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Smart Walking System for the Blind

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Abstract: There has been a great deal of research in the area of motional aids for the visually challenged and impaired. Smart systems have been proposed for ease of use and greater accuracy. The current paper proposes a smart system to aid visually challenged people in traversing obstacle-filled paths. The solution uses an Arduino board paired with ultrasonic sensor for implementation of the system, which is augmented by the addition of a piezoelectric speaker and variable intensity vibration motor.

Keywords: Visually Challenged, Smart Systems, Bluetooth, Arduino, Ultrasonic Sensor, Piezoelectric Speaker

I. INTRODUCTION

Design of systems that aid the visually challenged has been a well-explored area of research due to many factors, inclusive of the social implications of the same as well as the commercial aspects. Smart systems aiding the visually impaired or challenged have been proposed by many researchers due to the above mentioned factors. The current work aims to develop a relatively cheap yet accurate and easy to use smart walking stick system. Section II surveys some of the recent and relevant literature in the domain of locomotional aids for the visually challenged. Section III describes the smart walking stick system proposed by the researchers. Section IV concludes the paper with a discussion on the scope for further research in this domain.

II. LITERATURE SURVEY

Walking aids for the visually impaired have been designed and tested by many researchers [1]. Some scholars have proposed design of systems that implement image processing and echolocation to compare sensor results and aid the visually challenged in navigation [2]. Other researchers have proposed web-based electronic guidance [3]. Walking sticks relying on haptics have also been designed and tested by researchers [4].
Most of the proposed systems are either too costly to be practically viable or are extremely prone to malfunction or error due to comparatively lower accuracy or actuation. The current paper aims to address both these issues, optimizing the cost and the accuracy while maintaining the required robustness, through the proposed system discussed in the following section.

III. PROPOSED SYSTEM

A smart walking stick should, in the opinion of the authors, be able to help the user negotiate challenging environments while providing stability and accuracy of response.

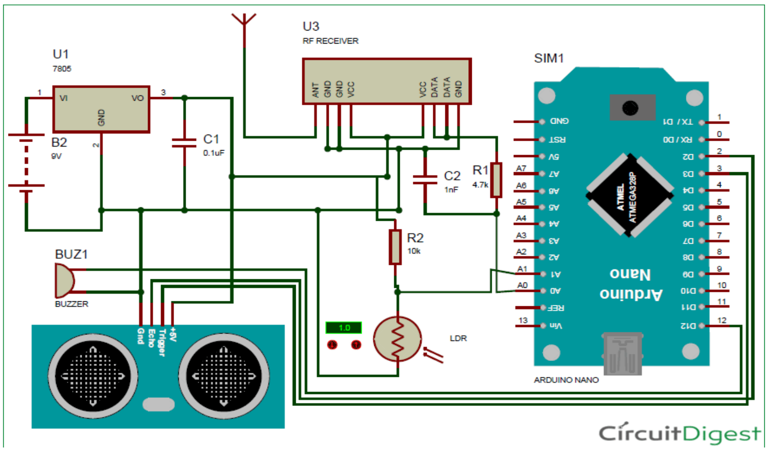

Figure 1: Basic Schematic Diagram

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To that effect, the proposed system consists of an ultrasonic sensor paired with an Arduino module for sensing obstacles. The simple innovation that the authors have made to this standard system is the introduction of piezoelectric speakers and variable intensity vibration motor for increase in stability of the system. The vibration motor's response along with the audible output from the piezoelectric speaker is used to guide and, when necessary, warn the user, through comparison with the ultrasonic sensor data processed by the Arduino module. The schematic diagram of the Arduino circuit is presented in the following figure 1.

The corresponding remote circuit is shown in figure 2.

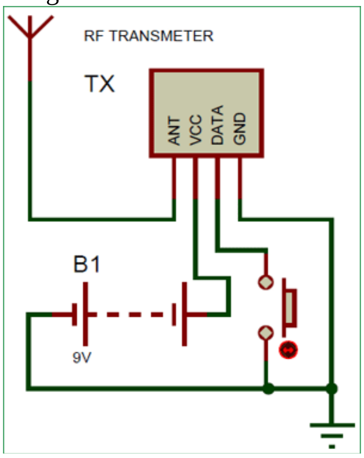

Figure 2: Remote Circuit

The formula used for calculation of proximity to an obstacle is as follows.

$$c = 331.4 + (0.606\times T) + (0.0124\times H)$$

Here, c=Speed of sound in meters per second (m/s), 331.4 is the speed of sound (in m/s) at 0 °C and 0% humidity and T is the Temperature in °C with H being the relative humidity in percentage form.

IV. CONCLUSION

The current work accomplished in this paper comprised of proposal of a smart blind navigation solution. In future, more expensive processors may be used for remote assistance of a visually challenged user using the interfacing of the current controller (as a slave) to a central processor (such as a Raspberry-Pi board) which can access greater amounts of data, inclusive of meteorological data, to aid the visually challenged individual to easily traverse complex outdoor environments.

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