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Designing an Ultrasonic Sensor Stick Prototype for Blind People

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Abstract. This study aims to develop a tool that can be used to detect obstacles for blind people. This tool also uses the HC-SR04 ultrasonic sensor. The method used in the manufacture of blind assistive prototypes in the form of sticks using Arduino and Ultrasonic Sensors for blind people with the method obtained by hardware design techniques used consists of ATMEGA328 as the main controller, Ultrasonic sensor HS-SRF04 as detecting objects and LM2596 Regulator modules used for lowering the DC voltage level, this study has produced a prototype design stick for blind people using sensor technology to help alert and move blind people who are able to detect objects at a minimum distance of 7 centimeters with output in the form of sound and vibration. The resulting stick has a frame consisting of 0.5-inch PVC material consisting of two parts, the stick rod and the sensor unit.

Keywords: Blind, Blind Sensor Stick, Ultrasonic, Arduino Uno

1. Introduction

Individuals are part of the community and their lives cannot be separated from the established values and norms within the community. A person with a disability is also a part of the community in general who has the same rights and obligations as citizens, and the same degree as human beings created by God. Blind people encounter many problems that prevent them from moving well.

Blind people are part of a community and their mobility in the environment and social life have been limited. The mobility expected by persons with visual impairments is not restricted to just being seen from the social point of view. For example, there is acceptance from the public, but they must also be accepted by providing supporting facilities and infrastructure that will enable persons with disabilities in carrying out their activities. Today we often see many people with disabilities around us, with increasing numbers of people with disabilities in Indonesia, especially for persons with visual

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impairments. The disadvantages suffered by blind people do not mean to sacrifice their life expectancy but must also be an encouragement to struggle in their life. Therefore, someone with visual impairments needs assistance by providing substitutes for their eye function, namely the visual function. In addition to the usual sticks used, which are aids with the sense of touch system, the blind also needs a switch for their sense of sight, so that the ultrasonic and sound sensors can be used by the user. This Arduino Uno-based assist stick can tell the obstacles to blind people using the corrected Audio Jack Headphones that are installed on the device so that the blind person can avoid an object in front of him.

2. Study of Literature

Blind people are individuals with vision problems. Blind people can be classified into two groups, namely: Blind and low vision. Definition of Blindness according to Somantri (2006) are individuals who have weak vision or accuracy of vision less than 6/60 after being corrected or no longer have the vision. Persons with visual impairments are individuals whose senses of vision (both) do not function as a channel for receiving information in daily activities as well as sighted people (1). Because blind people have limitations in their sense of sight, the learning process emphasizes other sensory devices, namely the sense of touch and sense of hearing. Therefore, the principle that one must consider in teaching the blind individuals is that the media to be used must be tactual and sound, for example the use of braille writing, embossed drawings, model objects and real objects, whereas the voiced media are tape recorders and JAWS software.
Blind people have several limitations, namely:

1. Unable to see hand movements at less than 1 (one) meter.
2. Visibility of 20/200 feet is sharpness that can see an object at a distance of 20 feet.
3. The field of vision is not more extensive than 200 (Somantri, 2006).

Blind sticks are a long, straight stick that is the most useful tool for mobility for the visually impaired. For most blind sticks in the form of long sticks that are still conventional, the *tunacommitnetra* stick that is a foldable stick. Blind sticks are generally made of one hollow aluminum tube with 6 mm outer radius (with a radius of 4 mm) and a density of 103 kg 2.7 xx. An excellent blind stick handle is a handle that is wrapped like a tennis racket with a thickness of about 200 mm from the top of an aluminum tube. At the lower end of the stick, it is covered with a material made of plastic and given a white color, red as a marker that shows as people with disabilities. The color placement as the marker is under the handle. The length of the stick is as high as someone's heart that uses it (measured from the handle to the end of the stick). The general design of conventional sticks has a height relative to each user. Angles formed based on the use of blind sticks generally range at 450 (2).
A wave is a symptom of the occurrence of a disturbance passing through a medium, where after the interference passes the state of the medium will return to its original state, as before the disturbance came. These disturbances / vibrations are not random, as in thermal vibrations, but sequentially, oscillatory movements generated by external sources. A typical source (called a transducer) is one or more crystals that are moved by giving an electric voltage to vibrate and give a connection to the surface side of the outer side of the wrapper. So, like the movement of surface particles, the bonds of adjacent particles change so that they move. In this case mechanical vibrations move very fast through the medium. A medium is a group of interacting particles where the interference propagates. Particles are used to describe a small volume of mediums where all atoms can be considered to have the same physical forces. If the movement of a particle in the ultrasonic transmission medium is viewed carefully, the particles appear to move back and forth with small amounts. A common form of vibration is simple harmonic movements or sinusoidal movements (3)
Waves based on the medium of propagation can be divided into two parts, namely:

1. Mechanical waves, namely waves propagating through a medium that can undergo deformation or elastic medium. Examples of these waves are sound waves (acoustics), waves on the surface of the water and waves on the rope.
2. Non-mechanical waves or electromagnetic waves. This wave does not need a medium because it can propagate in a vacuum. Changes caused are not mechanical changes. Examples of electromagnetic waves are microwaves, infrared waves and visible light (3)

Sounds are stimuli that vibrate the ear organ (hearing) of humans, so that humans hear stimuli or vibrations caused by these stimuli. Sound waves are longitudinal mechanical waves. These sound waves can be transmitted inside solid objects, liquids and gases. The material particles that transmit a wave oscillate in the direction of propagation of the wave itself. These sound waves are vibrations of molecular substances and collide with each other, but these substances are coordinated to produce waves and transmit energy even without particle displacement. When sound waves propagate to the surface boundary, the sound waves will experience transmission and reflection.
Basically, ultrasonic is a sound wave that has a frequency above the human hearing limit. The frequency of human hearing limits varies for each person. But in general, the frequency of human hearing is from 20 Hz - 20 kHz. And ultrasonic waves have a frequency of more than 20 kHz. Until now, the ultrasonic wave frequency has reached 1 GHz and if it exceeds the frequency of 1 GHz it is called hypersonic — spectrum of ultrasonic waves. At a frequency of 10 kHz - 150 kHz, ultrasonic is used for communication of several animals such as bats and dolphins. If at this frequency the power is increased, then ultrasonic can be used to assist the cleaning process (cleaner) of some materials such as jewelry. For medical imaging applications a frequency of 1 MHz up to 20 MHz is needed, for example as used for ultrasonography (USG). Likewise for other applications it requires its own frequency range (3).

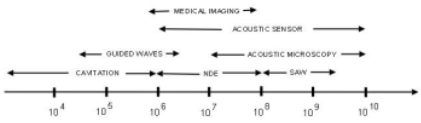

Figure 1: Spectrum of ultrasonic wave applications*(3)*

Ultrasonic waves in the material can propagate with three types of wave patterns that are often used, namely longitudinal waves, transverse waves, surface waves or Rayleigh waves. Longitudinal waves are the waves most often used for ultrasonic testing. The advantage of this wave is its ability to propagate in liquids and gases, as well as in solid materials. The mechanism of this wave is that the propagation is parallel to the direction of movement of the vibrated atom. Transverse waves are a type of wave that is also often used, but unlike longitudinal waves, these waves are difficult to propagate in liquids and gases, because their characters are less elastic and strong forces are needed on particles to oscillate. This wave can occur if the ultrasonic wave propagates in a perpendicular direction, with vibrations moving up and down, in the direction and field of vibrated atomic motion.
The microcontroller is a chip in an electronic circuit that functions as a controller that regulates the work process of an electronic circuit. In a microcontroller IC there are CPU, memory, timer, serial and parallel communication channels, input or output ports, ADC etc. Microcontroller with an average size and contains the basic units needed by all types of controllers: (4)

1. Arithmetic and Logic Unit: logic circuits that perform addition, subtraction, and various other logical operations.
2. Memory: logic circuits to store data. There are two types of memory, RAM can hold up to 72 bytes of data. ROM can hold up to 3 KB of data. This memory stores a program that functions to direct the controller's work.
3. Clock: A chip containing all the system's clock components.
4. Input and Output : from the 28 pins in the IC, 20 of them are used for input and output data.

Preliminary researches that are relevant third research is:

1. Emmanuel Gbenga's chest, Aryel Ibrahim Shani, Adebimpe Lateef Adekunle with the research title "Smart Walking Stick for Visually Impaired People Using Ultrasonic Sensors and Arduino" (5). The result of this study is that the design and implementation of a smart walking stick for the blind has been fully achieved. The Smart Stick acts as an underlying platform for future generations of more tools to help blind people navigate safely both indoors and indoors or outdoors.

2. G.J. Pauline Jothi Kiruba under the research title of "Smart Electronic Walking Stick for Blind People" (6). The simulation results are expected for ultrasonic sensors, WI-FI, Heartbeat sensors, temperature sensors and for GPS and GSM integrated modems on one Arduino board. However, this system has a delay when it detects obstacles between 2 to 4 second. The delay of the GPS to get the location for the stick is around 30 seconds to 0 minutes.
3. Pratik, NK, Poornesh V, Shashikant, Shreedhar Kudva & Saritha A. N with the research title "Smart Blind Stick" (7). It is essential that visually impaired people gain access to efficient and comfortable objects to live their daily lives.
4. Subramoniam S. with the research title "Smart Phone Assisted Blind Stick" (8). This command system has been designed and built to help the visually impaired community easily be attached to a standard blind stick without the need for modification. simultaneously detecting obstacles in four different directions gives a feeling of security for a blind person to travel.

3. Methodology

The research method used in the construction of this system is the SDLC (System Development Life Cycle) method. System Development Life Cycle (SDLC) is the process of creating and changing systems and the models and methodologies used to develop an application. SDLC is also a pattern taken to develop software, which consists of the following steps:

1. Planning: In the planning phase, things that are related to studies of needs, feasibility studies, both technically and technologically, and scheduling are also carried out in this study.
2. Analysis: In the analysis phase direct observation is carried out by looking at the problems that arise and are realized regarding the components and software and hardware.
3. Design: At this stage the application will be described in detail about the design process of each component in the prototype according to the needs in the prototype discussed earlier.
4. Implementation : At this stage implementation is carried out from the system planning to the real situation that is by selecting the components to be used and the preparation of the software (coding / coding)
5. Testing: At this stage testing is carried out to see whether the system created is in accordance with the needs of the user or not, if not, the next process is iterative, i.e. returning to the previous stages. And the purpose of the test itself is to eliminate or minimize defects so that the system developed will really help the users when they carry out their activities.
6. Maintenance: At this stage the process of operating the system begins and if necessary small repairs can be done.

4. Discussion

This prototype is made using a C programming language which is a language that is often used in making microcontroller programs. This tool works based on instructions or commands that are in the program that are inserted into the microcontroller. The sensor works as an input or input and will be processed in Arduino when the wireless sensor detects an object / obstacle around it, then outputs sound output through the audio jack connected to the headphone
A schematic circuit is made to make it easier to make tools. The schematic consists of Arduino Uno, Battery, Ultrasonic Sensor, TRRS 3.5mm Audio, and LM2596 Regulator module.

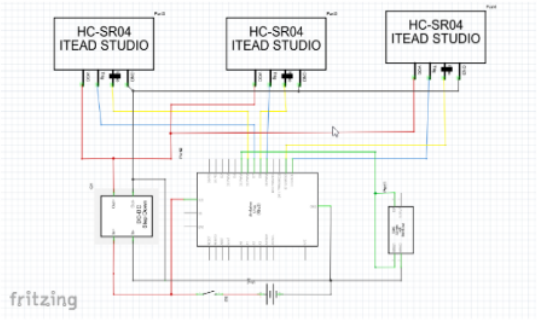

Figure 2. Schematic Tool Set

In evaluating this system, opinions were made on persons with visual impairments by conducting discussions and interviews with users to identify tools made for blind persons with disabilities. The following is an evaluation of the Design of a Stick Prototype for Persons with Blindness by Ultrasonic Use of Arduino Uno.

Opinion on blind people is one of the discussions to get an evaluation / evaluation from users. The number of users asked to rate the prototype is 4 people by being asked to try the prototype then answer the statements that have been provided.

Based on the answers in the test it can be said that blind people have been much helped by sticks using ultrasonic sensors. This prototype has reduced the element of accidents for the blind both in difficult road structures, the number of obstacles or when crossing the road. The length of the stick against the sensor which is set as far as 7 centimeters is effective because if it is set at a long distance it can cause frequent censorship of objects recognized around the stick. Advice to consider is the design of the blind stick design is made more flexible on the stick section so that it is more practical when carried.

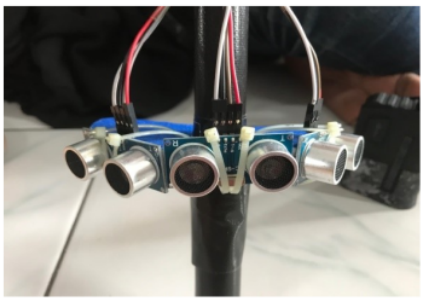

Figure 3. Ultrasonic Stick Prototype for blind people

5. Conclusion

This research has produced a design prototype of sticks for blind people using sensor technology to assist the alertness and movement of the blind who are able to detect objects at a minimum distance of 7 centimeters with output in the form of sound and vibration. The resulting stick has a frame consisting of 0.5-inch PVC material consisting of two parts, the stick rod and the sensor unit.

References

[1]. Somantri S.2006, http://staff.uny.ac.id/sites/default/files/pengabdian/ishartiwi-mpd-dr/makalah-tunanetra-yakkum.pdf. [Online].; [cited 2018 December Friday. Available from: http://staff.uny.ac.id/sites/default/files/pengabdian/ishartiwi-mpd-dr/makalah-tunanetra-yakkum.pdf.

[2]. FelipeJiméneza.2011, Improving the obstacle detection and identification algorithms of a laserscanner-based collision avoidance system, https://www.sciencedirect.com/science/article/pii/S0968090X10001622

[3]. Yusuf Rahman, Gelombang_Ultrasonik. [Online]. [cited 2018 December Friday. Available from: https://www.academia.edu/30239442/gelombang_ultrasonik.

[4]. Bishop. 2010, SISTEM KEAMANAN RUANGAN MENGGUNAKAN SENSOR PASSIVE INFRA RED (PIR) KC7783R DENGAN MIKROKONTROLER AT89S51. [Online].; 2010. Available from: http://eprints.undip.ac.id/6633/.

[5]. Gbenga DE. 2017, Smart Walking Stick for Visually Impaired Using Ultrasonic Sensors and. International Journal of Engineering and Technology (IJET).

[6]. Kiruba GJPJ. 2018, Smart Electronic Walking Stick for Blind. International Journal of Advanced Research in Electrical.

[7]. Pratik N,PV,S,SK&SAN. 2017, SMART BLIND STICK. International Journal of Latest Trends in Engineering and Technology.

[8]. Subramoniam S. OK. 2018, SMART PHONE ASSISTED BLIND STICK. The Turkish Online Journal of Design, Art and Communication.

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