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AN INTELLIGENT WALKING AND FINDING STICK FOR VISUALLY CHALLENGED PEOPLE WITH POT HOLE MONITORING SYSTEM

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ABSTRACT:

In this high-tech era, technology has made it possible that everyone can live a comfortable life. But somehow the physically challenged people need to depend upon others in their daily life which ultimately makes them less confident in an unfamiliar environment. But nowadays the explosion of innovative technology provides many opportunities for them to live confidently without feeling as a burden. The number of visually impaired people is increasing with the rapid growth of population. The visually impaired people face much difficulties in their daily living owing to losing their vision. Path hole is a major hindrance to their walking. So path hole detection has become a prominent issue to aid the visually impaired people. We proposed a solution by detecting path hole on the road surfaces using Convolution Neural Network. The proposed system is able to classify the road surfaces with path hole and non-path hole. So, in this paper, an intelligent device is represented for visually challenged people to guide them to reach their destination place safely without facing any difficulties 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 they travel to an unfamiliar location. Only few of the navigation systems available for visually impaired people can provide dynamic navigation through speech output. None of these systems work perfectly for both indoor and outdoor applications. In this paper, we propose a navigation device for the visually impaired which is focused on providing voice output for obstacle prevention and navigation using infrared sensors

KEYWORDS: ULTRASONIC SENSOR, ARDUINO, WATER LEVEL SENSOR, VISUALLY IMPAIRED PERSON, ALARM SYSTEM

INTRODUCTION

A Recent statistics from WHO shows that about 285 million people in the world are approximated to be visually impaired. Among them 39 are blind and 246 million have a slight vision [1]. Generally, the people over 60 years old have more risks of blindness and the number is rising by 2000 thousand per decade. An estimation shows that the number of blinds may be doubled in 2020 [2]. Blindness is the condition of lacking discernment because of physiological or neurological components. It is an interruption to some day-to-day events and there is a lack of sufficient assisting tools [3]. It is a standout amongst the most extreme sorts of handicaps a man must persevere through and, in spite of various progressions in innovation, it remains a significant issue till now [4]. The development of walking assistants has become a challenging issue and the necessity of the assistance devices is still now endless. However, there are many navigation tools and frameworks accessible for the blinds. The most significant devices are the dog guides and white cane. Though they are very famous, they are limited to speediness, coverage, and capacity which are normally accessible to persons having eyes for navigation [5]. Walking assistants [6] were acquainted with taking care of the day to day issues associated with navigation and location aids since 1960s. The assistants aid the visually impaired people by detecting and locating the obstacles around them using the sensors that take the sense from the exterior situation [6]. Though a number of researches have been demonstrated, almost all of the researches are not able to classify the road surfaces

with path hole and non-path hole. To aid the visually impaired people, previously we have proposed few approaches as shown in [7], [8]. However, these approaches are able to detect the obstacles in front of the visually impaired people. These tools are sensor based and are able to detect the obstacles and generate an alarm signal to notify the users but can't detect any holes on the road surface. There is a suggestion from orientation and mobility experts that there is an absence of tools to distinguish path hole and uneven asphalts which restrains safe mobility. From this motive, we propose a strategy to detect the path hole from the input images. Deep Learning approach has been used to classify the road surfaces with path hole or not. Vision is a precious gift from God that one can able to see and enjoy this beautiful world. But many people throughout the world are deprived of this. According to October 2017 report of World Health Organization (WHO) an estimated 253 million people live with vision impairment: 36 million are blind and 217 million have moderate to severe vision impairment. Un-operated cataract is the main reason for blindness in low income and developing countries [9]. So, in this case most of the visually challenged people cannot afford an expensive device to use as their supporter. So, in this paper we have proposed a cost-effective intelligent device. This device mainly consists of a walking stick and an APP. The walking stick is based on the integration of sensors which helps to detect obstacles in their path. A GPS module is also used to know the location of the blind person. For this, an APP is created, which makes them feel safe and secure because it helps in navigation as well as the relatives of blind person can also able to track their real-time location. Also in an emergency condition the blind person can contact his guardians immediately. In early days the blind persons used trained dog to guide their path which is costly as well as not so efficient. Again the traditional white cane is only able to detect objects by touch, so it has also limitations to get less time to react the situation after detecting an obstacle [8]. There are many other mobility aids known as electronic travel aids (ETAs) in the market. But most of the commercial ETAs are expensive and lack of accuracy. Visually impaired people are the people who finds it difficult to recognize the smallest detail with healthy eyes. Those who have the visual acuteness of 6/60 or the horizontal range of the visual field with both eyes open have less than or equal to 20 degrees. These people are regarded as blind. A survey by WHO (World Health Organization) carried out in 2011 estimates that in the world, about 1% of the human population is visually impaired (about 70 million people) and amongst them, about 10% are fully blind (about 7 million people) and 90% (about 63 million people) with low vision according to [1]. The main problem with blind people is how to navigate their way to wherever they want to go. Such people need assistance from others with good eyesight. As described by WHO, 10% of the visually impaired have no functional eyesight at all to help them move around without assistance and safely. The figure 1 below is a chart showing the percent of blind people across the globe. This study proposes a new technique for designing a smart stick to help visually impaired people that will provide them navigation. The conventional and archaic navigation aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs which are characterized by a many imperfections. The most critical shortcomings of these aids include: essential skills and training phase, range of motion, and very insignificant information communicated been communicated. Our approach modified this cane with some electronics components and sensors, the electronic aiding devices are designed to solve such issues. The ultrasonic sensors, water sensor, buzzer, and RF transmitter/Receiver are used to record information about the presence of obstacles on the road. Ultrasonic sensor have the capacity to detect any obstacle within the distance range of 2cm-450cm. Therefore whenever there is an obstacle in this range it will alert the user. Water sensor is used to detect if there is water in path of the user. Most blind guidance systems use ultrasound because of its immunity to the environmental noise. With the rapid advances of modern technology both in hardware and software it has become easier to provide intelligent navigation system to the visually impaired.

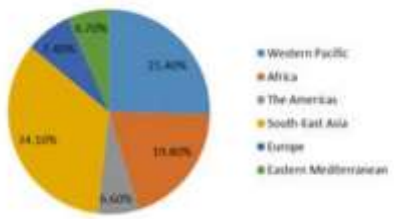

Fig: A Pie Chart Showing Blind People Across the World

Recently, much research effort have been focused on the design of Electronic Travel Aids (ETA) to aid the successful and free navigation of the blind. Also, high-end technological solutions have been introduced recently to help blind persons navigate independently. Another reason why ultrasonic is prevalent is that the technology is reasonably cheap. Moreover, ultrasound emitters and detectors are portable components that can be carried without the need for complex circuit. RF module will help the person to find the stick wherever it is placed. Whenever the user wants to locate it, such a person will press a button on remote control and buzzer will ring, then the person can get the idea of where the stick is placed. 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 70 million people in the world living with visual impairment, 7 million of which are blind and 63 million with low vision. The conventional and oldest mobility aids for persons with visual impairments are characterized with many limitations. Some inventions also require a separate power supply or navigator which makes the user carry it in a bag every time they travel outdoor. These bulky designs will definitely make the user to be exhausted. The objectives of this research work include: to design an assistive technology for visually impaired people that can detect obstacles and provides alternative routes for the blind; to alarm the user through vibration to determine the obstacles direction sources; and to help the user find his stick when he cannot remember where is was kept. Several attempts have been made to design guard or obstacle avoidance devices for the blind using components with limited number of applications. This section will discuss some of these attempts and their shortcomings. For instance; [2] proposed a Smart Walking Stick for Visually Impaired. The proposed method is a simple walking stick equipped with sensors to give information about the environment. 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 source code for the PIC microcontroller was developed with MPLAB software. 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 whilst 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 is 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 compromises 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.

IMPLEMENTATION:

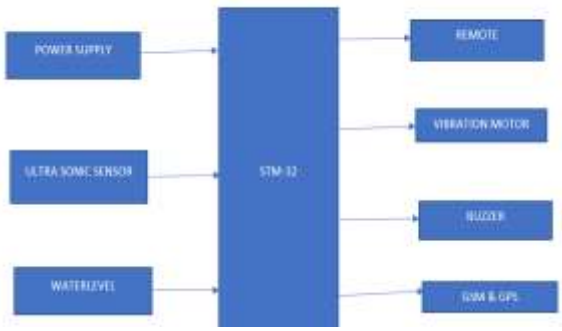

Fig: Block Diagram of walking stick for Blind People

WORK:

Several assistants are developed to guide the visually impaired people for easy walking. Many organizations have been working for a long time to make cost-effective and wellorganized tools for them. The work associated with this field is outlined briefly as follows.

- Rao et al. [9] proposed a computer vision based pothole detection system for the visually impaired people that is helpful in their safe mobility. The scheme records the pattern and extract the features from the pattern and give the proper way of waking by analyzing the features. The data was collected by a camera with a laser. The system detects the pothole with 90% accuracy. The system worked in the realtime environment. The major limitation of the system is that it is only appropriate for the dark environment as the laser patterns are visible only in dark.
- Madli et al. [10] presented an automatic pothole and humps detection system for autonomous vehicles. The presented system used a global positioning system to take the geographical position coordinates of the potholes and humps which includes the depth and height of the potholes and humps. The data that are sensed are stored in a cloud database. For a particular location, the data of the road remain stored in a database. When tracking on the road, an alert signal with the depth and height of the potholes and humps are sent to the driver using an android application. The ultrasonic sensors are used to collect data but the sensors readings are changed with the variation of temperature and humidity which misguide the vehicles.
- Harikrishnan et al. [11] introduced a road monitoring system that is able to detect the pothole and humps on the road surface and predict their harshness from vibration signal generated by vehicles. The smartphone accelerometer is used to capture vehicle vibration along z-axis and the pothole or humps are detected using x-z ratio filtering. The system also estimated the depth and height of the potholes and humps respectively. The system is able to detect the pothole and hump but can't detect Expansion joints, Manhole and Pipeline holes etc.
- The authors in [12] evaluated the performance of pothole detection system with an image classification modality using deep convolutional neural networks. The system is evaluated in terms of grayscale and color image. The system used 3028 images for training and 159 images for testing with 5000 iterations. The experimental results show that the classification accuracy obtained by the system is 96.5~97.5%. The system used some deep learning toolbox which is not best practice to evaluate the performance of a system.
- Zhou et al. [13] developed a smart system named as "Smart Eye" to help the visually impaired people by informing them about the surroundings. The system has two module such as the embedded wearable sensor and smartphone module. The wearable sensor module consists of power (9-V dc battery), CPU (32-b mbed NXP LPC1768), sensor (Ultrasonic Sensor, Motion Sensor) and communication (Bluetooth or Wi-Fi chip) parts. An android application is developed to provide the distance warning to the user that is returned by ultrasonic sensor. The communication between embedded module and smartphone is done by Bluetooth or Wifi. The developed application is vigorous and detects the obstacles about 10 feet away.
- O'Brien et al. [14] discussed a cost-effective electronic tool integrated with a conventional cane that provides an alarming signal by detecting the obstacles. A custom-built printed circuit board integrated with a microcontroller drove the sensor and motor. The weight is approximately 110g including battery. The system calculated the distance when notifying the obstacles. If the calculated distance is between 0.2-0.6m, and an alarm signal is generated and if the distance is within 0.6-1m, then another signal is generated. If there are no obstacles within 0.2-1m, the system searched for another obstacle. So, we can conclude that the system can detect the obstacles within 1m range. Kaushalya et al. [15] developed

walking assistants named as "AKSHI" to aid the visually impaired people using Raspberry Pi 2, Ultrasonic sensor, GSM module, RFID reader, and tags. The system is able to detect the obstacles as well as locate them with lesser cost. The RFID reader is attached with the bottom part of the stick that can detect the obstacles though RFID tag. The Ultrasonic sensor is placed below the circuit box on the track of 450 angles. Another box including Raspberry Pi, GSM, and GPS Modules are attached with the stick. A mobile application is also developed to keep the track of the user location using GSM, GPS Modules. The system is not compatible with offline connection.

- Bhatlawande et al. [16] proposed an electronic mobility cane for the visually impaired people for way-finding as well as obstacle detection. The system develops a logical map of the surroundings and keeps them on priority basis. It provides the priority information to the users using feedback signals like voice, vibration or audio. It is also able to detect the staircase and floor status. The system comprised of embedded system with ultrasonic sensors, liquid, and metal detection sensor, wireless transceivers, battery and microcontroller circuits. The system is able to collect and categorize the information of surroundings. The system is tested with few number of realworld trials.
- Bai et al. [17] developed a smart guiding tool look like as eyeglass to aid the visually impaired people to move safely. The system comprises of pair of display glass and some developed sensors which are cost effective that was tested by several people. The system worked in indoor environment only. The developed system contains a depth camera to gather information from surroundings, ultrasonic sensor and microprogrammed control unit used for obstacle distance measuring, a CPU for image processing, and sound analysis etc. Audio instructions are provided as feedback with the presence of obstacles. The system is tested in home, office and supermarket environment. The proposed glass is more efficient and very supportive for the eye insight people in indoor environment.
- Vera et al. [18] proposed a framework named as "Blind Guide" for the visually impaired people to navigate them in interior and exterior environment using wireless sensor networks. The system combined with various wireless sensors which can be utilized in various portions of the body. The sensor is able to detect the obstacle as well as give an audio signal as a feedback. The hardware component used in the scheme are the peripheral sensor, ultrasonic sensor, Wi-Fi microcontroller, a central device including camera module, raspberry pi, and a speaker. An audio signal is sent to the central device when the object is detected. After that, the central device capture an image of the object with the help of camera module and the image is sent to the cloud image recognition service. The system is able to identify chairs, tables, doors, walls and ordinary objects in the interior environment and avoid the common obstacles in the exterior environment.

CONCLUSION & FUTURE WORK

In this paper we proposed an intelligent system comprising a walking stick and APP for visually challenged people to make them comfortable in their daily life. From the experimental results, it is observed that the system is capable of delivering the nearly exact distance measurement and can avoid collision accurately. The created APP is useful to reach the user's destination place safely and independently and also to track their location by their parents. Mostly to reduce cost and complexity, we have tried to use less electronic components in the project, thus it is quite lighter in weight and also affordable. So, it is easy to carry and use by the user. Consequently we want to collect data from surrounding environment and data analysis will be done based on neural network learning algorithms to predict any dangerous situation encountered by the blind person so that it can be avoided in time by taking the correct decision.

REFERENCES

[1] Johann Borenstein and Iwan Ulrich, "The Guide Cane-A Computerized Travel Aid for the Active Guidance of Blind Pedestrians," IEEE International Conference on Robotics and Automation, Albuquerque, NM, Apr. 21-27, 1997.

[2] Zul Azizi Hailani, Sakinah Jamaludin, "An Electronically Guided Walking Stick for The Blind," 2001 Proceedings of the 23rd Annual EMBS International Conference, October 25-28, Istanbul, Turkey

[3] Susumu Tachi, Kazuo Tanie, Kiyoshi Komoriya, Minoru Abe, "Electrocutaneous Communication in A Guide Dog Robot (Meldog),",IEEE Transactions on Biomediacal Engineering, 7 July 1985.

[4] Sung Jae Kang, Young Ho, Kim, In Hyuk Moon, "Development Of An Intelligent Guide-Stick For The Blind," IEEE International Conference on Robotics & Automation Seoul, Korea, May 21-26, 2001.

[5] Sudeep Gupta, Ilika Sharma, Aishwarya Tiwari and Gaurav Chitranshi, "Advanced Guide Cane for the Visually Impaired People," 2015 1st International Conference on Next Generation Computing Technologies (NGCT-2015), Dehradun, India, 4-5 September 2015.

[6] Amjed S. Al-Fahoum, Heba B. Al-Hmoud, and Ausaila A. AlFraihat, "A smart infrared microcontroller-based blind guidance system," Act. Passiv. Electron. Comp., Vol. 2013, 2013.

[7] Anushree Harsur, Chitra.M, "Voice Based Navigation System for Blind People Using Ultrasonic Sensor," International Journal on Recent and Innovation Trends in Computing and Communication, Vol. 3, no. 6, pp. 4117-4122, 2015.

[8] R. Bhambare, A. Koul, S. Bilal and S. Pandey, "Smart Vision System for Blind," International Journal of Engineering and Computer Science, vol.3, no. 5, pp. 5790-5795, 2014.

[9] World Health Organization, http://www.who.int/

[10] Raspberry Pi Zero, https://www.raspberrypi.org/

[11] http://aprs.gids.nl/nmea/

[12] http://www.toptechboy.com/arduino/lesson-24-understandinggps-nmea-sentences/