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Research paper



Design and implementation of huvigation for the visually impaired

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Abstract

Background/Objectives: Visual impairments should take the risk alone, we need to design a Huvigation because it is necessary to study the route and surrounding dangerous obstacles with a convenient device.
Methods/Statistical analysis: Set the destination using voice recognition and braille input device to help the users find the way, guided by voice when user want, obstacles are read using an ultrasonic sensor. In the obstacle detection method, prioritize in the direction of things by three ultrasonic sensors. And the user recognize the direction of things reduces the probability of strike the object than other functions.
Findings: The proposed system can set the destination using speech recognition or a braille input device. The information is transmitted to a navigation web page linked with the input destination, and navigation is guided using the navigation function. This device transmits the information received using a speaker. This device receives information from the ultrasonic sensor. When objects come into range, a voice is transmitted to the user to prevent collision. When the user arrives at the destination, It announces the arrival using the speaker, and wait for the next command.
Improvements/Applications: The safety of the user is ensured through three ultrasonic sensors. Every time the user moves and checks the location information and provides movement information.

Keywords: *Visually Impaired, Cane; Navigation; Road Master; Obstacles Detection; Ultrasonic Sensors.*

1. Introduction

Recently, the number of blind people around the world is 37 million and many dogs have been killed or injured when walking as the guide dogs for blind people[1]. In addition, the number of visually impaired people is increasing. It is difficult for blind people to quickly recognize obstacles in unfamiliar places and to walk safely. Therefore, it is necessary to provide a guidance system that guides the route considering obstacles. Visually impaired people need a cane, a guide dog, a smart mobility assistance system, and a guidance system to guide the route to the destination in real time.
However, there are not many studies to integrate obstacle detection and path guidance. In this situation, there is a need for a product and a system that can improve the visual intelligence of the visually impaired and prevent accidents[2]. Blind people generally move around with a white cane or guide dog. In particular, guide dogs avoid obstacles provide warnings about danger. And guides the place where their owners want safely. However, even if you walk with a guide dog, you can get into an accident.
As a result, we find voice over on the iPhone and talk back on Android. We felt the need for a device to help the blind, so we looked for devices that would help the blind. Two functions tell you what kind of behavior you did. In addition, the current generation of mobile phones is required to have TTS (Text-to-Speech) function.
These features have the advantage that the blind can listen to text messages by voice. In addition the STT (Speech-to-Text) function, which converts voice to text, is also active. The functions and applications of smartphones were improving. But we felt that there was a lack of direct devices. So, in this paper we propose the Huvigation, which can use any visual impairment. Proposed method aims to provide real-time directions to the destination and the detection of objects for safety. Moreorver, this device is targeted at blind people who are blind at all.
Although there are many related researches and products, such as smartphone navigation for the visually impaired, there is a lack of customized devices and research for various types of visual impairment[3]. Therefore, in this study, we propose the Huvigation with obstacle recognition and GPS navigation function so that it can be applied variously to various kinds of visual impairments.

2. Related works

The visually impaired use a cane for identifying objects in front of them. Some of the existing systems are embedded onto this stick making it difficult to carry or use some wearable device that may not be comfortable. To replace these shortcomings, there is a smartphone navigation map for the visually impaired. It is designed for the visually impaired, has a bracelet protruding on the surface of the device4, and provides very detailed information on the way to the destination [5]. This studies proposed for visually impaired to navigate safely and quickly among obstacles and other

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hazards faced. However, the mobility of the object cannot be Detected in such a way that the user can avoid moving objects while moving.
The advantage is that blind people can go out on their own and go to their destination without a person or guide dog [6-7]. This device presents navigation information in real time about the way to sound and braille, not visual information[8]. The destination is searched for by recognizing the voice of the user, and the display such as the left turn, the right turn, the straight run, and the stop is displayed in braille[9]. These studies have limited angles of the ultrasonic sensor, which can make it difficult to detect when an object moves to the left or right side of the user.
The device receives many sensors and makes an audio or vibration in response to detected obstacles. Recent navigation systems for visually impaired use digital video cameras as vision sensor along with other multiple sensors. The existing systems also use of multiple sensors and alarm models to alert the user[10] and use of laser range finder to detect and acquire information of dynamic obstacles[11], and can detect obstacles upto 1.5m[12].These studies provide users with a variety of information, but they also cause problems when the most frequently used path becomes unsuitable. There is difficulty in providing an alternate path based on the past route. Therefore, there is a need for an efficient system that allows the visually impaired to navigate while avoiding objects on the move.

3. Design and implementation

3.1. System design

The system configuration of the proposed Huvigation device is shown in [Figure 1].

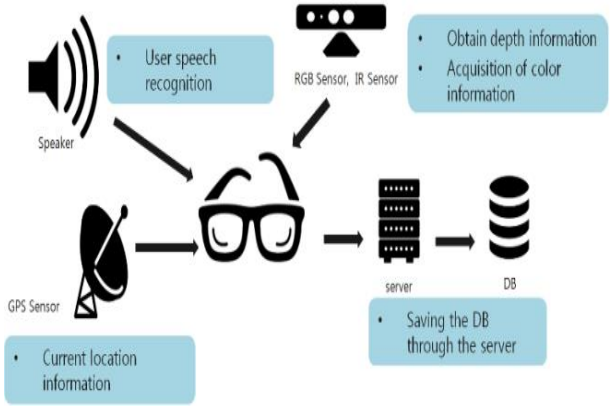


Fig. 1: System Architecture.

Huvigation has four major functions. First, the route search function gives directions to the set destination and supporters to get directions to the user. This device can set the destination using speech recognition or braille input device.
Second, target input processing through speech recognition and braille input tools is based on the user's speech recognition. The two languages, voice recognition function and braille input function, are able to set the destination through the voice recognition function and the braille input device. The information is transmitted to a navigation web page like google map or T-map linked with the input destination, and navigation is provided by the navigation function. This device receives the set navigation commands, l such as go left or right, and transmits the information received using the speaker.
The third function is the obstacle recognition function. This device receives information from the IR sensor. When objects come into range, a voice is sounded to the user to prevent a collision. The proposed algorithm to avoid obstacles is as follows.
Step 1: When object A moves from right to center for the first time.it compares the distances between the other B and C.Because B is closer than C, it sets the user's direction to the left.
Switch (finalCheck) {
Case 1: (MidCheck [0] > RightCheck [0]): "Go Right";
Break;
Case 2: (MidCheck [0] > LeftCheck [0]) "Go Left";
Break;
Case 3:
If ((LeftCheck[0] > MidCheck[0]) && (MidCheck[1] > LeftCheck[1]))
LeftToMid = LeftCheck[0];
If ((RightCheck[0] > MidCheck[0]) && (MidCheck[1] > RightCheck[1]))
RightToMid = RightCheck[0];
If (LeftToMid == 0 && RightToMid == 0) {
If (LeftCheck[0] > RightCheck[0])
"Go Left";
Else
"Go Right";
Step 2: However, if A is moving to the left based on the user, and if A continues to move left, A will conflict with the user. If the object in the front (center) is closest, we compare it with the right or left.
If (Left To Mid > 0 && RightToMid == 0)
"The Object is moving to the right. Go Left";
Elseif (Right to Mid > 0 && LeftToMid == 0)
"The Object is moving to the left. Go Right";
If the previous right position closer to the center position and the current center position is closer than current right position, we suppose that things are moving from the right to center. Set the to the direction of the user, because it has the least probability to crash.
Fourth, the voice service function called "obstacles in front" recognizes obstacles. When the device arrives at the destination, the device informs the user that it has arrived and then exits. Destination input processing through speech recognition and braille input tools is based on the user's speech recognition, and after saying a certain word "route", the destination is recognized, the source and destination are input, and other words are not recognized we tried to reduce the error.
In addition, if the user cannot speak with the Braille input tool, he / she is also able to input the destination through braille. The GPS navigation system provides directions using Google via GPS, and the user navigates through the walk. After the calculation of the route from the current position to the destination, the navigation is started and the route guidance using the speaker is set according to the route of the navigation.

3.2. Implementation

The configuration diagram of the proposed system is shown in [Figure 2].

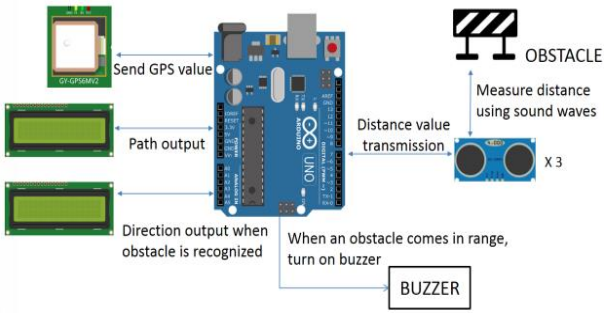


Fig. 2: System Diagram.

First, the GPS module sends GPS values to the motherboard, and, the motherboard calculates the direction of the correct path with the received GPS value. You can check the direction of the calculated route on the LCD screen. Obstacle detection uses three ultrasonic sensors to detect obstacles in front and to receive distances to obstacles. If the received distance is closer than the set distance, the connected buzzer will sound and the direction to the obstacle will be output to the 2nd LCD.

We used ultrasonic sensors to detect obstacle things. The ultrasonic wave sensor can measure Distance through sound waves which Are reflected by the obstacles. Three ultrasonic sensors are attached to this device, and the distance Measured by the three ultrasonic sensors is calculated to save the nearest distance. When objects come within a certain distance, the buzzer informs the user that there is something ahead the interval of the buzzer is shortened to recognize the distance.

3.3. Results and discussion

Table 1 shows the results of object recognition using three ultrasonic sensors.

Table 1: Implementation Results

	Mid	Right
Previous location	10M	1.5M
Present location	1.3M	10M

If the object in the front (center) is closest, we compare it with the right or left. If the previous right position closer than center position and the current center position is closer than current right position, we suppose that things are moving from right to center. For example, suppose an object moves from a distance of 10 meters on the right to a distance of 1.3 meters in front of a person. Then, three ultrasonic sensors determine the moving direction in measuring the distance of the object from the left, front, and right directions. Therefore, the user can move more safely while preventing collisions more safely. Set the right direction to the direction of the user, because it has the least probability to crash.
It is necessary to make a comparative study with the system which guarantees the safe movement of the user along with object recognition and collision prevention using Ultrasonic sensors. Table 2 shows the analysis results for each function.

Table 2: Analysis Results for Each Function

	IOT Cane[4]	Survey On Obstacle[2]	Obstacle Detection[1]	Proposed System
Obstacle Detection Method	Just Ultrasonic Sensor	Just Ultrasonic Sensor	Three Ultrasonic Sensor Prioritize By Distance	Three Ultrasonic Sensor Prioritize In The Direction Of Things
Obstacle Recognition Method	Vibration	Speaker	Speaker	Speaker
Directions	Beacon Based Navigation	X	X	Linkage Of Navigation Web

In this table, our functions of recognize the direction of things reduce the probability of collision with the object than other functions. The proposed system has better performance considering the moving direction of the object in the object recognition method, and it provides excellent web - based guidance based on the result of object recognition.
The proposed system focused on the ability to guide the road, if you are on the road, the current location will be saved.
Each time the user changes the direction, he/she will be able to save the location in the DB. If uesr want to get the route guidance starts through the specified route, this will provide them directions from the current location to the next location. It prevents the user from going in the wrong direction.

4. Conclusion

It is expected that the increase of the activity of the visually impaired and the increase of going out will increase the social adaptability of the disabled person, improve self - reliance and inspire confidence. It will also help to prevent accidents by improving visual intelligence. Expected effect from this is blind will increase confidence and social adaptability and prevention of accidents by improving visual intelligence. Huvigation's future study is smart Navigation which using real-time location information of user and destination for blind.

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