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Development of Vibrating Headphones to Help Student with Deaf Disabilities in Android-Based Lectures

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Abstrak

Penelitian ini dilatarbelakangi dari permasalahan yang ditemukan dilapangan pada mahasiswa disabilitas rungu yang kesulitan dalam mendapatkan informasi bersifat auditoris. Hal ini dikarenakan bentuk komunikasi pada saat proses pembelajaran menggunakan bahasa lisan. Oleh karena itu, peneliti mengembangkan *Vibrating Headphone* yang bertujuan untuk memudahkan disabilitas rungu dalam memperoleh komunikasi satu arah melalui teks. Penelitian ini menggunakan metode *Research and Development* (R&D) dengan model pengembangan 4D (*Define*, *Design*, *Development*, dan *Dissemination*). *Prototype* yang dikembangkan divalidasi oleh empat ahli, yaitu ahli disabilitas rungu, ahli teknik elektro, ahli teknologi adaptif dan ahli IT. Serta dilakukan uji pengguna untuk mengetahui praktikalitas *prototype* ke empat mahasiswa disabilitas di departemen PLB UNP. Hasil uji validasi oleh keempat ahli, mendapatkan nilai rata-rata 88,75% dengan kriteria sangat valid. Sedangkan hasil uji praktikalitas oleh ke-empat disabilitas rungu mendapatkan nilai rata-rata 76,75% dengan kriteria praktis. Berdasarkan uji validasi dan praktikalitas tersebut, terdapat saran dan juga komentar baik dari ahli dan juga pengguna.

Kata Kunci: Disabilitas rungu, Informasi, Teknologi adaptif

Abstract

This research is motivated by the issues identified in the field concerning deaf students who face difficulties in obtaining auditory information. This challenge arises due to the communication format during the learning process that predominantly utilizes oral language. Therefore, the researcher developed Vibrating Headphones with the aim of facilitating deaf individuals in acquiring one-way communication through text. This study employed the Research and Development (R&D) method with the 4D development model (Define, Design, Development, and Dissemination). The prototype developed was validated by four experts, including experts in deaf disabilities, electrical engineering, adaptive technology, and IT. Additionally, user testing was conducted to assess the practicality of the prototype among four deaf students in the Special Education Department at UNP. The validation results by the four experts yielded an average score of 88.75%, indicating a very valid criterion. Meanwhile, the practicality test results by the four deaf individuals produced an average score of 76.75%, meeting practical criteria. Based on these validation and practicality tests, valuable feedback and comments were received from both experts and users.

Keywords: *Deaf disability, Information, Adaptive technology*

Introduction

The rapid development of information technology in the world has significantly impacted various aspects of human life, providing assistance in both work and learning processes. In the era of Society 5.0, information is easily accessible not only through traditional print media but also through electronic media, accessible to anyone using digital devices. This convenience is attributed to the swift progress of information technology (Fory Armin Nawai, Ansar, 2021). Many technologies have assisted humans in their work and learning processes. Global demands necessitate the integration of technology in education as an effort to create effective and efficient learning environments (Haris Budiman, 2017). Furthermore, technological advancements have extended to assist individuals with special needs.

Assistive technology plays a crucial role in aiding individuals with disabilities in tasks that were previously challenging (McNicholl et al., 2021). Assistive technology is a term encompassing tools and services designed for individuals with special needs to reduce disabilities or barriers they may face (Rosita et al., 2020). The development of assistive technology varies for each individual's specific challenges, ranging from low-tech devices to high-tech solutions such as applications utilized to assist visually impaired individuals in detecting currency.

Despite the progress, assistive technology still has shortcomings that may not fully address the needs of individuals with special needs. For instance, individuals with hearing impairments face challenges in obtaining technology that aids in understanding information during the learning process. In educational settings, teachers may not use sign language due to a lack of competence in this regard (Setyawan et al., 2018). The use of oral speech in the learning process is encouraged so that children become accustomed to receiving information through lip movements.

In the Society 5.0 era, several technologies support individuals with hearing impairments in obtaining information. Applications like Hear Me can convert speech to text and text to sign language. However, these applications may not effectively capture sounds in non-conducive environments, from a distance, or from other media sources. Thus, when used in classrooms, such applications may not efficiently capture the voice of a teacher or lecturer who is far away.

There are also technologies, such as glasses that capture sound and convert it into text displayed on an LCD screen in front of the glasses (Suryadi, 2021). In the current Society 5.0 era, the use of non-stylish devices may decrease user interest, especially for visually impaired children who prioritize appearance. While assistive technology should facilitate individuals with hearing impairments in obtaining information, there are challenges, as they struggle to comprehend audio-based information in educational environments.

Therefore, the author proposes the development of Vibrating Headphones, specifically designed for individuals with hearing impairments, based on Android with the Talk Transcribe application. Typically, headphones can capture sounds within the frequency range of 20-20,000 Hz. However, Vibrating Headphones will be modified to accurately capture frequencies from 15-20,000 Hz, displaying the output in the form of text on the user's smartphone. The Vibrating Headphones use a vibrating motor DC sensor module connected to the Talk Transcribe application, generating vibrations when the user's name is called. This technology aims to assist in obtaining information related to classroom learning, as individuals with hearing impairments can read text corresponding to the spoken words.

Methods

This study adopts the research and development (R&D) approach, as defined by (Sugiyono, 2017). The research and development method aims to develop a new product or technology and assess its effectiveness. The study follows the 4D development model (Define, Design, Development, and Dissemination) formulated by Thiagarajan.

The stages of developing the Vibrating Headphone in this research, based on (Mulyatiningsih, 2015), are as follows:

1. Define

   In this phase, the objective is to analyze the existing problems in the learning process for individuals with hearing impairments. Initial and final analyses, learning analyses, task analyses, and analyses of concepts and instructional objectives are conducted.
2. Design

   After analyzing the problems, the next stage involves designing the prototype based on the identified issues. The design of the prototype is rooted in the analyzed problems, and solutions are devised to address these challenges.
3. Development

   At this stage, the author develops the Vibrating Headphone prototype, measures its validity, and makes improvements based on feedback from validators.
4. Dissemination

   Upon completing the development, the outcomes are disseminated to users with hearing impairments to assess the practicality of the product. The dissemination is limited to users, specifically blind students in the Department of Special Education at Universitas Negeri Padang, starting from the 2020 cohort up to the 2023 cohort, comprising a total of four students.

This research methodology aims to not only develop an innovative solution for individuals with hearing impairments but also to ensure the practicality and effectiveness of the Vibrating Headphone in real-world educational settings.

Results and Discussion

Results

The stages in this research follow the step-by-step guideline prepared by Thiagarajan, Dorothy S. Semmel, and Melvyn which is known as the 4D procedure (Define, Design, Development, and Dissemination). The steps are as follows:

1. Define

   a. Needs Analysis

      This activity aims to analyze the problems that exist in the learning process for deaf people. Preliminary and final analysis, learning analysis, task analysis and concept analysis as well as specific instructional objectives are carried out. This media aims to make it easier for deaf people in the learning process, where there are difficulties in getting information. The media used by deaf people has limitations in changing sound from a distance, causing deaf people to get bored in the learning process.

      This is proven from the results of interviews and observations in classes where there are students with hearing disabilities. Where the results of interviews and observations revealed that there were difficulties in the learning process which were considered boring and difficult to understand, even though using voice-to-text converting tools.

   b. Defines Vibrating Headphone

      Researchers carried out developments based on the results of needs analysis in the learning process of students with hearing disabilities to solve these problems. In this research, the development of Vibrating Headphones can help

students with hearing disabilities in Android-based lectures.

2. Design

This design stage is based on the results of the definition which will become the basis of the development process so that it meets user needs. The following is the product design that was developed after revisions:

Figure 1. Prototype Vibrating Headphone

Figure 2. Talk Transcribe application

3. Development

Vibrating Headphone development has two stages, namely the Vibrating Headphone development stage and the Talk Transcribe application development stage.

a. Headphone Component Assembly
   1) Assemble all the components including the Raspberry Pi 4, condenser mic, vibration module, and battery for the headphones.
   2) Once installed and connected, the next step is to create a program or code for the Raspberry Pi 4 to control the work of the components.
   3) After the design and program stages, the next step is testing the vibration of the tool, whether it functions according to the program that has been entered or not. If it is appropriate, all you

have to do is test the tool on the application.

b. Application Creation
   1) The application creation stage is carried out by adding components for application needs, for example Bluetooth modules, buttons, mouse recognition, and other elements such as images for the application display.
   2) The next stage is testing the connection of the application and tool. At this stage the aim is to test whether the appearance of the application is appropriate or not with the function of the tool being created.

The next stage is testing the Vibrating Headphone from the application function, the Raspberry Pi 4 function to the vibration module and condenser mic, as well as the application and tool connections. The success rate of the testing stages can be seen in the following table:

Table 1 Success of Tool Testing

Testing	Trial 1	Trial 2	Trial 3
Application functions	Succeed	Succeed	Succeed
The raspberry pi 4 functions as a vibration module and condenser mic	Not Succeed	Not Succeed	Succeed
Connection of applications and tools	Not Succeed	Not Succeed	Succeed

Based on Table 5 above, trial 1 shows the success of the application function that has been created on MIT Inventor. However, the first test of the Raspberry Pi 4 function using the vibration module and mic condenser was not successful.

Furthermore, in the second trial, the Raspberry Pi 4 function for the condenser mic was successful, where the condenser mic was able to run according to the program on the Raspberry Pi 4, while the vibration function was not successful. Likewise with the connection between the tool and the application, where the tool cannot yet connect to the application.

In testing 3 functions between the Raspberry Pi 4 and the condenser mic and vibration module, it was successful. Where Vibrating Headphones can produce vibrations when the user's name is called. In trial 3, the tool and application can be connected via Bluetooth and produce output in the form of text in the application if there is sound captured by the Vibrating Headphone.

Discussion

The trial phase carried out in this research and development involved experts in the field of hearing disabilities, electrical engineering experts, adaptive and assistive technology experts and IT experts as well as users, namely students with hearing disabilities in the Special Education department of Padang State University. Data analysis was carried out from the validation results of experts and users, as follows:

1. Data Analysis of Expert Validation Results

Data from validation results of the Vibrating Headphone prototype obtained from hearing disability experts, electrical engineering experts, adaptive and assistive technology experts and IT experts will be analyzed as a whole to obtain an average value. The expert validation data analysis can be described in the table below.

Table 2. Expert Validity Test Results

Expert	Number of instrument items	Total score	Presentase
Deaf Disability Expert	15	58	96%
Electrical Engineering Expert	12	44	92%
Adaptive and assistive technology expert	15	42	70%
IT Expert	9	35	97%
Average			**88,75 %**
Category			**Very Valid**

The final results from the validation by deaf disability experts, electrical experts, adaptive technology experts and IT experts were combined and then analyzed, so the average calculation obtained from the validation of the Vibrating Headphone prototype was 88.75% with a very valid category. Based on these final results, the Vibrating Headphone prototype does not need to be revised. Therefore, the Vibrating Headphone prototype can be used in the learning process in the classroom.

2. **User Practicality Data Analysis**

Data on the practical results of using the Vibrating Headphone prototype obtained from PLB UNP students from the 2020, 2021, 2022 and 2023 classes will be analyzed as a whole to obtain an average value. The practicality data analysis can be described in the table below.

User	Total score	Presentase
User I	22	67%
User II	26	81%
User III	25	76%
User IV	26	81%
Average		**76,75%**
Category		**Practical**

The final results of the practicality of users I, II, III and IV were combined and then analyzed, so that the average calculation of the practicality of the Vibrating Headphone prototype was 76.75% in the practical category. Based on these final results, the Vibrating Headphone prototype can be used in the learning process in the classroom.

Conclusion

The development of this Vibrating Headphone Prototype still has weaknesses, namely the output in the form of delayed text and also a design that is too big and heavy. Therefore, researchers provide suggestions for further development, namely developing Vibrating Headphones without using an internet network and making the design more minimalist. Researchers can then also develop the Talk Transcribe application so that they can input user names for vibrations that will appear on the headphones so that users don't have to bother changing programs in the application.

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