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Embedded System Application for Blind People Navigation Tool

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Abstract

The stick for blindman navigational aid can only provide information about the presence of objects that being touched. This navigational aid stick can not provide more information such as object distance and the name of the place. To overcome this problem, we realized a navigational tool that can provide information about the distance of objects around the user and the name of the places where being passed. The existing objects are detected using three sets of ultra sonic sensors. These sensors emit ultrasonic signals, when the signal collide the obstacle, then will be reflected back and being received by these sensors too. The time lag between the transmitting and receiving signals then will be converted into the distance. RFID reader is used to read the presence or absence of tags around the RFID reader. Identity tag emits a signal that will be used to mark the place name. The results of measuring distance and sequence voice database recorder gives a good yield. Voice database recorder circuit works as well as the detection of RFID tags.

Keywords: *blindman navigation tool, embedded system application*

1. Introduction

Navigation tools are requaired for blind persons to recognize their environment when doing daily activities, mainly when taking a walk. By using a stick, blindman can recognize objects in the area that will be passed. This information is received through the hands in the form of stick vibrations that touched to the object.

With the growing of technology, blind persons could have to perform shopping activities, learning in higher education, traveling to another places and so on. By implementing a microcontroller system that is equipped with a ultrasonic sensor, RFID reader, and the voice database can be realized a navigation tool for blind person effectively and easy to operate, because the information is provided in the form of voice information. These navigation systems require additional facilities such as tags that was planted in certain places, to give a unique identity of the place.

The use of RFID has been done for mobile robot tracking system [1] but the RFID tag is an active tags, for vehicle tracking [2], for anti colission system [3] and for attendance management system [4].

Almost of the navigation tools for blindman that have been realized, are using microcontroller to process data from sensors then released in the form of voice information. In terms of use, navigation tools, there is attached to the shoe [5, 6]. Sensors, battery and processor placed on the front and back of the shoes. However, for this type, requires specially designed shoes that good look.

The other way is combining conventional tools with a sets of sensors and processor in a stick [7] which is equipped with an electronic circuit. With this mode, a blindman will be familiar with a simple navigation tools. Sensors will give measurement signal which is processed in the microcontroller system. Then the information will be taken out as a sound like an alarm code [8], [6], remaining foot step distance [9] and the distance to the object [7].

The RFID reader has also been introduced in [10], and [5]. The use of a voice data base to provide distance information has also been carried out at [9] and [7]. In this paper will be explained a navigation tool for blind persons that uses ultra sonic sensors, voice database and RFID system.

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2. Research Method

Navigation tool for blind persons which have realized is a stick with three pairs of ultrasonic sensors used to detect the safe distance to the left, right and front. This tool is also equipped with a RFID reader to read the RFID tag presence.

2.1. Voice Database

The voice data base is realized by recording the voice information into the chip ISD25120. Recorded data and the address data is shown in Table 1.

Table 1. Voice Information and their Address

No	Voice	Address
1	Satu	0000 0000
2	Dua	0000 1000
3	Setengah	0001 0000
4	Meter	0001 1000
5	Kiri	0010 0000
6	Kanan	0010 1000
7	Depan	0011 0000
8	Anda di	0011 1000
9	Jl Sudirman	0100 1000
10	Jl Juanda	0110 1000
11	Masjid	0111 1000
12	Pasar	1000 0000
13	Toilet	1000 1000
14	Jl Paus	1001 0000
15	Perempatan PCR	1010 0000
16	Jl Sekolah	1011 1000

2.2. RFID Tag

The RFID tags that are used in this research have a data format that can be read by the ID-12. ID number of 8 pieces card are shown in Table 2.

Table 2. The Used Tags ID Number

No	ID Lokasi	No ID
1	Jl Sudirman	540062B8EB65
2	Jl Juanda	5400629170D7
3	Masjid	540062895DE2
4	Pasar	540062EC4C96
5	Toilet	5400629E11B9
6	Jl Paus	540062D6DA3A
7	Perempatan PCR	5400628DFB40
8	Jl Sekolah	540062923490

2.3. System Flowchart

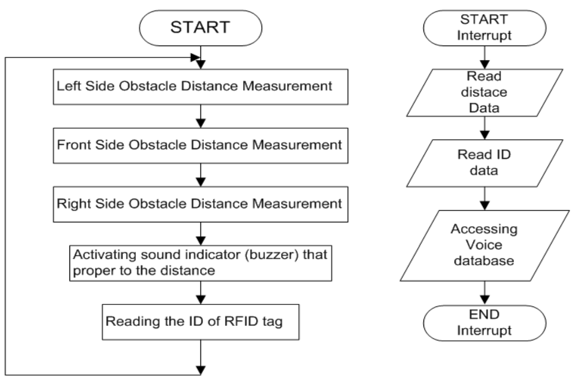

Figure 1. System Flowchart

System flow diagram is shown in Figure 1. The main program of the system is a continuous process that starts from a safe distance measurements to the left, front and right side, and then detect the presence of RFID tags followed by sounding a safe distance indicator on each side. Then the program back to a safe distance measurements again.

When an interrupt occurs, ie when the voice button is pressed, the program switches to read safe distance data for each side, read the data from the RFID tag ID, then based on these the voice information is generated from voice database, interruption is endded when the voice information is played completely then microcontroller continue to process the main program.

2.4. Implementation

The systems hardware that have been realized has the following specifications:

1. Using the AVR microcontroller ATMega8.
2. Using three pairs of ultrasonic sensors (paralax ping sensor)
3. ISD 25120 for voice data base
4. ID-12 RFID reader
5. Two 3.6 volt Lithium Batteries 2000mAh
6. Buzzer as an indicator of a safe or not safe distance

3. Results and Analysis

This system is tested by giving some obstacles on the left, front and right side of tool, then the test results are recorded based on the sound coming out of the loudspeaker. Prototype of navigational aids is shown in Figure 2.

Safe distance measurement data of the navigation tool shown in Table 3 (measurement error can be seen in Figure 4). From this table, it can be seen that the instrument can measure safe distance reliably in accordance with a program that has been entered into the system. The program works on the classification of range as being shown in Figure 3.

Figure 2. Photograph of Navigation Tool for Blind Person

Table 3. Safe Distance Testing

No	Object Distance (cm)			Output Sound		
	Left Side	Front	Right Side	Left Side	Front	Right Side
1	30	30	30	An half meter	An half meter	An half meter
2	60	60	60	An half Meter	An half meter	An half meter
3	90	90	90	An half meter	An half meter	An half meter
4	120	120	120	One meter	Satu Meter	Satu Meter
5	150	150	150	One meter	Satu Meter	Satu Meter
6	180	180	180	One half meter	One half meter	One half meter

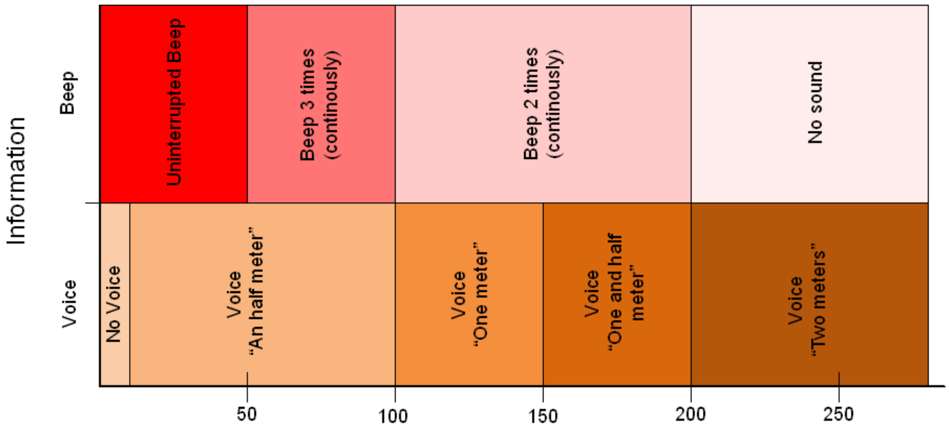

Figure 3. Range Classification and Voice Information

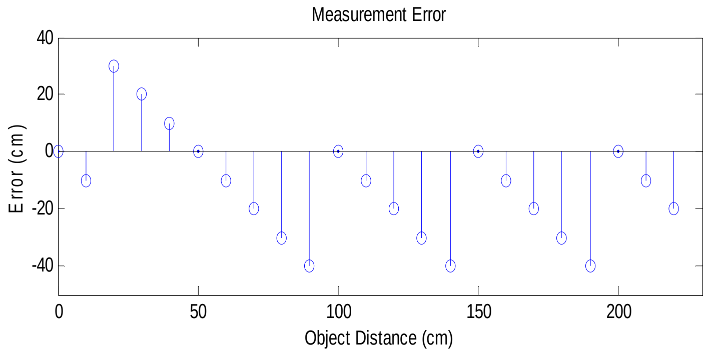

Figure 4. Measurement Error

Based on Figure 3, the voice information is not accurate, when the distance value between 0 to 1 meter is informed that the distance is a half meter. Distance of 1 to 1.5 meters is informed by sound "one meter". Distance of 1.5 meters to 2 meters is informed as one and a half meters. Distance of 2 to 2.5 meters informed as two meters. This has been considered in the design process. Because the purpose of the voice information for blind people is to illustrate a safe distance, ie, it is not safe when the distance is less than 1 meter, because there is possibility to hit the object. Voice information about one meter to two meters have mean that the distance is still safe to move. The more accurate voice information can be achieved by more range clasification but need more times to hear the voice information.

Errors were occurred because the predetermined distance classification that being used for program reference, as shown in Figure 4. This classification distance was chosen in order to save the voice recorder memory. For information in the form of a beep sound, if no beep, that means safe, 2 times beep has mean relatively safe, if 3 times beep, it means to be careful while continuously beeps means the risk of hitting the objects

This navigation tool is very simple, do not use complex devices [5], and easy to implement, also has two alternatives information, namely the indicator beep sound and voice of distance information that can be chosen by pressing the button. On the other hand this tool is familiar to use, easy to operate by blind persons. In contrast to [9] which provides an information about the rest of steps toward the objects, blind person has to think to count the foot steps to get to the object. While the tool in [7] only provide distance information. In addition to the distance information or warning indicator, this instrument is also equipped with an RFID reader that can provide information about the place that being passed by the user. In testing, the RFID reader can read RFID tags in a distance of 8cm.

Table 4. Voltage and Current Testing Data

Condition	Voltage (volt)	Current (mA)
Running only with sound indicator	4,7	100
Running with voice information	4,6	150

Table 4 is a measurement data of voltage and current for activate navigation tool. When the output system is only indicator beep sound, the circuit system draws electrical current of 100mA (or 0.47 WH). Meanwhile, when the voice button is pressed (an interrupt occurs), systems circuit draws current of 150 mA (or 0.69WH). Because the batteries that being used is 2x3.6volt x 2000 mAH (or 14.4 WH), the navigation tool can be used for 20 to 30 hours, based on the conditions as shown in Table 4.

4. Conclusion

In conclusion, the objective to build a navigation tool for blind person was successfully achieved. This system works.

As a conclusion, the objective to build a navigatio tool for blind people has been achieved well, which is a tool can to provide voice information in accordance with the real conditions, though still in rough approach, but this tool can be used to help blind people in their activities. This tool can be developed for the better accuracy by adding more distance classification database and detailed voice information. However, the process need a longer time for voice information playback.

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