Ultrasonic Blind Walking Stick

Abhishek Bhokare[#1] Amruta Amberkar[#2] Anvesh Gawde[#3] Pratham Kale[#4] Abhijeet Pasi[*5]
#Department of Information Technology
*Lecturer, Department of Information Technology Engineering
Shah & Anchor Kutchhi Polytechnic
abhi1497@gmail.com[#1], amrutamberkar@gmail.com[#2], dalvijay686@gmail.com[#3], kalepratham10@gmail.com[#4],
abhijeetpasi@sakp.ac.in[*5]

Abstract: God gifted sense of vision to the human being is an important aspect of our life. But there are some unfortunate people who lack the ability of visualizing things. The visually impaired have to face many challenges in their daily life. The problem gets worse when there is an obstacle in front of them. Blind stick is an innovative stick designed for visually disabled people for improved navigation. The paper presents a theoretical system concept to provide a smart ultrasonic aid for blind people. The system is intended to provide overall measures − Artificial vision and object detection. The aim of the overall system is to provide a low cost and efficient navigation aid for a visually impaired person who gets a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them. Ultrasonic sensors are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. Output is in the form of sequence of beep sound which the blind person can hear.

Keywords: Ultrasonic sensors, visually impaired person, Microcontroller.

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I. INTRODUCTION

There are approximately 37 million people across the globe who are blind, over 15 million are from India [1]. Even for the non-visually impaired the congestion of obstacles is sometimes problematic, it's even worse for the visually impaired. People with visual disabilities are often dependent on external assistance which can be provided by humans, trained dogs, or special electronic devices as support systems for decision making. Existing devices are able to detect and recognize objects that emerge on the floor, but a considerable risk is also includes the objects that are at a sudden depth, or obstacles above waist level or stairs. Thus we were motivated to develop a smart white cane to overcome these limitations. The most common tool that the blind currently use to navigate is the standard white cane. We decided to modify and enhance the walking cane, since blind are only able to detect objects by touch or by cane. The user sweeps the cane back and forth in front of them. When the cane hits an object or falls off of the edge of a stair, the user then becomes aware of the obstacle – sometimes too late [1]. We accomplished this goal by adding ultrasonic sensors at specific positions to the cane that provided information about the environment to the user through audio feedback. The main component of this system is the Radio-Frequency module which is used to find the stick if it is misplaced around.

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II. BACKGROUND

Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. The 2011 statistics by the World Health Organization (WHO) estimates that there are 285 million people in world with visual impairment, 39 billion of which are blind and 246 with low vision [2]. The traditional and oldest mobility aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information conveyed. With the rapid advances of modern technology, both in hardware and software front have brought potential to provide intelligent navigation capabilities. Recently there has been a lot of Electronic Travel Aids (ETA) designed and devised to help the blind navigate independently and safely. Also high-end technological solutions have been introduced recently to help blind persons to navigate independently. Many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is that the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuit. Blind people have used canes as mobility tools for centuries, but it was not until after World War I that the white cane was introduced.

III. LITERATURE SURVEY

Numerous attempts have been made in the society to help the blind. "Project Prakash" is a humanitarian mission to help the blind children especially by training them to utilize their brains to learn a set of objects around them [3]. The stick has a ping sonar sensor to sense the distant objects. It also has a wet detector to detect the water. The micro-controller used is PIC microcontroller. The microcontroller circuit is on the outside of the stick but is protected with a code so its security cannot be breached. The only feedback given to the user is through the vibration motor [4]. Three sensors are used viz. ultrasonic, pit sensor and the water sensor. Even this is a PIC based system. The feedback given is through the vibration as well as the speaker/headphones. There is a GPS system where-in the user has to feed his location. No information on how a blind man would do that. Also they haven't mentioned anything about the size and shape of their cane and neither

about the placement of their circuitry [5]. The author has made a detachable unit consisting of an ultrasonic sensor and a vibration motor. It can be fit on any stick. It detects obstacles up to 3m. The vibration feedback varies in the intensity as the obstacles come nearer. Many different approaches have been taken with the primary purpose of creating a technology to aid the visually impaired. The priorities set by different authors are different leaving a scope of improvement in every application [6].
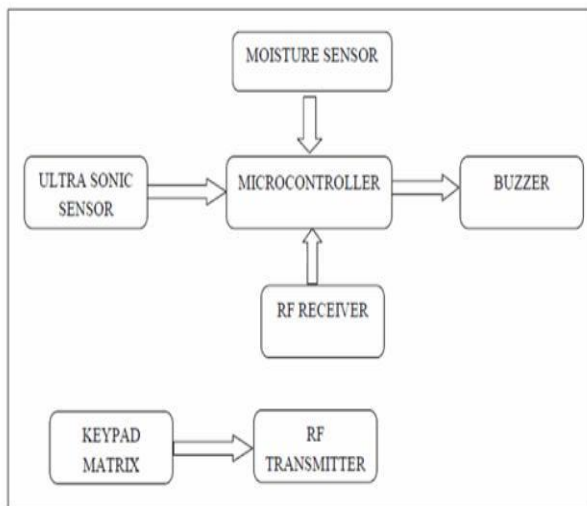
IV. DESCRIPTION

Figure 1. Block Diagram of System

In this system the ultrasonic sensor are used to sense the obstacle (if there is any). The signal is then send to microcontroller to operate a buzzer. There is one more advantage of this system. Sometimes when the blind loose there sticks or forgot where have they put it, they can find it by using the wireless remote.

V. COMPONENT DETAILS

1.1 Major components names
1. Ultrasonic sensor
2. Microcontroller
3. RF module
4. Micro-switch

1.2 Components description

1.2.1 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. This technology can be used for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or

water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultra sonography, burglar alarms and non-destructive testing. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a reading.

1.2.2 Microcontroller

A microcontroller is a small computer (SoC) on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

1.2.3 RF Module

An RF module (radio frequency module) is a small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight. RF communications incorporate a transmitter and/or receiver.

1.2.4 Micro switch

A micro switch, also known as snap-action switch, is a generic term used to refer to an electric switch that is actuated by very little physical force, through the use of a tipping-point mechanism. They are very common due to their low cost and durability, greater than 1million cycles and up to 10 million cycles for heavy duty models. This durability is a natural consequence of the design. Internally a stiff metal strip must be bent to activate the switch. This produces a very distinctive clicking sound and a very crisp feel. When pressure is removed the metal strip springs back to its original state. Common applications of micro switches include the door inter lock on a microwave oven, leveling and safety switches in

elevators, vending machines, and to detect paper jams or other faults in photocopiers. Micro switches are commonly used in tamper switches on gate valves on fire sprinkler systems and other water pipe systems, where it is necessary to know if a valve has been opened or shut. The defining feature of micro switches is that a relatively small movement at the actuator button produces a relative large movement at the electrical contacts, which occurs at high speed (regardless of the speed of actuation).

VI. LIST OF REQUIREMENTS

1.3 HARDWARE REQUIREMENT:
1. Microcontroller
2. Ultrasonic module
3. RF module
4. LDR
5. LED
6. Buzzer
7. Push button
8. GPS module
9. GSM modem

1.4 SOFTWARE REQUIREMENTS
1. Keil micro vision (IDE)
2. Compiler

VII. DEFINITION & ABBREVIATION

1.5 Microcontroller (ATMEGA328)
A microcontroller (sometimes abbreviated µC, uC or MCU) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

1.6 Ultrasonic Sensor
Ultrasonic sensor provides a very low-cost and easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects. Naturally, robotics applications are very popular but you'll also find this product to be useful in security systems or as an infrared replacement if so desired.

1.7 RF Module
An RF Module is a small electronic circuit which is used to receive, transmit or transceiver radio waves on one of a number of carrier frequencies.

1.8 LDR
A photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photo conductivity.

1.9 LED
A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons.

1.10 Buzzer
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.

1.11 Resistors
A resistor is a two-terminal electronic component designed to oppose an electric current by producing a voltage drop between its terminals in proportion to the current, that is, in accordance with Ohm's law: $V = IR$.

1.12 Push Buttons
A push-button (also spelled pushbutton) or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed.

1.13 GPS Module
New improved GPS Module with built-in antenna and memory back-up for OEM and hobbyists projects. This unit features low power consumption, high sensitivity. The unit is ideal for navigation systems, distance measurements, vehicle monitoring and recording, boating direction and location, together with hiking and cross country exploring.

1.14 GSM Modem
A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

1.15 Keil Micro Vision (IDE)
Keil an ARM Company makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, evaluation boards, and emulator's for ARM7/ARM9/Cortex-M3, XC16x/C16x/ST10, 251, and 8051 MCU families. Keil development tools for the 8051 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development. When starting a new system, simply select the microcontroller you use from the Device Database and the µVision IDE sets all compiler, assembler, linker, and memory options for you.

1.16 COMPILER
Compilers are programs used to convert a High Level Language to object code. Desktop compilers produce an output object code for the underlying microprocessor, but not for other microprocessors.

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VIII.   FUTURE SCOPE

The system can be supplemented with actual GPS MODULE used in cars and we can provide a vibrator for the partially deaf person.

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