hearing impaired that has also beed developed from time to time.And aplication currently use today is aplication designed to convert into text, speech to video sign language or computer generated voice, ext to computer generated voice [19]

In this study the involvement of users as research subjects, has not been maximized because users are only asked for opinions about using the application. This research has not tested whether this application can really help deaf students in improving their ability to comprehend material verbally delivered by lecturers. Therefore, in the next stage of research, further research must be carried out that can test the effectiveness or influence of the use of software that has been developed by involving more number of deaf students, so that the influence can be quantitatively calculated.

A few studies have also look into integrated wearable and network devices [12] They proposed a devices consisting of eyeglasses on which microphonesand LEDs are attached [20]

Generally, the development of assistive technology can help deaf students during lectures. However, when the trial process there are facts that sometimes the text received in real time has not occurred consistently due to an unstable wifi signal. According to research there are several factors

that influence the strength of the Wifi signal, including access points, device performance, environmental conditions [21]. Therefore, it requires the placement of the appripriate access point and a good device to produce voice to text transmissions in real time.

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