AERIAL OBSTACLE DETECTION SOFTWARE FOR THE VISUALLY IMPAIRED

PATENTED TECHNOLOGY

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ABSTRACT

The research group “Mobile Vision Research Lab” of the University of Alicante has developed software aimed to detect aerial obstacles (e.g. tree branches, awnings), addressed to the visually impaired.

The main advantages of this technology are that this software can be executed in any smartphone equipped with a 3D camera, which is used to detect the distance to the obstacles, and it provides an accessible interface that alerts the user by means of beeps or vibration when it finds an obstacle. The alert becomes more and more frequent as the obstacle is closer. The system is comfortable and discreet making easier the user social integration.

The technology can be used in the following industrial sectors: handicap aids, robotics, and computer vision systems. The research group is looking for companies interested in exploitation and/or adaptation of the technology as well as developing of technical cooperation projects in this area.

TECHNICAL DESCRIPTION

Introduction

Blindness is considered the major sensory disability, which determines to a large extent the life of a person, the interaction with the environment and with the society, the learning, and so on.

One of the daily challenges faced by a blind person is the autonomous movement. Regarding the global orientation, there are different GPS-based systems available in the market with specific cartographies and a voice interface that solves this problem largely. As for the detection and obstacle avoidance, classic systems such as the walking stick and the guide dog are the most used (Figure 1).

Despite the technological advances in this field, they have not managed to become daily use tools for this community. This is due to the fact that the classical systems achieve their goals successfully and the new developments are bulky and uncomfortable, hindering the social integration of the user. In addition, these devices often send acoustic signals via earphones, which deprives the blind user of his main information source: the sound.

Technology features

The main goal of the application is to act as a walking stick or a guide dog complement. It does not replace these elements, but it solves their main problem, that is, their inability to detect aerial obstacles (Figure 2). These obstacles have not projection to the floor (typically tree branches, awnings, etc.). In the case of walking sticks, this limitation is obvious. The dogs cannot be trained to detect theses obstacles, because they are not aware of the height difference between them and their owners.

As one of the main advantages, the application is embedded into a smartphone, obtaining a comfortable and discreet system that favors the user social integration. Furhermore, the invention is also able to notify the presence of an obstacle by means of acoustic signals (through the phone speaker, not earphones) or vibrations. The latter option makes the system less noticeable and does not deprive the user of the sense of hearing.

To make possible the obstacles detection, the application is able to take measures of the environment in a radius of several meters. For this purpose, the device must incorporate hardware that allows obtaining the scene in stereo. Within these devices, we find the “3D phones” (Figure 3 left and center) that are endowed with a double front camera, and every smartphone equipped with a catadioptric system (Figure 3 right) that allow us to obtain two shifted observations of the environment. The application is fully compatible and functional in both types of devices.

In addition to the observation of the stereo pair of images, the application uses data from different sensors, such as magnetometers and accelerometers. These sensors provide the global orientation of the device, to detect the direction in which the user is walking.

It is worth to highlight that this technology is new for this kind of devices. Until now, smartphones were not able to extract real measures from the environment. This application extracts about 30000 measures per frame, with a frame rate of 9 fps (Figure 4).

This system has been developed for the Android platform, because other platforms (like iOS) do not have currently available 3D devices. Nevertheless, it could be ported to any other platform whenever the required hardware is available.

Using the application

The usability of this application is directly related to its portability, because the device must hang from the user neck with the camera facing forward and the screen on the chest to activate the obstacle detection mode. Once the proximity sensor detects the device is in this position, the screen is locked and the obstacle detection begins. The detection finishes by flipping the device, or simply separating it from the chest.

The obstacle detection is performed up to four meters forward, within the space corresponding to the user torso (a volume of 0.5 x 0.5 x 4.0 meters is estimated). The system incorporates an algorithm to correct the swing movement produced when the user walks. This correction makes the system to search the obstacles in the walking direction, instead of the direction the camera is pointing.

The user receives obstacle alerts when they are closer than two meters in the direction the user is walking. Once an obstacle is detected, the device sends a sound or vibration alert. The closer is the obstacle the stronger is the alert.

The application presents an accessible user interface, designed for blind users. This interface allows the user to configure different system features. The interaction with the user is based on three simple gestures: vertical swipe to change the menu item, horizontal swipe to explore the different values for the current item, and touch to select the current value. After each gesture, the device pronounces the current selection, to let the user know the actions he is performing.

The interface allows configuring different features: operation mode, alert type (sound or vibration), volume, speech velocity, language (the application is localized to several languages), etc.

ADVANTAGES AND INNOVATIVE ASPECTS

MAIN ADVANTAGES AND INNOVATIVE ASPECTS

• The technology is **embedded in a smartphone**.

• **Ease of use** via touch interface specially designed for the blind. Items and options are vocalized.

• The system does **not require previous calibration** to start the obstacles detection.

• In contrast to others, the use of this technology is **comfortable** and d**oes not attract attention**. It facilitates the user **social integration**.

• Also, the system warns the obstacles via acoustic signals or vibrations **without depriving the user from the sense of hearing**.

CURRENT STATE OF DEVELOPMENT

A prototype developed on 3D devices HTC Evo 3D and LG Optimus 3D is currently available. This prototype is under test by blind people within limited fields.

MARKET APPLICATIONS

- Companies developing software for mobile devices.
- Companies specialized in products for visually impaired.
- Organizations for visually impaired support (foundations, associations, national and regional public authorities, etc ....)
- Other companies or entities interested in new developments in robotics, and computer vision systems.

COLLABORATION SOUGHT

- Software License Agreement, know-how and / or patent to exploit the technology by third parties.
- R & D cooperation projects for development or adaptation of technology to other applications or sectors.
- Outsourcing Agreement for advisory activities, technical assistance, development of turnkey software, training, etc...

INTELLECTUAL PROPERTY RIGHTS

This technology is protected by patent application:

N° of application: 201201247

Date of application: 19/12/2012

RESEARCH GROUP PROFILE

The research group "Mobile Vision Research Lab" at the University of Alicante is focused on the following lines:

- Analysis of data and Biomedical Images. Bioinformatics.
- Video Analysis.
- Mobile Multimedia Applications.
- Network Science including analysis of mobile dynamic networks.
- Theories of Vision, Pattern Recognition and Complex Systems: Information Theory, Spectral Theory and related complementary methodologies.
- Computer Vision and Pattern Recognition.
- Vision in Mobile, Embedded and independent devices.

MARKET APPLICATION (3)

Computer Science, Language and Communication
Engineering, Robotics and Automation
Medicine and Health