Design and Development of a Smart Hybrid E-Cane for Visually Impaired People for Indoor Environments

Neetu[1] Narender Kumar[2]
[1]P.G. Student [2]Assistant Professor
[1,2]Department of Electronics & Communication Engineering
[1,2]B.R.C.M CET BAHAL Haryana

Abstract— The objective of the research work is to design and develop a smart and viable mobility-aid in the form of a hybrid e-cane for visually-impaired people for indoor environments. Visually impaired persons find themselves challenging to go out independently and are always in need of helping hands. The objective is to give blind users the ability to move around in unfamiliar environments, for indoor through a user friendly interface. The idea is to provide a simple walking stick equipped with sensors to give an active feedback to the user about the environment. The smart white cane uses the ultrasonic sensors arranged in such a way that it detects pits, potholes, downfalls, a staircase (up and down), low lying and knee level obstacles and even those above the waist. The user is notified about the same by the pre-recorded sound messages and a haptic feedback in form of vibrations. This can considerably alleviate the risk of accidents. The vibration becomes stronger with increasing obstacle approachability. Thus the overall aim of the device is to provide a convenient and safe method for the blind to overcome their difficulties in day-to-day life.

Key words: E-Cane, Visually Impaired, Microcontroller, Ultrasonic Sensors, GSM

I. INTRODUCTION

Canes are used by people for whom walking is difficult or impossible due to illness, injury, or disability. A smart E-Cane is a stick with a circuitry designed specifically to assist a visually impaired user in order to provide a safe mobility aid. The main motivation was to develop an assistive device to provide visually impaired persons with the experience of independent movement and enhance their ability to participate in community. Smart E-canes are designed for a variety of user types. The Hybrid E-cane allows the subject to select arbitrary modes through tactile switches and provides a high degree of autonomy to the user. To offer a viable mobility aid for the betterment of a class of underprivileged community of people in a developing country like India. Facts and figures provided by the Census of India 2011 on disability provide the scope of this study and reflects the acute need of this device. In this proposed system, ultrasonic sensor, pit sensor, GSM module, level converter, driver, vibrator, voice message playback, keypad, microcontroller and battery are used. A speaker built into the cane will guide users through voice command to go straight or turn wherever required. The cane also vibrates if it senses an obstacle on the path through ultrasonic sensors.

II. PROBLEM FORMULATION

The objective of the proposed work is to design and develop a smart mobility-aid in the form of a hybrid e-cane for visually-impaired people for indoor environments. The proposed e-cane should possess the below mentioned features:

- It should be based on State-of-Art Technology and highly versatile
- It should consider the major safety issues for the patient
- It should be reliable to handle alarming situations as well as panic situations
- It should be highly responsive and capable of performing real-time operations
- It should be able to easily detect static as well as dynamic obstacles in its range
- It should be made highly configurable for easy alterations as per the patient needs
- It should be light in weight and portable
- It must be viable so that every class of the society can be benefited

III. PROBLEM SOLUTION

The proposed system has been designed around a widely used microcontroller of Atmel make i.e. AT89S52. The operational features can be well explained by the block diagram shown below.

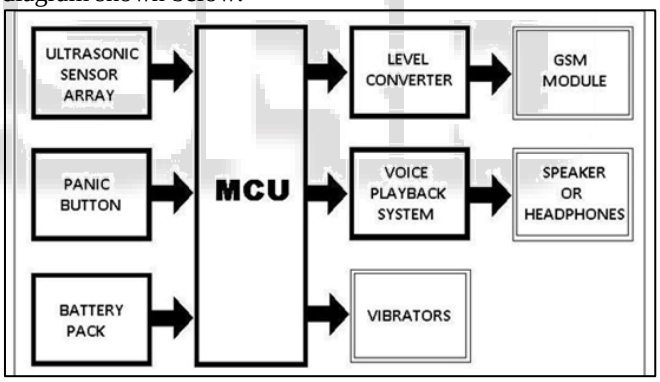

Fig. 1: Block Diagram of Proposed System

IV. BLOCK FUNCTIONALITIES

A. MCU (Microcontroller Unit)

The system is built around an eight bit microcontroller i.e. AT89S52 supporting the following features 40MHz, 5 Volt 8051-based Microcontroller with 32 I/O lines, 3 Timers/Counters, 9 Interrupts/4 priority levels, 64K+8K FLASH, 1K on-chip RAM, SPI, Dual Data Pointers, WDT, 5-channel PCA, built-in UART module.

1) GSM Modem

Here a GSM modem is being interfaced with the microcontroller AT89s51 for SMS/Call communication. Text message may be sent through the modem by interfacing only three signals of the serial interface of modem with microcontroller i.e. TxD, RxD and GND. AT commands are instructions used to control a modem. AT is the abbreviation of AT tention. Every command line starts with "AT" or "at".

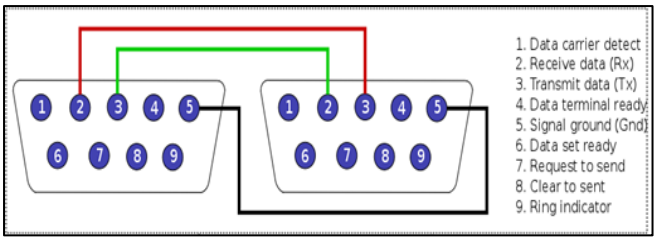

Fig. 3: Schematic Diagram of Proposed System

2) Ultrasonic Sensors

Though the IR based sensors are cheap, their working range may vary due change in ambient light and won't give accurate range values. These devices work on a similar principle of sonar or radar which evaluates the target by interpreting the echo from sound or radio waves. It offers excellent range detection with high accuracy and stable readings. The operation of the module is not affected by the sunlight or black material. Most of the ultrasonic sensors are equipped with temperature compensation circuit to avoid changes in readings due to temperature changes. The module transmits an ultrasonic signal, picks up its echo, measures the time elapsed between the two events and outputs a waveform that's high time is modulated by the measured time which is proportional to the distance. The programmer needs to provide a trigger pulse at its TRIG pin and receive the echo signal at ECHO pin to calculate the distance value in centimetres.

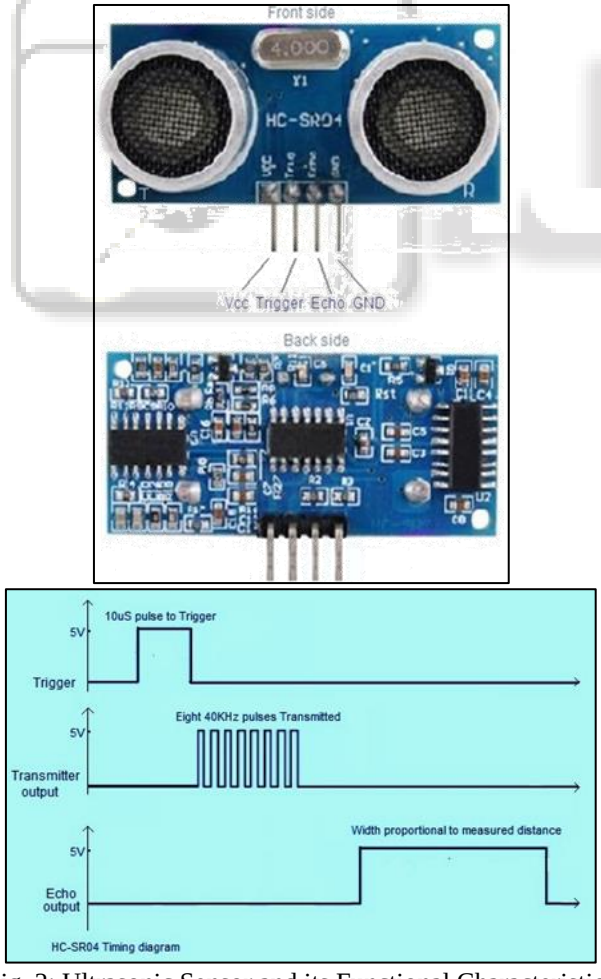

Fig. 2: Ultrasonic Sensor and its Functional Characteristics

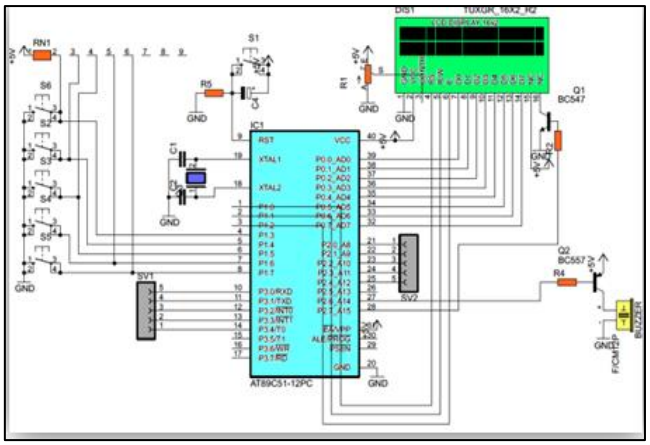

Fig. 3: Schematic Diagram of Ultrasonic Based Obstacle Detector System

Voice Playback System: The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications. Their high level of storage capability is by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form.

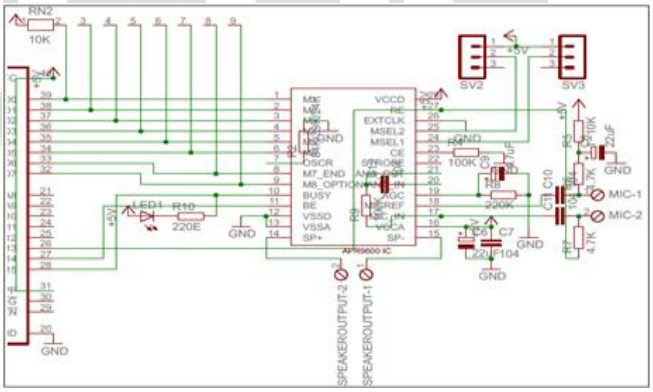

Fig. 4: Schematic Diagram of Proposed System

V. CONCLUSION AND FUTURE WORK

The smart white cane is a practically feasible and viable product to carry around like any other walking stick. This could also be considered a crude way of giving the blind a sense of vision. This also reduces the load of caretaker and boost self-confidence while walking around. It can serve as a benchmark in aid for the blind. A GPS can be used to navigate the paths and to detect the user's position .A wall-following function can be included into the algorithm so that the user can walk straight along a corridor in an indoor environment. Some other alternative techniques that can be exploited are lasers, image processing, and other sensors.

REFERENCES

[1] Shashank Chaurasia, K. V. N. Kavitha, An Electronic Walking Stick For Blinds, IEEE Conference, Feb. 2014, pgs-1-5, ISBN: 978-1-4799-3835-3.
[2] Rohit Sheth, Surabhi Rajandekar, Shalaka Laddha, Rahul Chaudhari, Smart White Cane -An Elegant and Economic Walking Aid, AJER, 2014, pgs-84-89, Vol.3, Issue-10, ISSN: 2320-0847.
[3] G.Gayathri, M.Vishnupriya, R.Nandhini, Ms.M.Banupriya, Smart Walking Stick For Visually Impaired, IJECS, March 2014, pgs-4057-4061, Vol.3, Issue-3, ISSN: 2319-7242.
[4] Prof.R.R.Bhambare, Akshay Koul, Siddique Mohd Bilal, Siddharth Pandey, Smart Vision System for Blind, IJECS, May 2014, pgs- 5790-5795, Vol. 3, Issue-5.
[5] Cang Ye, Soonhac Hong, Xiangfei Qian, A Co-Robotic Cane for blind navigation, IEEE Conference, Oct. 2014, pgs-1082-1087.
[6] Amjed S. Al-Fahoum, Heba B. Al-Hmoud, Ausaila A. Al-Fraihat, A Smart Infrared Microcontroller Based Blind Guidance System, Hindwi Publishing, June 2013, pgs1-7.
[7] J.Ramprabu, Gowthaman.T, Smart Cane for Visually Impaired People, IJCSIT, 2013, pgs-24-28, Vol.4 (1), ISSN: 0975-9646.
[8] S. Nithya, A. S. L Shravani, Electronic Eye for Visually Impaired Persons, IJETAE, Oct. 2013, Vol.3, Issue-10, ISSN 2250-2459.
[9] Mohd. Ali Mazidi; The 8051 Microcontroller and Embedded Systems, Pearson Education India, 2012.

