An Artificial Eye for Blind People

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Abstract— The visually challenged people are always trying to lead their life comfortably with their surroundings. However, due to the loss of eyesight, their day-to-day life activities are greatly restricted. So it is necessary to find an easy way to make them familiar with an environment or routes in the world. The conventional walking sticks used by visually challenged people are not efficient for object detection. Those walking sticks are capable of detecting the stuff with which they collide. To overcome that difficulty, the authors developed an electronic assist as an intelligent stick using Raspberry Pi. This proposed stick offers artificial vision, object identification, and real-time GPS guidance for blind people. The proposed device senses an object in its vicinity and delivers voice information, alert signals via earphones, and navigation to a particular location via GPS. The ultimate objective of the intelligent stick is to offer a subtle amount and effective direction finding and obstruction detecting assist for the blind that provides a perception of imitation vision by supplying knowledge about the ecological situation of stationary and lively objects nearby them, allowing them to walk autonomously.

Keywords—Object detection, Navigation, Artificial eye, Audio output

I. INTRODUCTION

Many people who have entirely lost their vision or have, varying degrees of visual impairment are increasing. The World Health Organization estimates that 253 million people have vision impairment, of which 36 million are blind and 217 million have moderate to severe vision impairment. Furthermore, refractive errors cause an estimated 12 million children under the age of 15 to lose partial or complete vision. Approximately 1.4 million children have irreversible blindness, necessitating access to vision rehabilitation services in order to optimize functioning and reduce disability. Independent mobility is required for people with visual impairments to live a fulfilling life [1]. Mobility, on the other hand, can be extremely difficult for blind people due to vision loss. As a result, the quality of life of blind and visually impaired people suffers. Accidents occur, especially when performing mobility-related tasks. In total, 7% of people fell while walking once a month or more. Due to their shortcomings in object recognition above knee level, navigation, and orientation, assistive equipment such as stickand pilot dogs could not avert the collision.

As depicted in Fig. 1, Brambring's journey model indicates that movement is achieved by object awareness and orientation awareness [2]. Visually impaired and blind people use milestone recognition to find their identifiable sites on a route for orientation and navigation.

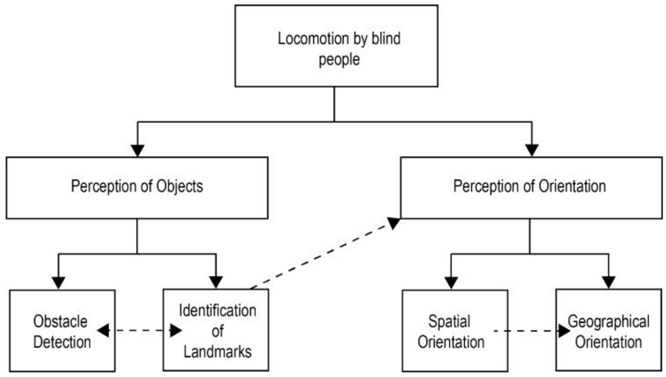

Fig. 1 .Brambring's journey model(Source:Ugulino, Wallace & Fuks, Hugo. 2015)

Since World War II, several technical assistive aids were invented to solve these obstacles and authorize blind and visually damaged folks in their autonomous movement. These instruments, however, are not generally utilized or adopted by the blind community poor user satisfaction, such as user experience, affordable purchasing price, and usability, are barriers to the widespread use of technological mobility aids.

The authors proposed a voice-based, intelligent stickto fulfill the following requirements:

- To help blind people to detect obstacles
- Navigation on roads
- Notify their family members if there is any problem
- Make them know the things in front of them throughearphones or speakers
- Find the location of the stick if they forget wherethey left it
- Assist them in crossing the road without assistance

The remainder of the paper is structured as follows. Section II reviews the literature review, whereas Section III depicts the system model and details the proposed scheme's approach. Section IV discourses the experimental results in a detailed manner. Finally, section V brings the paper to a conclusion.

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II. LITERATURE SURVEY

K. G. Krishnan et al. devised an image recognition method [3] in which a blind individual can receive data regarding the geometry of an image by listening to speech. As more data is encrypted visually, blind persons confront several obstacles when engaging with their surroundings. Visually handicapped people can see with the help of their hearing using the proposed method.

I. Joe Louis Paul et al. fostered a sensible system to help visually damaged individuals in their daily routines [4]. The difficulty of traveling from one location to another without the support of others is one of the challenges. Other efforts include recognizing people, spotting obstructions, and so forth.

N. Loganathan et al. created an intelligent stick to detect the existence of any impediments in their path when going from one point to another, and it is hard to locate the stick's exact location if it is misplaced [5]. By incorporating an ultrasonic sensor, this intelligent stick provides a solution for the blind.

Zubair Khan et al. proposed an algorithm for image perception by sound patterns created by the image [6]. The authors proposed a novel method for creating an audio signature from an image used to visualize it. The visionless individual will be capable to recognize the image after few training sessions.

Manjur Alam suggested a novel way where a blind individual can learn about the contour of an object by listening to spoken sounds [7]. S. Matta et al., proposed a hypothetical system that delivers audio picture depictions as a rough substitute for vision [8]. It can be used by the blind to assist them in navigating. To communicate with the blind, the authors used 2D image processing techniques and the tactile input channel.

The goal of H. Jabnoun et al. is to present a proposed system that recovers the identification of surrounding objects, which is a central function of the visual system [9]. This method utilized the concept of extracting local features. The simulation results utilizing the SFIT algorithm and key point matching indicated that detecting objects was fairly accurate. The author's contribution is to provide the concept of a visual substitution system for recognizing and locating items in images based on feature extraction and matching.

A system for visually challenged people is proposed by B. Deepthi Jain et al. [10]. The suggested system attempts to develop wearable visual assistance for visually impaired people. Its capabilities include the item and signboard identification. This will assist the vision- impaired person in managing daily activities and navigating the environment.

To solve the challenges of travelling, M. R. Miah and M. S. Hussain designed a unique smart glass for visually challenged persons [11]. Using an ultrasonic sensor and a microcontroller, it can identify the obstruction and accurately measure the distance. By combining several sensors with the Raspberry Pi, A. Pardasani et al. created a smart glass and a smart pair of shoes [12].

L. Chen et al. proposed intelligent goggles, an knowledgeable ambulatory stick, a portable gadget application, and an online communication podium for visually impaired people [13].

M. Nassih et al. used RFID to create a blind recognition system employing canes [14]. K. Mona Teja et al. presented a strategy based on the sensation of sound for optically diminished people [15]. The goal of this artefact is to convert the text into speech that can assist even blind persons.

M. Maiti et al. developed a novel intelligent electronic eye that gives blind people with traffic assistance while walking [16]. The progress of routing assistance for blind and optically diminished people done by M. Bousbia et al. [17]. Navigation aid consists of a microprocessor that generates synthetic speech. This device is portable and provides information on walking routes to help the user make decisions.

BlinDar is a clever Electronic Traveling Aid developed by Z. Saquib et al. This keen guided ETA progresses the survival of visionless people. [18]. L. Albraheem created a mobile application for Arabic blind users that uses an Arabic language interface [19].

S. R. Arko et al., developed a model that is a microcomputer-based gadget that can breed various prototypes on its individual, which is the spirit of Industry 4.0 [20]. As a result, this assistive technology will benefit visually impaired persons by imparting them the forms and structures of various characters set.

S. Chinchole and S. Patel demonstrated the stick system, which employs artificial intelligence and multiple sensors in real-time to assist vision-impaired people in independently navigating their environment [21].The system executes three errands: picture identification, crash exposure, and obstruction recognition. The image identification task will be carried out by exploiting an intelligent handset product with artificial intelligence. Ultrasonic sensors are used in crash exposure, and obstruction recognition tasks to inform the handler of obstructions in his path.

The electronic walking stick designed by S. Chaurasia & K. V. N. Kavitha will assist the blind by giving a more convenient way of life [22]. S. Gupta et al. developed an enhanced model stick for assisting optically diminished people in indoor and outdoor environments [23].

S. Tachi et al. discussed the twofold key issues that need to be addressed when building truly operative motion assistance for the visionless people. [24]. M. Varghese et al. combined the established white walking stick with an boundary comprising of an onboard system and ultrasonic sensors to sense obstructions [25]. D. S. Raghuvanshi et al. built a sonar technique-based prototype for obstacle detection and communication [26].

According to the literature review, many advanced ways for supporting blind or visually challenged people are available and there is a space to enhance the research further.

III. EXISTING SYSTEM

Sticks used by Blind persons must tap on the floor as they walk in the current system. If there is any water in front of the person, the cane will not detect it, and the person will walk on it, slipping and falling. Blind people are led around by trained canines that help them understand their environment. Cane affords the aid for the blind. The device is fully controlled with spring concepts with mechanical suspension to spot hitches on the land, boundless surfaces,

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trenches, and moves with changing slopes. People trained to use a cane are obliged to provide training for blind people, which can take many days or even months to learn. Dogs are simply tutored as per the requirements of human beings, so blind person acclimates them to a tutored dog for navigation and other obligations. But it has few threat aspects in terms of dog's approach to diverse environment. Since most of the blind person are old in nature , danger to them are more so security dealings are not up to the level in existing system.

The existing systems are generally having poor reliability, cannot sense all types of environment and not suitable for detecting dangerous obstacles. But the proposed system is designed to be more stable, secure, user friendly, lower cost, efficient navigation, accurate object detection and provides walking support for the blind people or visually diminished people in comfortable manner.

IV. Proposed System

Fig. 2 denotes the block diagram of an artificial eye for the blind. There are two units present one in the walking stick which is the receiver/transmitter unit and the transmitter unit that is placed on the person's hand.

Ultrasonic sensor is used to identify the hitch and to inform the blind person. RF transmitter is fitted to blind person if he miss the stick, then sound is produced by buzzer with switch and RF receiver. In built GSM and GPS combinations are used to send the location of disabled person to friends and family. It also has a special feature called pulse detection which is used to detect the visually challenged persons pulse if it goes high or low.

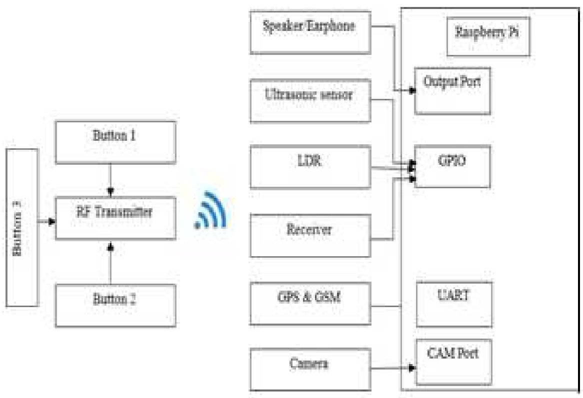

Fig.2. Block diagram of an artificial eye for the blind

Button 1 is used to identify the stick, Button 2 is to navigate the blind person to home and Button 3 is used to send emergency message. Raspberry pi is implanted with Ambulatory cane at, which Ultrasonic sensor is bonded with GPIO terminals of Raspberry pi. The camera is connected with raspberry pi where camera and ultrasonic sensor should appear on the consistent track on the road. It should be linked with Web so that taken image can be treated for target discovery to suggest which thing is a hindrance at this moment. RF transmitter is also connected with Raspberry Pi. Each command is communicated by pressing the button on the Radio Frequency aerial which is detained by them.

Fig. 3 is the flowchart of the artificial eye, describes clearly the operation and working of this proposed system. Procedure given in flowchart is discussed below for easy understanding.

Stage 1: Start

Stage 2: Examine the GPIO terminals

Stage 3: If terminal 1 is high go to stage 4, if terminal 2 is high go to stage 7, if terminal 3 is high go to stage 10 else go to stage 2

Stage 4: Begins "open street map" and Identify current location and start the navigation to the predefined location.

Stage 5: Will assist one by one command for navigation.

Stage 6: Creates audio production and steps to stage 2

Stage 7: Will activate the buzzer.

Stage 8: The buzzer present in the stick will make buzzer sound.

Stage 9: Moves to stage 2

Stage 10: Starts webcam, takes a picture, saves it as "objsamp.jpeg," and saves it to home/pi/object.

Stage 11: Uses Python to recognize objects and saves the results as "output3.txt."

Stage 12: Moves the text from "output3.txt" to "audio.txt" and performs text-to-audio conversion.

Stage 13: Stage 2 is reached after the audio output has been generated.

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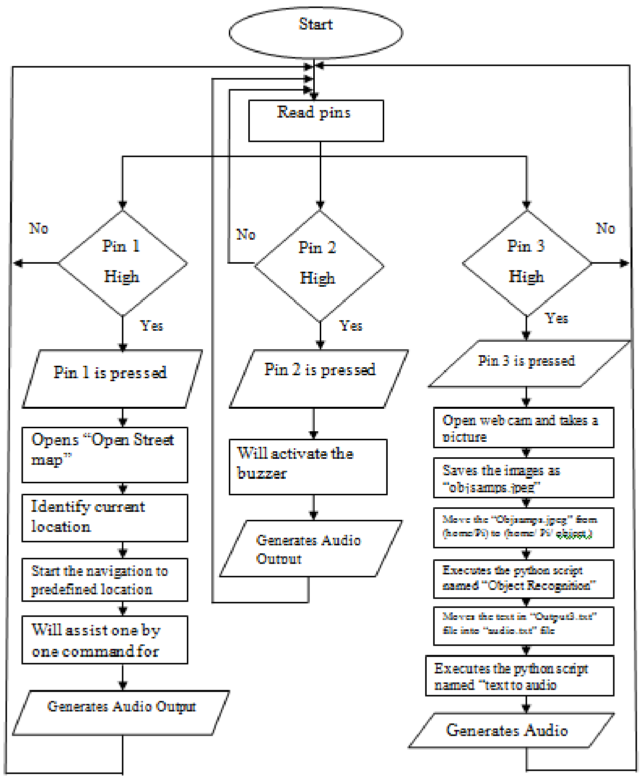

Fig. 3. Flowchart of an Artificial eye

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V. Experimental Results

Fig. 4 shows the prototype of an artificial eye for the blind.

Fig.4. Artificial eye for the blind- prototype

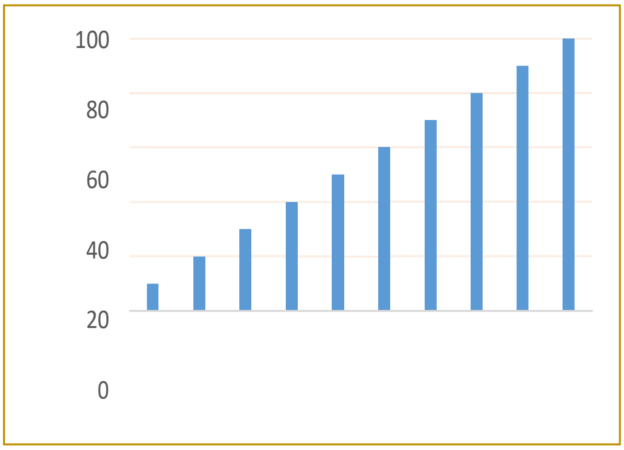
The blind stick is equipped with an ultrasonic sensor, and ultrasonic sensors sense obstructions into the future by using ultrasonic waves. On sensing obstacles, sensed information is communicated to the raspberry pi. The raspberry pi then treats this data and estimates if the obstruction is adjacent enough. If the obstruction is nearby the stick raspberry pi directs a warning what is in front of them in the form of voice. When the stick is in dark areas, the light present in the stick automatically turns on by sensing the darkness with the help of LDR sensor.

Fig. 5. Remote Handheld unit

Fig. 5 shows the Remote Hand held unit. Remote control handheld unit consists of three buttons which is connected wirelessly to stick through RF transmitter and receiver. When button 1 is pressed a buzzer sound starts to beep from the stick which helps the blind people to recognize where they left the stick. When the button 2 is pressed, it tells the navigation to their respective home which is given as a default by their friends or family members. When the button 3 is pressed in case of urgent situation, it sends an alarm message to the family and friends of the blind people who is using the stick.

For obstacle detection, the system was experimented on the roadside of Chennai city as shown in Fig. 6. The result was found that ultrasonic sensors were able to detect obstacles accurately, and the distance is calculated as a product of time taken and speed of sound waves. Calculated distance is compared with Actual distance and it is found to be closely matching as shown in Fig. 7.

Fig. 6. Demo of Artificial eye for the blind



VI. Conclusion

The system helps blind and visually impaired people to be highly self-dependent by assisting their mobility regardless of where they are; outdoor or indoor. Results show that all the sensors work properly and give accurate readings, though the range of the prototype sensors is not high. Object detection algorithm utilizes 100% CPU which makes the raspberry pi hot and thus, in future system, two raspberry pi are recommended to be used one for object detection and one for all the sensor.

Future work includes installation of additional sensors like accelerometers, PIR motion detector, vibrator motor, water sensor and the cane can be replaced by robotic arm which guides the user.

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