Designing the blind stick using the SRF-04 distance sensor based on GPS tracker and navigation

S A Hulukati¹* and I A Salihi²

¹Electrical Engineering, Universitas Ichsan Gorontalo, Gorontalo, Indonesia.
²Information System, Universitas Ichsan Gorontalo, Gorontalo, Indonesia.

Abstract. The wider the area of the blind, the more difficult it will be for them to carry out the activities carried out. This study aims to develop a tool that can be used to detect obstacles for blind people. This tool was developed with Arduino nano because of its small size, so it does not interfere with their activities and power consumption against the speed of low command execution. This tool is also developed using a proximity sensor (SRF-04), and GPS Tracking is a remote monitoring system that uses GPS Satellites as a determinant of the location of vehicles/assets to move accurately and accurately in the form of coordinates. The tool will be designed according to the needs of the blind so that they use feel safe and comfortable so that it is designed with feeling and the position of the sensor with the layout needed, based on the results of testing the blind visual aid to function correctly if objects are detected by proximity sensor and tool does not work if this tool is to identify holes because the sensor used is a distance sensor with a distance of 0 - 60 CM and GPS tracking can read the position of the user well with the position on latitude: 0.555698 and longitude: 123.056655.

1. Introduction
The blind stick is an innovative stick designed for visually disabled people for improved navigation. This study tries to propose an advanced blind stick that allows visually challenged people to navigate with ease using advanced technology. The blind stick is integrated with the ultrasonic sensor along with water sensing using a moisture sensor. The proposed project first uses ultrasonic sensors to detect obstacles ahead using ultrasonic waves. On sensing obstacles the sensor passes this data to the microcontroller. The microcontroller then processes this data and calculates if the barrier is close enough. If the constraint is not that close the circuit does nothing. If the obstacle is close the microcontroller sends a signal to sound a buzzer. It also detects and sounds a different buzzer if it detects water and alerts the blind. The system has one more advanced feature integrated to help the blind find their stick if they forget where they kept it. A wireless rf based remote is used for this purpose. Pressing the remote button sounds a buzzer on the stick, which helps the blind person to find their stick. Thus this system allows for obstacle detection as well as finding stick if misplaced by visually disabled people [1-2].

Independence is the building methodology in achieving dreams, goals, and objectives in life. Visually impaired persons find themselves challenging to go out independently. There are millions of visually impaired or blind people in this world who are always in need of helping hands. For many years the white cane became a well-known attribute to blind person’s navigation, and later efforts have been made to improve the cane by adding remote sensors. Blind people have big problems when they walk on the
street or stairs using a white cane, but they have sharp haptic sensitivity. The electronic walking stick will help the blind person by providing a more convenient means of life. The main aim of this paper is to contribute our knowledge and services to the people of the blind and disable society [3,4].

One of the important human senses is the eye; in this sense, humans can look around so that they can interact with the environment. The sense of sight is one of the vital sources of information for humans. If humans lose these senses, humans cannot see their surroundings; this condition is often referred to as blind (blind).

The brief history of the birth of Arduino originated from a thesis made by Hernando Barragan, at the Institute of Ivrea. Then in 2005, it was developed by Massimo Banzi and Daid Cuartielles and was given the name Arduin of Ivrea. Later renamed Arduino, which in Italian means a brave friend. Arduino's initial goal was to make devices easy and inexpensive, from existing tools. And the equipment is intended for students who will make design and interaction devices.

In the research that I have done, a stick has been produced, which can detect the presence of objects without touching, so that the user can already know the existence of an object. To help the visually challenged people, a study that allows those people to walk more confidently is proposed. The study hypothesizes a smart walking stick that alerts visually-impaired people over obstacles, pit, and water in front could help them in walking with fewer accidents. It outlines a better navigational tool for the visually impaired. It consists of a simple walking stick equipped with sensors to give information about the environment. The GPS technology is integrated with pre-programmed locations to determine the optimal route to be taken. The user can choose the area from the set of destinations stored in the memory and will lead in the correct direction of the stick. In this system, ultrasonic sensor, pit sensor, water sensor, GPS receiver, level converter, driver, vibrator, voice synthesizer, keypad, speaker or headphone, PIC controller, and battery are used such illustrate in Figure 1. The overall aim of the device is to provide a convenient and safe method for the blind to overcome their difficulties in daily life [5-7].

In front and prepare early. The stick of the results of the research responds to the form of vibrations that are felt through the user's hand. The vibrations given are base far near the object detected. The closer the object is, the stronger the vibration is given. The results of the research that I did, the maximum vibration is when the distance of the obstacle is 50 cm, the obstacle is more than 50 cm the stick does not vibrate and then the GPS Tracker functions to find out and track the user [8-10].

![Figure 1. Blind users.](image)

2. Methods
The method obtained is a design technique that consists of several stages, namely: (1) Identification of the needs of the blind; (2) Distance requirements analysis and Tracking; (3) Designing hardware and software; (4) Making safe and comfortable tools; (5) Testing of distance sensor and GPS tracking devices; (6) Operation of the device. Hardware consists of: (1) The Arduino nano minimum system as the main controller; (2) SRF04 Distance Sensors as detecting objects; (3) The buzzer gives a warning if there is an object detected by the sensor; (4) The on/off button turns the system on or off, (5) the vibrator gives vibrations to the stick when the ultrasonic sensor detects obstacles. (6) GPS Tracker to detect the
presence of blind people. In this study, the output was a tool in the form of a Blind Stick Design using GPS-based SRF04 Distance Tracker & Navigation with the division of tasks. The Chair made the hardware design of the device, and the Member made a program from the rigorous tool. Figure 2 describe block diagram for blind people.

![Figure 2. Block diagram for blind people.](image)

2.1 Arduino Nano
Arduino Nano is a microcontroller development board based on the ATmega328P chip with a tiny shape (Figure 3). Functionally there is no difference with Arduino Uno. The main difference lies in the absence of a DC power jack and the use of a USB Mini-B connector. The Arduino Nano in WSN acts as a medium to a sensor for providing the data to the Raspberry Pi which acts as a base station. The Arduino consists of analog interface pins from A0- A7. The sensors having analog output are usually interfaced with the Arduino nano analog pins. The output from the sensor node can also be compared with the voltage that can be given to the analog Ref pin. The production coming from sensor nodes can also be monitored on serial monitor provided by Arduino programming software. Arduino is a widely used open-source hardware and software platform for developing WSN, resulting in cheap, low power standard and most flexible systems employ with wireless monitoring [11].

![Figure 3. Arduino nano.](image)

2.2. Ultrasonic sensor
The four potentiometer outputs have been used to compute a distance reference value to be compared with the ultrasonic measured distance. The end spring heights, which have been estimated by adding the tire deformations to the spring heights measured by the potentiometers, have been used to identify the plane of the vehicle body. The distance reference value that corresponds to the distance the ultrasonic sensor should produce has been determined by putting the measuring head coordinates into the identified plane equation [12].

An ultrasonic sensor is a sensor that functions to convert physical quantities (sounds) into electrical numbers and vice versa (Figure 4). The workings of this sensor are based on the principle of reflecting a sound wave so that it can be used to interpret the existence (distance) of an object with a specific frequency. It is referred to as an ultrasonic sensor because this sensor uses ultrasonic waves.
2.3. **GPS Tracking.**
GPS Tracking is a remote monitoring system that uses GPS Satellites as a determinant of the location of vehicles/assets moving appropriately and accurately in the form of coordinate points, which is then implemented into a digital Map so that its users can easily understand it (Figure 5).

![Figure 5. GPS Tracking.](image)

2.4. **Buzzer.**
The buzzer is an electronic component that can convert electrical signals into sound vibrations. In general, the Buzzer, which is an audio device, is often used in anti-theft circuits, alarms on watches, house bells, reverse warnings on trucks, and other hazard warning devices. The type of buzzer that is often found and used is the type of piezoelectric buzzer; this is because the Piezoelectric Buzzer has various advantages such as cheaper, relatively lighter, and more comfortable to combine into other electronic circuits. The buzzer included in the Transducer family is also often called Beeper (Figure 6).

![Figure 6. Buzzer.](image)

2.5. **DC Vibrator**
DC vibrator is a tool for increasing vibration if the user cannot hear the sound from the buzzer (Figure 7). DC motors require direct voltage supply in the field coil to be converted into mechanical energy. In a dc motor, there are two coils, namely a field coil that functions to produce a magnetic magnet and an anchor coil that works as a place for the formation of electromotive force (emf E). If the current in the anchor coil interacts with a magnetic field, a torque (T) will arise, which will rotate the motor [13].
3. Results and discussion

3.1. GPS Tracking Programming
Before doing the testing tool, the thing that needed to be done was programming with the Arduino application to create programs using the C language and insert the program into the Arduino nano (microcontroller) hardware.

![Arduino IDE screenshot](image)

**Figure 7.** DC Vibrator.

![GPS Program code](image)

**Figure 8.** Display of GPS programs.

The program in Figure 8 is a program to activate GPS so that it is connected to Arduino Uno and displayed via the serial monitor, as shown in Figure 9 and GPS monitor serial display shown in Figure 10.
Figure 9. GPS monitor serial display.

Figure 10. GPS monitor serial display.

Figure 11. The position of the blind tool user.

Figure 11 shows the position of blind users on the Ichsan University of Gorontalo campus via the google maps application, namely latitude: 0.555698 and longitude: 123.056655.

3.2. Programming the Blind Tool

After doing GPS Tracking, the next step is to do a blind hearing aid to activate the buzzed and vibrator functions. The design, as shown in Figure 12.
Based on the program uploaded on Arduino the stick will detect the presence of objects without touching so that the user can already know the object or object in front with a distance of obstacles as far as 50 cm, then the GPS Tracker functions to find out and track where the user is.

```cpp
#define trigPin 7
#define echoPin 6
#define relayPin 8

void setup() {
  Serial.begin (9600);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(relayPin, OUTPUT);
}

void loop() {
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(2);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 29.1;
  if (distance <= 50) {
    digitalWrite(relayPin, HIGH);
  } else {
    digitalWrite(relayPin,LOW);
  }
  if (distance > 50) {
    Serial.println(".....");
  } else {
    Serial.print(distance);
    Serial.println(" cm ");
    Serial.print(".... ");
  }
  delay(100);
}
```

**Figure 12.** Design of a blindfold.

**Figure 13.** Display of proximity sensor testing.
3.3. **Testing tools for Blindness**

At this stage, testing the instrument as a whole, wherein the function of the vibrator and the buzzer will be checked, whether it will function if it is on a particular object barrier.

3.3.1. **Distance sensor testing**. The distance sensor test will do by looking at the monitor serial on the computer, whether the sensor will show the distance in the centi meter (CM) shown in figure 13.

![Graph of distance sensor testing results.](image)

**Figure 14.** Graph of distance sensor testing results.

It can be seen in Figure 14 where the line contained in number 1, the sensor is active (On), and the line included in number 0, then the sensor is inactive (Off).

3.3.2. **Testing the function of the Vibrator and Buzzer**. In testing, the function of the vibrator and buzzer will do by observing directly using the spell model whether the functions of the two outputs function correctly as shown in figure 15.

![Blind visual aid user models.](image)

**Figure 15.** Blind visual aid user models.
Table 1. Blinds tools testing.

| No | Object   | Distance (Cm) | Vibrator | Buzzer |
|----|----------|---------------|----------|--------|
| 1  | Human    | 0 - 50        | On       | On     |
| 2  | Table    | 0 - 50        | On       | On     |
| 3  | Chair    | 0 - 50        | On       | On     |
| 4  | Car      | 0 - 50        | On       | On     |
| 5  | Motorcycle | 0 - 50     | On       | On     |
| 6  | Wall     | 0 - 50        | On       | On     |
| 7  | Hole     | 0 - 50        | Off      | Off    |

4. Conclusion
Based on the results of testing tools for blind people to function correctly if given an obstacle that can be detected by the proximity sensor and the device does not work if this tool to identify holes because the sensor used is a proximity sensor. For GPS tracking, it takes a long time to connect to the satellite and its function will be disrupted if it is in a signal-tight room.

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