VeRO: Smart home assistant for blind with voice recognition

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Abstract. In daily life, people with visual impairment have difficulty in their activities, especially at home activities. People with visual impairment as of 2017 reached 1.5 percent or around 3.75 million people from the population of Indonesia and more than 253 million people worldwide. The number of blind people who are not small need help to get a good quality of life and independent. Friendly home design for the blind is not yet available specifically. It is a particular difficulty for blind people to access the latest electronic goods or information (news). Then this becomes the basis of this research on how to provide easy access for blind people. This research provides a solution that is designing a prototype of a house that is visually impaired in addition to the use of electronic equipment. This system starts from the microphone as a sensor in charge of picking up sound and then the results are processed by Android and then connected to NodeMCU via Wi-Fi. The microphone used is the default microphone of the Android smartphone. By using the speech recognition method, the command is enough to say the keywords, Android will manage the sound into a code that will be sent to the microcontroller to perform the task. There are several categories of commands that can be handled, including (a) Turning on / off electronic devices, (b) Providing news information from popular news web portals, (c) Entertainment by playing streaming radio and (d) General information on hours and dates. All planned functions are running properly, there are some features that might be developed further. Adding sensitivity to starting voice commands and adding the ability to read long stories can be further research.

1. Introduction
The sense of sight is one source of information that is vital for humans, because most of the information obtained by humans from the five senses, while the rest comes from other senses. So, with a problem in vision will make a decrease in the ability of its activities, different from normal conditions. People with visual impairments or people with visual impairment can be divided into two types of groups: Total Blindness (Blind) and Low Vision. Blind Total (Blind) is a person who is blind who really cannot see clearly what is around or can see light. Low Vision is a type of blind person who can still see even though the condition is still not alert or with certain distance restrictions.

This problem makes the decline in activities for the blind, especially activities at home. Based on the results of interviews with Pertuni (Indonesian Association of the Blind) Central Java Regional Office in November 2018, it was stated that the number of blind people in Central Java reached 600 people consisting of 25 branches spread in Central Java. While the number of blind people in 2017 reached 1.5 percent or around 3.75 million people of the Indonesian population. Based on WHO data, more than 253 million people worldwide suffer from visual impairment or visual impairment [1]. However, with such a number of people with visual impairment, homes for friendly blind access are not yet available.
Then this makes the conversation for easy access for blind people. With the strengthening of Law No. 8 Article 16 of 2016 concerning the equalization of persons with disabilities, the true housing for persons with disabilities should be made with disability-friendly aspects.

Alexa and Google Home are one of the technologies that have implemented Voice Recognition, with voice recognition expected to make it easier to implement in homes that are disabled by people, especially those who are blind. With a cylindrical shape, Alexa and Google Home have good assistant features, and despite the fact that both of these technologies cannot yet be implemented to support Indonesian, and have not yet been implemented into a house with disabilities friendly.

Reporting from www.forbes.com in the first quarter of 2017, Amazon echo controls 80 percent of the market in the smart speaker market, while Google 19.3 percent. With these two smart speaker giants, Google grew to 483 percent, compared to Amazon's 8 percent [2]. Users in America alone have reached 90 million who already take advantage of the benefits provided by smart speakers and will increase in the next quarter [3]. This fact confirms the acceptance of Voice Recognition technology is highly accepted by millennial users as it is today. For alexa prices range from $ 45.00 - $ 51.00, while google home ranges between $ 11.00 - $ 11.50 survey from www.alibaba.com.

From these data and facts, the longer the number of users is increasingly accepted by the market, it is necessary to develop a tool that can be used to facilitate or help people with disabilities in this case the blind need to develop tools that are simple, cheaper and easier. Ease of access control for persons with disabilities to electronic goods, making the house occupied more comfortable and easier in terms of accessibility of the use of electronic devices. Starting with this problem, we designed a prototype of a house that is not yet blind to the use of electronic equipment, namely "VeRO: Assistant Smart House for the Blind with Voice Recognition".

2. Research methods

2.1. Problem analysis

To find out the problems that occur in everyday life it is necessary to observe by conducting surveys in the environment, taking and analyzing data, which are then compared according to the level of urgency that exists. As a result of this step the researchers found problems arising in people with visual impairment such as (a) Turning on / off electronic devices, (b) Providing news information from popular news web portals, (c) Entertainment by playing streaming radio and (d) General information time and date. Thereby encouraging researchers to determine more appropriate solutions to be implemented, namely by using speech recognition to turn on lights and other home devices. Then it is processed with the required logic outputs.

From the plan, then the group determines the hardware requirements needed such as an Android operating system smart phone as data input; NodeMCU as hardware control; 8 channel relay to turn on or turn off the appliance according to the switch function; Wi-Fi for data transfer intermediaries and some additional equipment such as LED lights for indicators, etc.

2.2. Design

At the design stage, the most optimal preparation of processes, data, process flow and data relationships to meet the needs in accordance with the results of the needs analysis. The interface design will be designed as attractive as possible so that users are more interested in using it. The design to be used is an environmentally friendly design that is easily accessible and understood by users. The prototype design plan for the application can be seen in Figure 2.
How to use the blind Android application:
- The application will be ready for use the first time the phone is turned on.
- Users just shake their cellphones to activate the application.
- Users mention keywords (using voice commands) that have been determined to turn on / turn off electronic equipment in the house or select a menu that has been prepared.
- The application will return to standby after receiving an order and the order is processed.

Figure 1. Schematic of the Vero system.

Figure 2. Home maid application design visually impaired friendly.
2.3. Implementation
In this implementation phase, the design will continue with writing the program code, the interface design that has been designed will be translated into a language that can be recognized by the computer so that it can work in accordance with the functions that have been designed.

2.4. Testing method
After the code writing phase is complete the testing of the system / application will be made. Blackbox Testing Method is used in this study, this test is based on functionality and output tests on software design in accordance with standards and reactions that can run well. In addition, this stage also serves to find errors in the system and can then be corrected.

**Figure 3.** Vero system flowchart.
2.5. Maintenance

The last stage is maintenance, the software to be designed is as good as possible so that it has fulfilled the functions and uses needed by the user, and if it needs to be upgraded, the system will be done in the long term.

3. Results and discussion

To run this application, make sure the application on the mobile used to be connected to the internet, without an internet connection this application will not work. The way this application works is to listen to instructions (which have been implemented into this application) and then execute them. To start giving instructions to this application, follow these steps:

- Move the cell phone right and left until your cellphone vibrates and a dialog box appears as shown below.
- After the dialog box appears, the application will start listening to the instructions (in the form of sound) that we provide.
Figure 5. Giving voice commands “nyalakan lampu” (turn on the lamp).

- After we give instructions, the dialog box will disappear and the application will execute the instructions.

Figure 6. The light is on the mockup.

Some instructions that can be used in this application are as follows:

1. Info aplikasi (Application info)
2. Jam (clock)
3. Tanggal (date)
4. Nyalakan radio (turn on radio)
5. Baca berita popular (read popular news)
6. Baca berita pertama (read first news)
7. Baca berita kedua (read second news)
8. Baca berita ketiga (read third news)
9. Baca berita keempat (read forth news)
10. Baca berita kelima (read fifth news)
11. Nyalakan lampu (turn on lamp)
12. Matikan lampu (turn off lamp)
13. Nyalakan kipas (turn on fan)
14. Matikan kipas (turn off fan)
15. Nyalakan air (turn on water)
16. Matikan air (turn off water)
17. Nyalakan semua alat (turn on all device)
18. Matikan semua alat (turn off all device)

The system can provide output according to what was planned beforehand, there are some notes in testing:

- Voice to Text release application using the Accelerometer takes a long time and requires swing / wobble accuracy when you want to enter voice commands,
- When the Application reads the news with text that has more than 4999 characters, it will be cut at 5000 characters because the API cannot support more than the maximum number.
- It is still difficult to use Mobile as a blind tool in terms of relatively large device dimensions.
4. Conclusion

In designing the system and tools in this study, it can be concluded that the development of both the application and the embedded system that has been prepared has worked well. Performance that has been successfully carried out by the application include: (1) The system can apply voice recognition in the android application to the commands that will be performed. (2) The system has been able to carry out orders to turn on and turn off electronic devices using internet media. (3) The system has been able to play radio streaming in accordance with the programmed radio channels. (4) The system has worked to help blind people follow news from popular news portals.

From the testing that has been done there are several developments that can be developed in the future implementation. The application can be applied in real terms to the blind to find out problems that arise after use. Applications can be developed for wearable devices for easy access.

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