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A Leading Hand for the Blind –A Review

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Abstract: Across the world there are at least 285 million blind people with visual impairments. Out of which 39 million are fully blind and 246 million are having low vision problems. These people find it difficult to perform the daily chores and lead a normal life. This brought the need to develop different aids for easing their lives. Such systems could be derived by the advances in technology and researches done all over the world. Technologies like RFID, GSM, GPS, voice assistance, image processing have been a boon to these discoveries.

Index terms: Visually impaired, smart stick, navigation, Ultrasonic sensor, Voice assistance, Buzzer, Navigation, GPS, GSM, RFID.

1. INTRODUCTION

The five senses-sight, hearing, touch, smell and taste are all indispensable part of human beings. Not everyone in the world is gifted with this boon. One of the most important senses is ***vision*** which guides us in choices that we make in our lives. Some lack this sense of vision by birth, while others acquire it due to chronic disorders like retinopathy, accidents, exposure to harmful chemicals.

Having not being able to perceive things with their eyes or perform routine chores normally, hinders the self-confidence of the visually challenged person. It affects their personality both physically and mentally. Yet the support available to them is merely week. This propelled us to build a smart stick that can simplify their lives.

There are various sensors which gather information from surrounding which are processed by the controller. These sensors include ultrasonic sensor, IR sensor, PIR sensor, Image sensor. RFID has been efficiently tested for providing path or information related to tagged objects. It is the best choice for identification of objects by tagging method. Also an auditory feedback is adopted in order to provide guidelines to the visually challenged people for navigation.

GPS is satellite base radio navigation system that enables to determine a real time location. This location information is send to concerned person in case of emergency. A GSM module is used for the same. Other modules like Bluetooth, Wi-Fi, etc. can also be used for communication. The computing engine used in these aids are usually microcontrollers. Some examples are PIC18F2520, MC68HC11E2, PIC16F887, LPC2148 etc.

This paper is split into various sections. The section ahead includes historical perspective, literature review, conclusion, acknowledgment and reference.

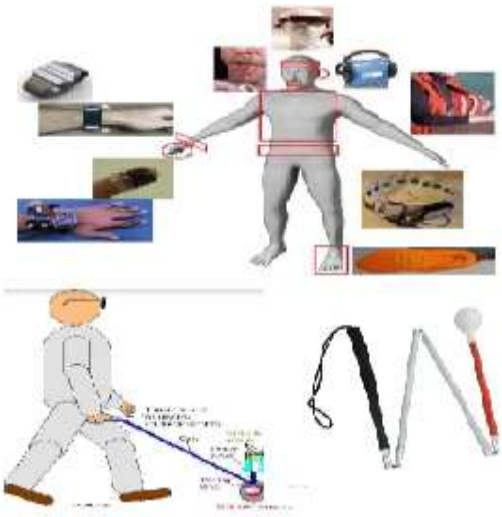

Figure 1: Modern Aids for visually challenged

2. HISTORIC PERCEPTION

Blindness is a state wherein a person has lost his ocular perception. A person may be blind by birth or could have lost his vision due to accidents or chronic ailments like age related vascular degeneration, diabetic retinopathy, etc.

Over the decades, human beings have come up with their own ways to make lives of visually impaired easier. Trained dogs were used to guide their blind masters. Braille system was derived to make the education of blind people easier. Blind people have been using the white canes over a long period of time. This has not only made the observer aware of the presence of the blind person, but also helped to detect obstacles to certain extent.

The advancements in the technologies and researches has led to development of various assistive aids. The White canes got smarter, various wearable solutions were also proposed. Some of them have been discussed in the literature review section.

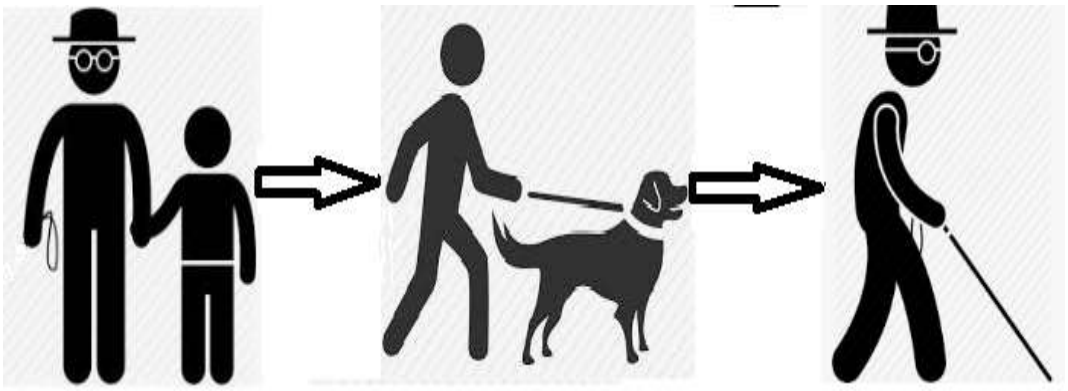

Figure 2: Conventional assisting methods for visually challenged people

3. RELATED WORK

B. Ando *et al.*[1] The paper proposes a system for the visually challenged people- an electronic travelling aid which makes use of haptic feedback. It performs various tasks like detecting obstacles, their identification and provides information about them. A circuitry is embedded in the cane for the same. When the cane comes across an obstacle along its path it will generate a vibration, mimicking the real sensation of the object with help of eccentric mass motor as actuator installed in the cane. Obstacle detection is performed using ultrasonic sensor (disc shaped) and detection-simulation algorithm. Also this system provides smart processing architecture, avoids cross interference between actuators and cane and avoids cane-floor interaction. Though this system provides aid in navigation it cannot adapt itself in new surrounding whose database is not stored.

Iwan Ulrich *et al.* [2] in this refer, the user pushes the light weight Guide cane, which is used for obstacle avoidance. The ultrasonic sensor detects an obstacle, the embedded computer determines the suitable direction of motion that steers the guide cane and user around it. This steering is quite noticeable at the handle, hence the user is easily guided. Here the user needs minimal training to use this aid. The guide cane is very intuitive and users can travel effortlessly at an average speed of 1m/s. Since sonars are closer to the ground, sometimes they may detect minor irregularities in the ground and misinterpret them as obstacles. The obstacle avoidance performance is adequate to indoor environments only.

G.Gayathri *et al.* [3] in this proposed system the smart stick aids visually impaired over any obstacles pits or water. It helps the visually impaired person to lead a more confident life. The proposed walking stick consists of GPS which is pre-programmed for identifying the optimal route. Sensors like pit sensor, water sensor, ultrasonic sensors are used. It also consists of voice synthesizer, keypad, vibrator, level converter, speaker or head phone. The controller used is PIC controller-the proposed system includes two parts: sensor unit and GPS unit. For the identification of pit infrared sensors is used whereas ultrasonic sensors can be used to detect any other obstacle. In order to detect water electrodes are fixed at the bottom so that they sense water and give indication to visually impaired person. When the person reaches the destination using GPS, the blind person is alerted with the voice response. As it is used only for defined set of routes it may not be helpful in navigating at new route.

Olakanmi *et al.* [4] in this paper visually impaired walking aid is designed and implemented using a network of ultrasonic sensors, thereby capable of detecting the direction and position of obstacles. The performance and functionality are also improved by addition of alert light, and voice guidance signal which is relayed to a miniature headset. The recorded voice alerts

the user of the presence and direction of the obstacle. It can detect obstacles within 0m to 1m at left, right and in front of the stick with an appropriate voice alert. The walking stick designed here can't determine the distance of the obstacle to the multidimensional.

PiyushPatil *et al.* [5] The Proposed system consist of a belt along with smart cane which mimics the real sensation of touch. This is achieved by using haptic feedback. Along with obstacle detection (using ultrasonic sensor), this system provides solution like staircase detection and human detection (using PIR sensor).The voice assistance is provided with the help of smartphone app. An object database is maintained with which the captured object is matched and identified. Initially the destination information is collected from the user and given as input to the smart phone and Google Maps which are used to provide direction to that destination. There are three pairs of ultrasonic sensors which detect the object in right and left directions and provide direction accordingly. In scenarios where obstacle are present in all directions there may be ambiguity in detection. Also smart phone app used may not always yield accurate results.

Akhilesh Krishnan *et al.* [6] in this reference the author proposes a smart walking stick called assistor. It works on the principle of echolocation which uses ultrasonic sensor to echo sound waves and detect objects. An image sensor is used to capture the runtime objects and a smart phone application for the purpose of navigation. These two sensors are placed on the assistor which continuously feeds information to smart application through Bluetooth technology. The system is also provided with servo motors for the mobility of the stick. The motors are adjusted based on the directions provided by Google Maps. Deepening Depth first search algorithm is implemented in order to provide a better navigation. The major drawback of this paper is unreliability of smartphone app. Also it does not provide any solution to determine the distance between the obstacle and the user.

Hanen Jabnoun *et al.* [7] the paper proposes a visual substitution system based on the video analysis and interpretation. It is based on robust algorithm to recognize and locate objects in the image. A single camera is used to capture the image. The type of features extracted depends on the type of image captured. The images could be in binary, gray level Orin color. The major algorithms used are Scale Invariant Feature Transform (SIFT) and Speed up Robust Feature (SURF). SIFT algorithm works by comparing the target image with reference image stored in the database based on the Euclidean distance between feature vectors and key points. SURF algorithm can be used in the field of computer vision for obstacle detection and 3D object reconstruction. SURF algorithm works on the principle of Haar-wavelets responses. The proposed system uses 2 frames. While the first frame is matched with objects in database the successive frames will be matched from previous frames. When an object is recognized the corresponding voice output is given to the user. Here precision of object recognition and time processing play a vital role in object recognition.

Ashwini *et al.* [8] the proposed system helps the blind person to navigate alone safely and avoid any obstacles that may be stationary or mobile. The device provides voice output direction to the user through RFID technology. The system consists of five sections viz. obstacle detection, traffic signal information, Bus route information, location of blind stick and power generation. Obstacles are detected through IR sensors and a notification is given to the user through vibrations. There are 2 IR receivers placed on the blind stick which help in determining the distance of the object from the user. For traffic signal detection, when the signal goes green the IR receiver installed on the traffic pole gets activated and corresponding voice output is generated. This enables the user to cross the street independently without relying on others. For the bus route information system the destination of the bus is provided to the blind person, through a prerecorded voice output. The user is prompted with a voice message about the arrival of the bus when it is within RF range. The location of the blind stick can be obtained by providing a switch that consists of an RF transmitter which gets activated when pressed and gives a beep sound at the receiver end. The wheels placed in the stick can be used for generating power by transforming mechanical energy to electrical energy. Since the IR sensors are placed on the belt which is a wearable for the user, it may cause discomfort in wearing it always.

Akshay Salil *et al.* [9] in this reference IR sensors along with ultrasonic range finders circuits are used for hurdle detection. By using the combination of Bluetooth module along with GPS technology and an Android app for blind, a voice assistance is provided and in panic situation location information is shared with the concerned person through SMS. Here the user is guided through different duration of buzzer ringing and vibration for determining distance from the obstacle and provide path. It is an easy to operate, low power consuming and low cost approach. If there is any malfunctioning leading to change in the duration of vibration or ringing will result in unreliable navigation. The android app (Google Maps) is not always reliable as it depends on internet connectivity.

Zeeshan Saquib *et al.* [10] in this paper a smart electronically travelling aid - BlinDar has been derived. The location information is shared on the cloud using GPS and ESP8266 Wi-Fi module. A gas Sensor is used in order to detect fire in case of fire accident. Also RF Transmitter/Receiver module is used to locate the stick when it is misplaced. Apart from these the main sensing devices are ultrasonic sensors, which can detect the obstacles and potholes up to a range of 2m. The main computing

engine used here is Arduino Mega2560. BlinDar is a fast responding, low power consuming light weight and cost effective device for the visually challenged. Navigation gets difficult sometimes as GPS is not that reliable in indoor environment.

4. CONCLUSION

Loss of vision has been a hindrance in the development of the human race. The feeling of being blind folded for a day itself is too terrifying, just imagine how the lives of visually challenged can be. Yet they do not give up in lives and try to lead a better life. This can be made simpler by various electronic aids and system that have been developed. After having surveyed so many papers, it can be observed that the aid developed should not only meet the requirement of the design but should also be cost efficient, easy to use and hassle free.

5. ACKNOWLEDGEMENT

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