

Intelligent obstacle detection footwear for visually impaired

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Abstract:

Vision is a beautiful gift to human beings by GOD. Vision allows people to perceive and understand the surrounding world. Till date blind people struggle a lot to live their miserable life. Their problems have made them to lose their hope to live in this competing society. Global estimate of the number of visually impaired people according to World Health Organization survey made in 2010 is 285 million people are visually impaired worldwide. Numerous technical aids that have been developed through recent decades for the orientation and mobility that makes the lives of the blind easier. For doing so, sonar input and camera input systems are offered. Assistive devices are a key aspect in wearable systems for biomedical applications, as they represent potential aids for people with physical and sensory disabilities that might lead to improvements in the quality of life.

Index Terms - assistive technology, sensing and alerting system,

1. INTRODUCTION

Blindness is a state of lacking the visual perception due to physiological or neurological factors. The partial blindness represents the lack of integration in the growth of the optic nerve or visual centre of the eye, and total blindness is the full absence of the visual light perception. Total blindness is the complete lack of form and visual light perception and is clinically recorded as NLP, an abbreviation for "no light perception". Blindness is frequently used to describe severe visual impairment with residual vision. Those described as having only light perception have no more sight than the ability to tell light from dark and the general direction of a light source. Blindness is the inability to see. There are four levels of visual function, according to the International Classification of Diseases -10 (Update and Revision 2006):

- i) Normal vision
- ii) Moderate visual impairment
- iii) Severe visual impairment
- iv) Blindness

Moderate visual impairment combined with severe visual impairment is grouped under the term "low vision": low vision taken together with blindness represents all visual impairment.

2. LITERATURE SURVEY

A complete and reliable sensing system for obstacle detection can value a lot from the collective usage of numerous types of sensors, especially from the active - passive combination. Any precise type of technology may have hitches to meet all necessary necessities in order to detect an obstacle in various lighting or weather conditions. The muddle background and intricate moving patterns of all objects which may appear on a road scene in urban streets demand erudite processing of sensor inputs. In order to overcome this problem, a sensor - fusion and segmentation approach can be used. From the technology's point view, different sensing technologies such as ultrasonic sensor, microwave radar, laser scanner and computer vision can be used for obstacle detection task. The main problem is to design algorithms that are robust enough to reliably detect and warn for any obstacles that can appear in front of the user on the road area.

In [1] A Discant et al. speaks about the different types of sensors such as active and passive sensors. It also throws light on various sensing systems designed using the combinations of these sensors.

[2] This paper presented the use of ultrasonic and infrared sensors for distance dimension in the enlargement of an obstacle detection system for senior and people with vision impairment. Investigational results show that ultrasonic and infrared sensors have diverse characteristics in terms of output voltage measurements. It is clearly designated that ultrasonic sensor gives a linear output representative whereas infrared sensor shows a nonlinear output representative. Both sensors are able to detect an obstacle at the distances within their usable range with percentage of precision between 95% and 99%. The experimental result indicates that the US and IR sensors are able to provide reliable distance measurements even with different colors and materials of obstacles. Another thing that has been shown is that IR sensor has slightly advanced resolution than that of the US sensor, particularly for slight distance measurement within their usable ranges. Future work, the system should determine the sensor location on the shoe, and the sensors only detect the obstacle when the foot fully touching to the ground.

[3] A motion supporting device is proposed which can be used to help navigate in the surroundings and avoiding from collisions with obstacles. This could help decrease health costs incurred and improve the quality of care and independence of the elderly. Conventionally, mobility-assisting devices have been electromechanical devices, in which the main function is to provide physical support for the elderly whilst moving around using canes and wheelchairs. Microcontroller and wireless network applications and usages have increased the functionality of these devices in terms of obstacle detection and information processing. They have also brought in stirring new concepts, which make these devices to be hands free and small. The system which is proposed here is based off optical and ultrasonic sensors. These are able to detect a wide range of obstacles, such as small objects on the walkway, large static obstructions (e.g., building wall), as well as stairs and uneven surfaces, and hence warns the wearer several times before making contact with the object (e.g., 1.5m, 1.0m and 0.5m).

[4] Provides a comprehensive summary of state of the art techniques, which are used for navigation systems for visually impaired people. It concludes that navigation systems have not achieved large-scale advantages mainly due to unaffordable costs, accuracy and usability. Further, in the future, navigation systems need to firstly reduce the installation expenditure by curtailing the infrastructure disagreements that is required for confining the consumer. Usability can be enhanced by curtailing the amount of sensors users have to carry and also providing usable directions in a vigorous modality of feedback. Systems need to take into account the user's special necessities, minimize

Intellectual load, cost effective, user friendliness and minimize any meddling from the surroundings.

[5] An ultrasonic sensor based navigation system for blind people, which is based on microcontrollers with synthetic speech output and portable device to guide the user about urban outdoor paths to point out what choices to make. This device uses the principle of echo of high frequency ultrasonic beam to detect hindrances in the path. These mobility supports instructions are given by vibro-tactile form rto reduce navigation complications. A shortcoming of ultrasound is that walls may reflect or block ultra sound signals, which result in less accurate localization.

[6] Vibration and voice operated navigation system developed using ultrasonic sensors to detect obstacles. Since visually impaired people are more sensitive in hearing and possesses strong perception than ordinary people. So this system gives alert through vibration and voice feedback. System works in indoor as well as outdoor navigation and focus on continuously sensing surround obstacles and alerting through vibration and voice feedback. Depending upon the distance between obstacle and user different intensity levels are provided to vibration motor to alert user's mobility.

3. PROPOSED METHODOLOGY

The scope of this product covers its usage by visually impaired and blind people who cannot find their way without use of an explicit tool or some other persons help. The idea is to use daily-use apparel that is our shoes to guide the user to his/her destination with description of obstacles in his/her path. The product does not deal with guiding about how to avoid the obstacle. It only deals with notifying the user of the product about the presence of the obstacle and the position of the obstacle. The block diagram of the system is given below.

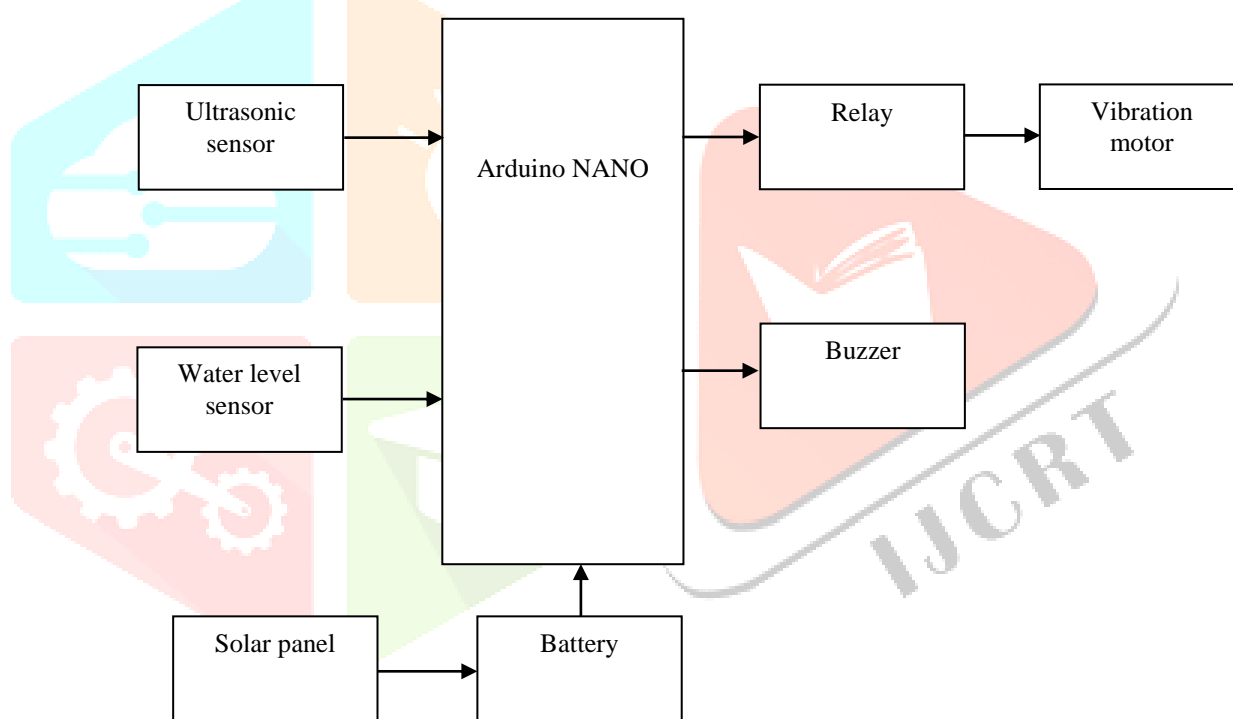


Fig.1 Block diagram for obstacle detection footwear for visually impaired

3.1 Assistive technology

In this proposed system the user i.e. blind people can walk through the streets without any interference and also independently. The whole process is divided into modules and separated so that the processing can be easier. The functions performed by the system are as follows:

1. Both the sensors in the system are activated.
2. Each sensor has its own search area.
3. When an obstacle is detected by either of the sensors, the shoe vibrates, as well as the buzzer also activates.
4. While walking, if the intensity of the vibrator is low, the buzzer acts as signal to the user.
5. For the detection and signaling fuzzy logic is used to avoid complexity in the algorithm of the system.

There are various components used to build this system. The important components necessary for working of the system are as follows:

- a. Ultrasonic sensor
- b. Water level sensor
- c. Battery
- d. Buzzer
- e. Vibrator

- f. Relay
- g. Arduino panel

3.1.1 Ultrasonic sensor

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

3.1.2 Water level sensor

Water level sensor is designed for water detection, which can be widely used in sensing the rainfall, water level, even the liquefied leakage. This item can judge the water level through with a series of exposed parallel wires stitch to measure the water droplet/water size. This item can easily change the water size to analog signal, and output analog value can directly be used in the program function, then to achieve the function of water level alarm

3.1.3 Battery

A lead-acid battery is used in this system, as it can be recharged at will. Most lead-acid batteries are constructed with the positive electrode (the anode) made from a lead-antimony alloy with lead (IV) oxide pressed into it, although batteries designed for maximum life use a lead-calcium alloy. The negative electrode (the cathode) is made from pure lead and both electrodes are immersed in sulphuric acid.

3.1.4 Buzzer

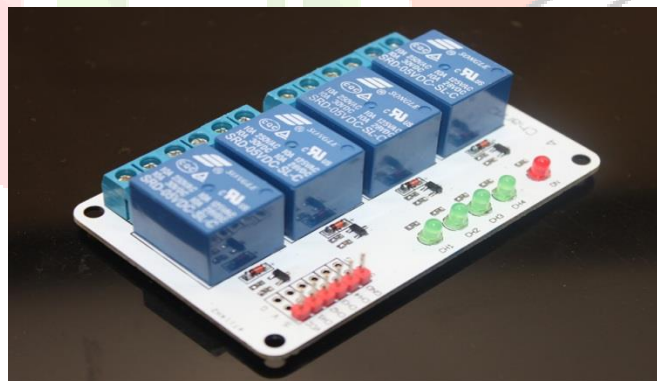
A 5 V buzzer is used in this system for alerting purposes. A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

3.1.5 Vibrator

Miniature vibrating motors are used in a wide range of products, such as tools, scanners, medical instruments, GPS trackers, and control sticks. In this system, vibrator is used for alerting the user.

3.1.6 Relay

Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps. Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state.



3.1.7 Arduino Nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P. It is used for connecting all the components together. It works with a mini-B USB cable. The pin diagram for the Arduino Nano board is shown on Fig.2.

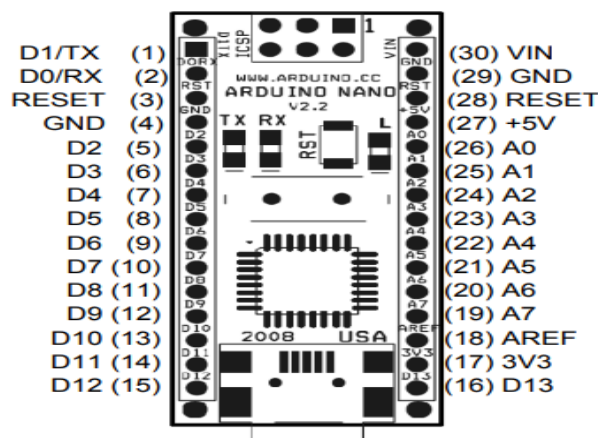


Fig.2 Arduino panel pin layout

4. CONCLUSIONS

This paper is focused on wearable assistive devices for the blind. Devices worn on the finger, hands, wrist, forearm, tongue, head, chest, abdomen and feet have been proposed over the last decades to provide wearable solutions to the problems of reading and mobility.

For the blind, hearing and touch become the first and second major senses, respectively. They will never replace vision but they still gather much information from the environment for daily tasks. That is the reason why assistive devices provide acoustical and tactile feedback to compensate for visual information.

Several universal design concepts for acoustical/tactile based assistive devices have been presented. They provide guidelines to stimulate both hearing and touch in order to obtain the best performance from these senses. Thus, with the ease of use and faster response time, a visually impaired person can sense, feel, listen and walk with the environment around him with the help of these Smart Shoes.

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