Object Detection System for Blind Users

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***Abstract* – This paper presents a system developed in the context of a final project of *Licenciatura* in electronics and telecommunications at ISEL. The Project offers the ability to detect objects that are at head height of a blind user. The obstacle's detection is supported on ultrasound signals and the communication with the user is made through vibrating motors, placed around the waist, giving him the sense of the obstacle's location. This way, besides protecting the user against potential targets, it's also providing an intuitive reference of the surrounding area.**

Keywords: Ultrasounds, target detection, sonar, blind users, user interface.

I. EXTENDED ABSTRACT

At head height, there are obstacles which are not detected by blind people using a regular cane or a guide dog. This fact represents a potential danger to their locomotion.

The developed system objective is not only to present a solution to this problem, but also to develop a tool that offers a wide sense of the surrounding space around the user.

The first developed prototype is composed by three modules – a sonar module, a user interface and a signal processing module – which is shown in Fig. 1.

The system has two modes of operation: Indoor Mode – for environments that are less crowded, but have more obstacles around; and the Outdoor Mode – for more dynamic environments.

Nowadays, there are systems with a similar goal. The main difference of this project, comparing to those, is the user interface, which proposes a man-machine interface supported on vibrating motors, that gives the user information about the location of objects in an intuitive way.

II. DEVELOPED SYSTEM

The sonar module is composed by ultrasonic sensors at head height. The objective of this module is to simulate vision, emitting ultrasonic signals at the frequency of 40kHz, and processing the echoes reflected from obstacles, assuming that these travel at the speed of sound.

Fig. 1. Developed system for object detection for blind users. It is composed of three main modules: sonar module, user interface module, and a signal processing module.

To reduce mutual interference, we ensure orthogonality between each distance measured.

Within -13,6 º C to 43,9º C, the error rate associated to temperature is considered irrelevant.

The user interface is composed by an array of vibrating motors placed around the waist. Each motor is associated to an ultrasonic sensor, and consequently, to a direction.

The signal processing module is composed by a microcontroller, a printed circuit board and a power bank which serves as the battery of the system.

In order to maximize the performance of the system, the time of each distance measure cycle is as short as possible, considering the travel time of a wave that gets to the maximum range of the used HC-05 sensors – 4 meters.

The obtained results are very promising as well as the feedback given by blind users that have already tested the system.

II. FUTURE WORK

Based on the feedback given by blind users, a new version of the system is currently under development.

The new system is composed by two independent modules which communicate wirelessly, via Bluetooth. It will be composed by five sensors and five vibrating motors, which maintain the range of the system, improving the problem of dead angles of the previous prototype. This improvement is illustrated in Figures 2 and 3.

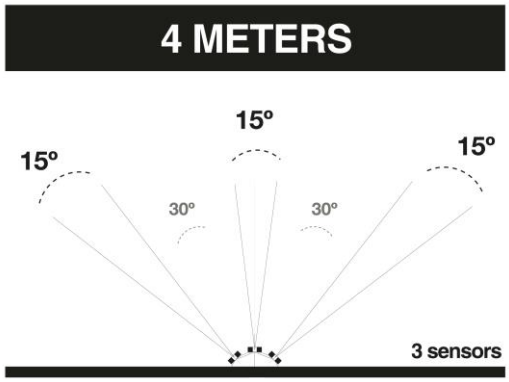

Fig. 2. Dead angle between each sensor (30º) and their range (15º), for the first prototype.

III. MAIN REFERENCES

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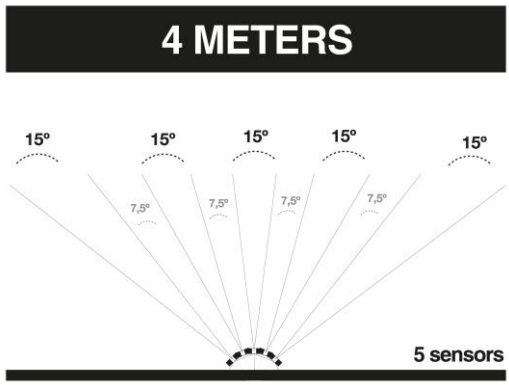

Fig. 3. Dead angle between each sensor (7,5º) and their range (15º), for the second prototype.