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Evolution of Electronic Aid for Navigation

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ABSTRACT
Evolution of technology has always been endeavored with making daily life simple. With a fast paced life everybody today is harnessing the benefits of technology except some parts of the society .One of them is the visually impaired who have to rely on others for travelling and other activities. The paper aims at providing one such theoretical model which incorporates the latest technologies to provide efficient and smart electronic aid to the visual impaired. The basic objective of the electronic aid is to provide a convenient and easy navigation aid for visual impaired which helps in artificial vision by providing information about the environmental scenario of static and dynamic objects around them. IR sensors can be used along with ultrasonic range finder circuit for hurdle detection. Bluetooth module along with GPS technology and an Android application for blind will provide voice assistance to desired location and in panic situations will send SMS alert to registered mobile number.

KEYWORDS: *Navigation aid, blind, visual impaired*

I. INTRODUCTION

According to a survey done by WHO (World Health Organization) on August, 2017 the percentage of visually impaired in this whole universe is approximately 13.68% [1]. Normal white long cane is used by visual impaired for navigation. But without a physical touch between the object and the cane, visual impaired remains unaware about the object's presence. Besides, cracks or holes and high surfaces remain undetected and he hurt himself by those. Hence a smart cane need to be designed which will be more reliable, self-reliant and easy to implement. At the same time, the module needs to be cost efficient system to detect both static and dynamic objects [3] because 90% of blind people comes from underdeveloped side of this world [4] and can't afford a very high cost technology.

At present most of the commercial solutions for autonomous navigation system is Global Position System (GPS). As a routine, GPS is not very accurate and precise. Moreover, a risk of signal loss and limitations faced in reception of satellite signals restrain the practical implementation of GPS based system [5], [6]. So for implementing a risk free and instant functioning device, a high frequency sound wave can be triggered to detect objects. So to transmit a sound wave and also to receive the reflected sound signal from any object, ultrasonic sensors can be used [3]. Sonar sensors have special feature of neglecting object's color, transparency and shape or surface texture while detection process.

II. Literature survey

In this paper [1], The simple navigation stick was equipped with sensors to give information about the obstacles in the vicinity of navigation. GPS technology integrated with pre-programmed locations allows the user to choose the optimal route to be taken. In the system, ultrasonic sensor, pit sensor, water sensor, GPS receiver, level converter, driver, vibrator, voice synthesizer, keypad, speaker or headphone, PIC16F877A microcontroller and battery were used. The proposed system intended to provide low cost and efficient navigation aid for the blind which gives a sense of artificial vision by providing information about the environmental scenario of objects around them while providing real-time assistance via GPS. The performance of the prototype developed was evaluated with four obstacle scenario which are: Concrete wall, Human body, Cardboard box, and Plastic. The proposed solution was a moderate budget navigational aid for the visually impaired. As far as localization is concerned, it will be able to provide accurate details of the location of the blind in case they get lost via the GPS. The developed prototype gave good results in detecting obstacles placed at a distance in front of the user. Obstacles and pit can be determined easily by sensor readings. The cost effectiveness of the proposed solution leads to compromise in performance. One of the drawbacks of their proposed method is that the capability of the prototype is limited as a visually impaired person can travel only to four locations using the stick. Also, the navigation system will need to convey information other than that needed for guidance, and it is not feasible to provide guidance information at high intermittencies. It did not provide the functionality for voice control using speech recognition. Other improvements that could have improved the proposed system include: Increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. Synchronization with external memory to increase the number of routes stored. Synchronization with various navigation software applications available on the internet so that new, un-programmed destinations can also be chosen. Integration of a GSM module for safety purposes.

In this paper [2], Electronic aid is embedded with infrared, ultrasonic and water sensors. It also used GPS and GSM module. GPS to give positioning and navigation to the stick. GSM module helps to give notifications when the visual impaired is facing the threats. The system is powered by a rechargeable battery. The hardware implemented on their proposed system consists of the Pair of ultrasonic sensors, Infrared sensor, Water sensor, GPS module, GSM/GPRS module, and Arduino Uno microcontroller board (ATmega328P). The smart stick facilitates the blind person to make calls at times of emergency via the GSM/GPRS module. The GPS module also helps to trace the blind person through the data collected by it. It alerts the visual impaired

through beep sound whose intensity increases as the person nears the obstacle which aid him to move aside of the obstacle. Also, when obstacles are detected, it invokes the right speech warning message through a Bluetooth earphone. The use of a rechargeable battery in the system also ensures longer time usage. The system can also detect obstructions that are hidden such as downward stairs, holes etc. The drawback of this proposed stick was that it was difficult to keep because it was not designed to be foldable.

In this paper [3], Smart Walking Stick which is an Electronic Approach to Assist Visually Disabled Persons. Their device is a microcontroller based automated hardware that can assist a blind to detect obstacles in front of him/her promptly. The hardware consists of a microcontroller PIC16F690 incorporated with ping sonar sensor, proximity sensor, wet detector, a GH311 Ultrasonic obstacle sensor, a micro pager motor and additional equipment. The simplicity of the proposed design makes it easy to use by any person and at the same time the cost of manufacturing such sticks is kept low. The power consumption of the proposed stick is low and can be operated easily. It is also very cost effective compared to the conventional ones. Obstacle can be determined easily by sensor readings. The design has an added vibratory feedback mechanism necessary for creating vibratory signal for multiple disable persons to get precise information from the output. Also, the microcontroller can be code-protected so that its security cannot be overridden except by the user or vendor. Wet, muddy or possibly slippery terrain can be detected by a pair of electrodes. Apart from others blind guidance systems; it has a fingernail controller. This provides mechanical advantage beyond anyone's imagination. Running this integrated set of hardware requires an alternative to the battery. The use of solar panels for instance, will be more advantageous in order to get recharged. The proposed stick is not bendable therefore keeping it might be challenging. This cost effective and light weight device can be designed to take the pattern of a plastic and portable device which can be completely fixed on the familiar white cane or blind stick.

In this paper [4], The Voice Enabled Smart Walking Stick for Visually Impaired persons was proposed. Their proposed system consists of a simple walking stick equipped with ultrasonic sensors to give information about the environment such as object detection, pit sensing and water sensing. GPS technology is integrated with pre programmed locations to determine the optimal route that the visual impaired should navigate. Also, a voice enabled equipment switching is provided to help the blind person in private domain. The proposed system used two ultrasonic detectors which are Pit sensor and Water sensor; GPS receiver, GSM module, Voice synthesizer, ATmega328/P microcontroller, relay, speaker and battery. The GSM module and relay are for the purpose of switching on the equipment. It helps in transferring the information about the needed operation to be performed on the equipment and generates the resultant switching action. The central merit of this system is that it helps the blind people in both inside and outside, care-free navigation. The GPS based blind device with user input interface signals the blind person when he/she reaches the destination by voice. The integration of room equipment switching along with this system makes it even more useful, thus making it suitable for both indoor and outdoor environment. The smart stick not only aids in detecting obstructions placed at a distance in front of the user, but also provides real time assistance via GPS. The information regarding barriers is given through voice alerts that nullify the problem of understanding vibration patterns which was used in previous systems.

Their system is a reasonable budget navigational aid for the visually impaired. The cost effectiveness of the proposed solution leads to compromises in performance. Some improvements that could be made are as follows: Increasing the range of the ultrasonic sensor, and implementing a technology to determine the speed of the approaching obstacle. Also, running this integrated set of hardware requires an alternative to the battery. It should also accommodate wide varying grips for flexible handling. Their proposed combination of various working units makes a real-time system that monitors position of the user and provides dual feedback making navigation more safe and secure.

In this paper [5], Smart White Cane which is a sophisticated and economic travel aid, is designed to detect obstacles which may help the visual imapired to navigate carefree. Their device is made up of components such as ATMega328PU microcontroller, 4 HC-SR04 Ultrasonic Sensor Modules, Sound IC-APR33a3, Vibration Motor, headphones, battery and audio feedback. In this method alerts are provided by pre-recorded sound messages and a haptic feedback in form of vibrations. The cane can detect pits, potholes, downfalls, staircase (up and down), low lying and knee level obstacles and even those above the waist. The system is a moderate budget navigational aid for the visually impaired. The entire circuitry along with the battery cubicle is hidden within the stick thereby decreasing the risk of damage to the circuit and making the device less bulky. The system provides ON/OFF switch, vibration feedback and the audio jack on the handle itself. The system does not have a global positioning method to find the position of' the user using the GPS and guidance to their destination given to the user by voice navigation. The drawback of this cane was, it does not detect oncoming vehicle, slippery floor, and there is no fire or smoke alarm. The idea behind the design of the cane was to keep it structurally similar i.e. thin, lightweight and easy to handle, yet give an active feedback to the user regarding hazards in his walking path.

In this paper [6], An Intelligent Walking Stick for the visual impaired was proposed. The proposed navigation device for the visually impaired is focused on providing voice output for obstacle navigation using infrared sensors, RFID technology, and android devices. The device has proximity infrared sensors; RFID tags are installed into public building and also integrated into visual impaired navigation cane. The device is connected to an android phone through Bluetooth. An android application is designed which gives voice navigation based on RFID tag read and also updates person's location information on the server. Another application is designed for family members to access the blind person's location through the server whenever needed. The components of the system are: AT89C51 microcontroller, Bluetooth HC05, MAX232, ADC 0808 and IR sensors, RFID sensor, Android phone, Server and Android application. The system can be used both indoor and outdoor navigation. Blind person's location can be tracked whenever needed which will ensure additional safety. Their approach have the ability to detect obstacles and alerts the blind person

through vibration alert and speech output. The drawback of this approach was that it is not compact.

In this paper [7], Smart Electronic cane for Visually Impaired, the system was intended to provide artificial vision, object detection and emergency messaging facility. Ultrasonic sensors calculate the distance of the obstacles around the blind person to guide the user towards the available path. Output is in the form of beeps which the blind person can hear. GPS and GSM are used to acquire the exact location of the blind person at times of emergency and send the co-ordinates to registered mobile number. The hardware consists of Arduino mega board ATmega2560, ultrasonic sensor, Infrared sensor, GPS, GSM, Keypad and two speakers. The sensors used in the stick proposed are highly accurate and sensitive. They provide exact readings of obstacles and distance to be travelled. The GPS and GSM modules provides the location of the patient and thus help the patient in time of need by sending an emergency messaging. The speaker helps in human-machine interface by sending the signals to the patient about obstacles and route to be travelled.

III. Objective

To design and implement low cost, portable and detachable electronic travel aid for independent and safe navigation of visual impaired.

IV. Methodology

The sensors are arranged on waist belt to identify obstacles above knee height and sensors placed on cane detect the obstacles below knee height which assures safe and independent navigation for visual impaired.

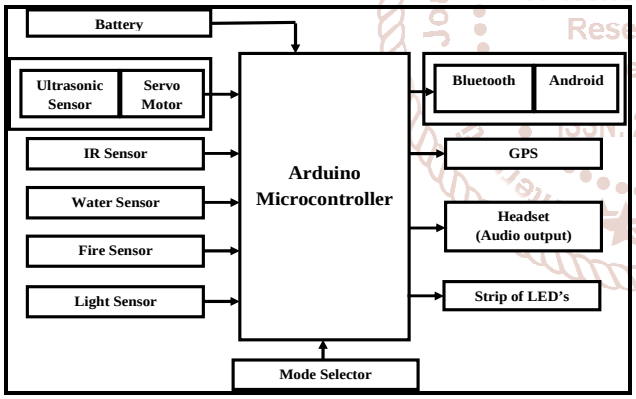

Fig. 1 Block diagram of proposed model

The above Fig.1 represents block diagram of the proposed concept. The unit can be operated in two modes. Mode 1 is Indoor mode and Mode 2 is Outdoor mode.

In Indoor mode the cane is not essential the user can navigate only using the belt tied at the waist which produces audio alert if the user gets any obstacle in his way.

In outdoor mode unit acquires input about obstacles from all four directions using ultrasonic sensor tied on the waist belt and guides the visual impaired to navigate in required direction safely. During the move, if any obstacle is approaching or vice-versa it provides audio alerts indicating from which direction the obstacle is addressing.

The navigating aid is embedded with various sensors such as; moisture sensor to detect the presence of water, IR sensor to detect the pits, LDR sensor to detect the ambience of light, flame sensor to detect the presence of fire in the travel path. To alert the surrounding pedestrians about presence of visual impaired in the vicinity an LCD is attached on the rear end of the visual impaired wherein a message is displayed "I AM BLIND".

If visual impaired person has forgotten where he had rested it last it can be found by pressing a remote button which sounds a buzzer and helps to find it.

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