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Research paper

Navigation and Obstacle Detection for Visually Impaired Individuals Using RFID and Supersonic Sensor

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Abstract

This work represents the implementation and architecture of a system that helps the visually impaired people (VIPs) to navigate to their desired location. The system is designed with RFID tag and voice communication along with obstacle avoidance for the purpose of guiding visually impaired people. The visually impaired people issues the command through a Braille keypad (supermarkets, medicals, hospitals and stores) and receives the direction response by using a RFID tag as an audio message. Supersonic sensor is used to detect an obstacle to avoid collision in their surroundings by sending an audio message. ZigBee protocol is also used to intimate the VIPs about the traffic signals in order to avoid accidents. With the advancement in voice communication it becomes easier to issue commands regarding directions to the visually impaired people. In future it can be implemented with GPS for long distance navigation.

Keywords: *Blind, voice control, navigation assistance for visually impaired people, way finding, RFID, ultrasonic sensor, Zigbee*

1. Introduction

Blind mobility is one of the main challenges encountered by visually impaired people in their daily lives. The work of the blind people and their other activities are greatly restricted by loss of eyesight. According to the World Health Organization in 2014, a total of 285 million people were estimated to be visually impaired, out of these there are about 39 million people were visually blind and 246 million have low vision [1]. Traditionally (VIPs) used to travel by having a trained dogs with them which is used to travel them effectively. But they are expensive and useful only for 5 years. But it was estimated that only 1% of 2million VIPs have guide dogs.

In recent technologies such as GPS is used. It is designed in such a way that it is able to calculate latitude and longitude which will determines the direction to them earth with an accuracy of within 10 meters.Recently, voice navigations systems such as Google maps, have become virtually ubiquitous. In this user has to look at the screen of the smart phone repeatedly because it shows map and text on the screen. But at some point it may even result in collision. To overcome this problem, voice navigation method is studied [2] which makes the user to walk freely. White canes are most widely used because they are inexpensive, light weight and small and used in finding of objects on even and uneven surfaces.

Another real-time technology developed to alert visually impaired user by the presence of static / dynamic obstacles in a few meters surrounding, which works without depending on any Smartphone, uses camera for background motion detection. This system is robust to complex camera and background motion and does not required any prior knowledge about the obstacle size, shape or position. This camera based image processing system can be a better option but it requires lot processing power and hence system becomes bulky, costly and it must be transportable [3].

Based on the already proposed works and on the specific needs of the local blind community we decided to develop a new low cost tool, portable, user friendly which helps them to navigate freely in the surrounding. The guidance mode is done using RFID tag which is arranged on the environment, linked as nodes.

1.1. Contribution

People who become blind due to some disease or by nature they think how to get back their eyesight. Because of that Braille was an invention which happens of the same kind, later called as Braille dots. The blind person learnt [4] how to read computer screens and papers by using touch technique. But by using with finger technique they feel difficult to use it. To overcome that problem a technology is used named as Braille capacitive touch keypad, where some places are predefined in it. According to the command of the user through the Braille keypad along with RFID tag to determine their location. A ZigBee protocol is also used to indicate a traffic signal and it will intimate them by giving a voice command when they are moving on the road sides.

This work mainly focuses on the problem of navigation and collision avoidance. But obstacle avoidance is classified into 2types such as human generated and nature generated[4-8].

2. System Architecture

The proposed system works as follows: It is operated by the microcontroller that is accountable for the interaction between the user and therefore the device. RFID is connected to the walking stick and therefore the RFID tag area unit put in on all the areas that required to be known. These tags can function a landmark to the person exploitation the cane. Each tag are going to be equipped with

the maximum amount info as got to clearly outline the placement of that precise tag. The tag also will incorporate further info regarding direction and placement of alternative sensitive location. The tag are going to be lined by a protecting defend to stay it safe from any damage. The cane employed in this technique is that the one presently offered in its specific market which is usually employed by the visually impaired person. The microcontroller can for good checks if there's any command that is given by the user through the Braille input device and method it
parallel in determinative the placement through RFID tag which can facilitate the visually impaired individuals wherever they need to travel and it permits the user to find obstacle on the bottom like holes, steps, walls that interfere within the path through Associate in Nursing unbearable device. The instruction that has been processed is send through the voice playback to the earpiece to intimate the person. A ZigBee is additionally enforced to point the traffic light and it'll intimate them by giving a voice command once they area unit moving on the road sides shown in fig 1.

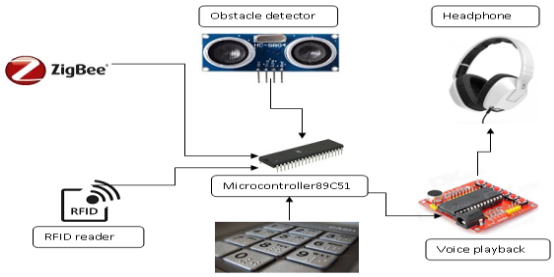

Fig1: Basic block diagram

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89c51 microcontroller

The AT89C51 may be a low-power, superior CMOS 8–bit digital computer with four Kbytes of Flash programmable and eradicable browse solely memory (PEROM). The device is factory made victimization Atmel's high density non-volatile memory technology and is compatible with trade customary MCS-51 instruction set and pin out shown in fig 2.
By combining a versatile 8-bit CPU with a flash on a monolithic chip, Atmel AT89c51 is a powerful microcontroller, which provides a high flexible and cost effective solution to many embedded control applications.

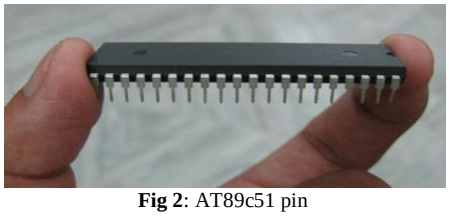

Fig 2: AT89c51 pin

Features:
4Kbytes of flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry.

Ultrasonic sensor

The HC-SR04 is a long range ultrasonic sensor module for measuring the distance or we can also use it for detecting the objects. The range of the ultrasonic sensor is around 2cm to 400cm. The sensor module has an ultrasonic transmitter and receiver. Ultrasonic sensor working principle is similar to bats and dolphins shown in fig 3.
Ultrasonic sensors are almost completely insensitive to interfering factors (such as extraneous light, dust, smoke, mist, vapor, lint, oily air, etc.). They are best suited for the detection of transparent and dark objects, reflective surfaces, shiny objects and of bulk materials and liquids.

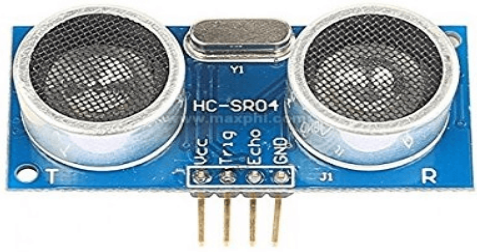

Fig 3: Ultrasonic Sensor

As we know the ultrasound signal travels to the object and bounce back so the travel path as well as time will be double. So to get the exact calculation we use this formula.

$$\text{Distance} = \frac{\text{Speed} * \text{Time}}{2} \quad (1)$$

Braille Keypad

It is a helpful technology that permits blind or other visually impaired folks to do their common tasks much easier than the manual keypad which is harder and require

Fig 4: Braille keypad

more time for recognition. It will facilitate the user to input his/her detail as needed and guide blind of us in navigation and finding obstacles in their path shown in fig 4.

RFID Technology

Radio Frequency Identification (RFID) is the use of radio frequency electromagnetic fields through wireless to transfer data from the tag of an object for system identification and tracking. The tag contains electronic stored information that can be identified from some meters away. The radio frequency identification is more used in the canes for the blind people as it is unaffected by poor lighting conditions or any other constraints that impede the performance of other systems. The use of the RFID system became widespread as it offers its users a wide range of products depending on whether it

includes a battery or not, which will give the canes users or not, which will give the canes users best meets their needs.

Zigbee Technology

ZigBee is a specification protocol to suite high level communication with ultra Low power Digital radio signals IEEE 802 standard. The technology involved in Zigbee is simpler and intended for lesser cost compared to WPANs, such as Bluetooth. ZigBee is a IEEE 802.15. wireless mesh network standard. The technology can be widely deployed in all types wireless control & monitoring applications because of its Low cost and easiness. It is Low Power usage device with high distance and hence finds its application in Networks where Longer Battery Life is required. 802.15.4 – ZigBee Physical Layer shown in fig 5.

Fig 5: ZigBee protocol

Features:

Support for multiple network topologies such as point-to-multipoint, point-to-point, and mesh networks, provides long battery life, Low duty cycle –Low latency.

3. Software

Keil Microvision 2.0

The µVision IDE combines project management, run-time, atmosphere, build facilities, ASCII text file writing and program debugging in a very single powerful atmosphere. µVision is easy to use and accelerates our embedded code development. µVision supports multiple screens and permits you to make individual window layouts anyplace on the visual surface. The µVision program provides one atmosphere within you'll check, verify and optimize your application code shown in fig 6.

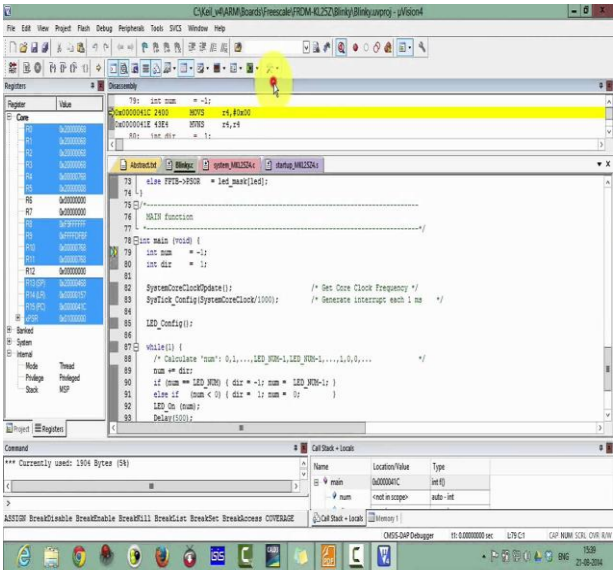

Fig 6: Keil µVision Software

4. Result and Conclusion

In this system, user had a contact of 8 RFID out of these only 2 tags were falsely identified due to false hearing by the user. A success rate was 94.55% for RFID navigation and 97.8% to perception of obstacle.

Helping blind folks to steer associate freelance life is that the main motivation of this analysis. This system shows an honest ends up in sleuthing locations and obstacle for them which ends in human activity with them in with them in an exceeding clear and operative method. Less coaching time is needed to use this technique. The technology that is used in this makes the visually impaired person to measure a practical life ignoring the actual fact of vision defect in him/her. The solution developed during this system could be a low price and user friendly navigation for VIPs. In future it may be enforced with an alarm for low power and GPS based mostly bus info module.

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