Designing augmented reality sibi sign language as a learning media

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Abstract. Sign language is language used by deaf people to exchange information. Indonesia has two sign languages used in its application, namely SIBI and BISINDO. SIBI is an adaptation of the American Sign Language which is currently being applied in a special school (SLB) environment. To provide support in learning SIBI sign language in technological advances, the design of Augmented Reality to introduce the letters SIBI will help in the learning process. The black box test results showed all the features and functions of the application can run well. In observing the response time when scanning markers using the Xiaomi PocoF1 marker on the letters SIBI, it had an average time of 6.05 seconds. Observation of the scan distance of the SIBI letter, the average scan distance of the marker can be scanned at a distance of 5 cm to 50 cm.

1. Introduction

Sign language is communication through hand or finger movements that form a word or sentence. In communicating with deaf and speech impaired people using sign language that has been implemented, in Indonesia there are two models of sign language, SIBI (Indonesian Sign Language System) and BISINDO (Indonesian Sign Language). SIBI is used as a sign language in schools, not used as a medium of daily communication, this is because the vocabulary in SIBI is made only by changing spoken Indonesian into sign language. While BISINDO is a sign language that has been used since the beginning by a region, group, community of deaf people, it can be said that BISINDO is the mother tongue of the deaf. The problem that exists is not the inability to communicate but the result of the development of language skills, namely the inability to understand language symbols and rules [1]. The Indonesian Language Research Laboratory (LRBI) at the University of Indonesia, Pheter Angdika said, SIBI was taken from the United States sign language, added with initial and final affixes [2]. SIBI has an additional feature in the form of sentences consisting of three sign words that will be displayed sequentially. The SIBI learning system can also be used for the general public who want to learn sign language. To make it easier for deaf people to understand SIBI sign language, which is the standard of education in every special school, mobile-based applications are used to support understanding SIBI.

The design of Sign Language Augmented Reality Applications as a learning medium is expected to provide solutions in introducing Indonesian Sign Language Systems to deaf children with SIBI letter recognition material. This application is expected to be an alternative media in learning by stimulating creativity, increasing concentration, and improving language skills, especially sign language through media. The design of this application was Augmented Reality technology with the consideration of displaying reality in the virtual world by projecting unreal objects (2D or 3D) to become visible. Augmented Reality or AR was used to combine illustrations (images) with audio and animation so that...
the information conveyed will be easier for users to understand and feel. The Information was shown in the form of a SIBI sign language video after the letter recognition poster was scanned using the AR application.

1.1. Augmented Reality
Augmented Reality is technology that combines virtual objects either 2D or 3D into a real environment that is interactive in real-time [3]. AR or Augmented Reality is a collection of technologies that display or bring up the real-world environment to be "added" by elements or objects from computerized results. More specifically, AR describes a mediated reality, in which the visual perception or view of the physical environment of the real world is enhanced by using computational devices. Virtual Reality (VR) is a technology that allows users to interact with computers in a simulated environment (either the simulated real-world or imaginary world [4]. Combines an environment with 3D virtual objects into a real AR environment that allows users to interact in real-time [5]. The conclusion of AR is to perform interfacing to place virtual objects into the real world. In its application, AR technology is related to multimedia, because it can provide interaction and information in more detail about an object both in two 2D or 3D. The use and application are very influential in fostering development in various fields, especially in the field of education [6].

1.2. SIBI Sign Language
Sign language is a form of communication with hand or finger movements that form words or sentences. The standardized Indonesian Sign Language System (SIBI) is one of the media to assist deaf communication in the wider community. A systematic arrangement of fingers, various hand movements that symbolize Indonesian vocabulary. People who experience hearing deficiency or loss of hearing ability due to damage or malfunction of part or all of their hearing aids so that they experience problems in language development are called deaf [7]. Sign language is a language that uses body movements and facial expressions as symbols of the meaning of spoken language. Deaf people are the main group who use this language, to express their thoughts, usually by combining hand shape, orientation, hand gestures, body arms, and facial expressions [8].

1.3. Multimedia as an education
The use of mobile applications is an intermediary medium between educators and students to assist in the learning process. Multimedia packaging in applications has a very important role in the creation of information delivery goals. Multimedia is able to convey interesting information and is able to touch various senses such as sight, hearing, and touch [9]. The use of graphics, illustrations, text, and sound in education as a medium that can provide effectiveness and efficiency in learning objectives. The presence of visualization can provide different stimuli from each other [10]. The SIBI sign language media application can display visuals in the form of videos with sign language in accordance with augmented reality technology.

2. Method
The method in the application of sign language applications (SIBI) with AR is Research and Development was used to create and produce a particular product and then performs tests to determine the effectiveness of the product [11]. Details the flow of the AR design process can be seen in Figure 1.
In Figure 2, the structure of the mindset design process started from observing problems and studying literature to finding the right basis and data through references. The second stage was conducting a survey to analyse the need for sign language letters and the appropriate media for their application. Collection of needs analysis was done to make the media design augmented reality. The structure of the AR application framework consisted of 3 process parts (1) Making a SIBI character recognition video, which consists of recognizing letters A to Z, then exported to the unit. (2) Designing the AR application, by including the marker database and the SIBI video on unity. After that, the application is built into a mobile. (3) Making markers consists of a 2D object configuration in the form of a poster for the introduction of the letters SIBI with Vuforia to store the marker database.

The process can be said to be running well, so an augmented reality prototype test was carried out with the planned data and needs. Black box testing was carried out, observing the marker scanning time, and observing the scanning distance. Testing of the SIBI letter recognition application was carried out to provide input in the development of the application. The test results was determined by the feasibility step of the application.

**Figure 1.** The flow of the augmented reality design process.
Table 1. List of assets.

| ASET | DISCRIPTION |
|------|-------------|
|      | Designing posters as a reference in understanding sign language letters and as markers in this application. |
|      | The user interface for the SIBI sign language application on the main menu display consists of two buttons, namely the SIBI button and the application button |
The SIBI sign language video will appear when the sign letter marker is scanned via mobile to translate sign language letters.

3. Result & Discussion
Communication is one of the important things that need to be considered in designing augmented reality applications. Communication is a process in delivering messages from communicators to communicants, while the communication in question is verbal communication with an emphasis on an attractive visual appearance. Visual communication with an attractive appearance was chosen because the segmentation is children of deaf people. In designing augmented reality, the first step taken was to carry out the pre-production process by preparing the material, namely by selecting the sign language letters A - Z, then proceeding with the production process (making illustrations and sign language videos with image and video processing applications on a computer), ending with the post-production process which was the process of editing and linking all production processes into one part. The pre-production process was began with selecting letters in sign language to be used in applications and posters. Then, it continued by preparing a marker that was used to detect objects on the poster so that a sign language video can be appeared. The main menu displayed two menu buttons, the letters SIBI and a button about the application. SIBI character recognition application was showed in the Figure 2.

![Figure 2. Main menu of SIBI character application.](image-url)
In the SIBI letter recognition menu, the process required to display sign language videos by mobile. There were two processes in this stage. First, preparing a SIBI letter recognition poster, then press the SIBI menu on the AR application. Second, pointing the mobile camera at the poster, and at the intended letter, a video of the SIBI letters will appear. Figure 3 showed how AR works in the SIBI letter application.

![Figure 3. AR works in the SIBI letter application.](image)

After all the merging processes have been completed, test the application before testing the feasibility of the application using the black-box. In black box testing, there were several methods that can be used, one of which is alpha testing. Alpha testing aims to identify and eliminate problems before the application reaches the user. Table 2 below figured the results of the tests carried out.

| Testing                                    | Result   |
|--------------------------------------------|----------|
| Application installation                   | Successful|
| Button function on the menu                | Successful|
| Installation of the letter SIBI marker     | Successful|
| Display video and sound                    | Successful|

Performance observations were carried out by paying attention to response time and scanner distance. Scanning time observations were carried out to find out how fast the device can respond when the camera looked at the marker until the AR object appears. This observation was carried out by scanning 26 SIBI
sign letter markers in good lighting conditions and a tilt angle of 0° or a straight line facing the marker as far as 20 cm. Figure 4 showed the observed results of the average response time with devices with different specifications.

![Figure 4. Graph of SIBI Scanning Time Observation.](image)

This observation was made during marker scanning by the Xiaomi PocoF1 mobile device. In the observation, a variation of the distance was given to determine the minimum and maximum range of the device in scanning a marker measuring 5 x 6 cm. Figure 5 below is the result of observing the scan distance in good lighting conditions and a tilt angle of 0° or straight parallel to the right opposite the marker.

![Figure 5. SIBI Scanning Distance Observations.](image)

4. Conclusion
By designing an application using Augmented Reality, it is expected that this application can provide solutions in the teaching and learning process, especially in the recognition of SIBI sign letters. Users, especially deaf children, can be stimulated by creativity and increase concentration, as well as improve
language recognition skills through a medium using an attractive visual appearance. Augmented Reality Application of SIBI Sign Language as a Learning Media has been successfully built. The black box test results have showed all the features and functions of the application can run well. This was supported by Unity 3D software and Vuforia which are very good in developing AR technology. In observing the response time when scanning markers using the Xiaomi PocoF1 marker on the letters SIBI, it has an average time of 6.05 seconds. Observation of the scan distance The SIBI letter has a scanning distance that the average marker can be scanned with a distance of 5 cm to 50 cm. Marker scanning is best done in bright lighting conditions to minimize errors and scan failures.

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