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Multifunctional Blind Stick Using Machine Learning – A Review

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Abstract*— An visually handicapped person finds it tough to find the presence of any obstacles in their approach and it's terribly tough to search out the precise location of the stick if it is misplaced. Thus, the multifunctional blind stick comes as a projected answer to assist the visually impaired folks in their day to day living while not the assistance of others. This paper conducts a survey on few of the vital and up to date developments in blind sticks keep on with the utilization of various microcontrollers, sensors, and technologies.

Keywords*—ultrasonic sensor, radio frequency transmitter and receiver, obstacle detection, controller, GSM and GPS.

1.Introduction

According to the World Health Organization, there are [1] nearly 285 million people with some form of visual impairment out of which 86% people have low vision and 14% people are blind. Vision is one among the foremost vital senses to humans to survive. Vision helps us to attach with the environment. People deprived of vision rely on other dependencies like a simple walking cane or other people. In familiar places like the interiors of a house, they memorize the site directions, obstacles on their way and navigate according to them. However, it is not always safe for the blind to rely on their memory to move from one place to another. Especially when they are out-doors. Not all the times blind people are offered help from others and hence there is a need for a device, such as a stick, which can assist the visually impaired people in all forms of life. Blind is someone who has confined with their vision. They frequently experience hindrances in their day-by-day life.

The limitations in vision certainly cause issues in obtaining information and new encounters happening around in daily lives. There are various bearing systems frameworks for outwardly debilitated voyagers to explore rapidly and securely against hindrances and different dangers confronted. Every development has its own preferences and drawbacks. Presently, blind people utilize a stick for bearings to move and walk. Owing to amount of strain which is being subjected to our eyes, the probability in enhancement of number of blind people are bound to rise. The purpose of this blind stick would be to make blind people more independent. In fact, it will give positive dimensions to their life. The traditional obstacle detection methods are obsolete and need considerable modifications.

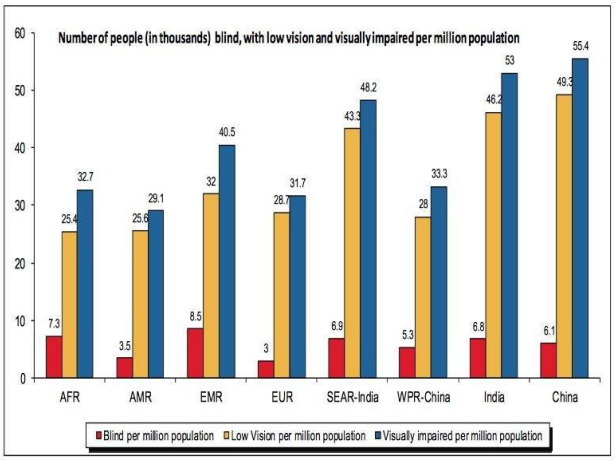

Fig 1: Graph showing number of visually impaired per million population of different countries

In this paper we focus on different types of ways in which a multifunctional blind stick can be made. The first domain is the IOT where multiple sensors such as ultrasonic sensor, water sensor, infrared sensor etc can be used. As well as different microcontrollers can also be used like Arduino uno, Arduino mega, STM32, MSP 430, PIC microcontroller etc for controlling all the devices and acting as brain of the blind stick. The second domain is the Machine Learning where small computer like Raspberry Pi can be used with camera functionality to detect the object. It doesn't stop here at this only one can also implement the type of object such as whether it is chair, table, car, bike, glass, person, etc. This can be achieved with help of different types of object detection algorithms which are R-CNN (Region Based Convolution Neural Network), Masked R-CNN, Fast R-CNN, YOLO (You Only Look Once), SSD (Single Shot Detector), Mobile net, etc. Out of these algorithms YOLO is the fastest to detect an object because it is one stage detector while R-CNN is a two-stage detector but its accuracy is more than YOLO. For communications GPS and GSM is included

which will send location of the user, RF transmitter to know the location of stick if it is lost.

2. Literature Survey

In this section we present the review of various blind sticks made by others.

Saurav Mohapatra, Subham Rout,Varun Tripathi, Tanish Saxena, Yepuganti Karuna (2018) [1] proposed a Walking Stick with in-built ultrasonic sensor with a Raspberry Pi The authors have used ultrasonic sensor is used to detect obstacles. On sensing obstacles, the sensor passes the data to the microcontroller. The microcontroller then processes the data and calculates if obstacle is close enough. If obstacle is close then microcontroller sends Alert signal to the blind person. In addition, they have also planned to embed e-SOS system. Whenever blind person feels any discomfort while navigating then he presses an e-SOS distress call button on the stick to give a video call to his family member using RPI camera. The video is streamed in an Android mobile via Android application. The Android application also shows the location of the blind person to his family member.

Arnesh Sen, Kaustav Sen, Jayoti Das (2018) [2] proposed to design an artificial navigating system with adjustable sensitivity with the help of ultrasonic proximity sensor and a GPS module to assist these blind persons to walk fearlessly and independently in both indoor and outdoor environment. Their system can detect any type of upcoming obstacles and potholes using the reflection properties of ultrasound.

Mukesh Prasad Agrawal, Atma Ram Gupta (2018) [3] proposed a blind stick with MSP430 Microcontroller. The ultrasonic sensor, water sensor will help to identify obstacles. The microcontroller will retrieve data and pass it on as vibrations which will notify the user about hurdles on the way. The authors have also used RF module to locate the stick if misplaced.

Naiwrita Dey, Ankita Paul, Pritha Ghosh, Chandrama Mukherjee, Rahul De, Sohini Dey (2018) [4] proposed a blind stick using PIC microcontroller 16F877A. An ultrasonic sensor module, HC-SR04 is used for obstacle detection in the path of the blind person and a buzzer is used to make the person alert. It can detect obstacle within 5 to 35 cm range of distance.

G.SRINIVAS, G.M.RAJU, D.RAMESH, S.SIVARAM (2019) [5] proposed a blind stick using Arduino Uno with the help of an ultrasonic sensor which detects the distance between object and the person. If any obstacle comes in front of blind person, he/she can know about the obstacle by hearing the sound generated by the BUZZER.

N.Loganathan,K.Lakshmi,N.Chandrasekaran, S.R.Cibisakaravarthi, R.Hari Priyanga, K.HarshaVarthini (2020) [6] proposed a blind stick using Arduino Uno with the help of an ultrasonic sensor and infrared sensor which detects the distance between object and the person.

Vanitha Kunta, Charitha Tuniki, U. Sairam (2020) [7] proposed a blind stick which is integrated with ultrasonic sensor, infrared sensor, push button, soil moisture detector along with Arduino UNO. The ultrasonic sensors are used to detect obstacles and alert the user through buzzer. The GSM, GPS is used to send location of the user to specific person.

T.S. Aravinth (2020) [8] proposed a blind stick using Raspberry PI, ultrasonic sensor, camera for object detection. An interfacing GPS is also used to identify the exact location in case of any trouble.

T. Tirupal, B. Venkata Murali, M. Sandeep, K. Sunil Kumar, C. Uday Kumar (2021) [9] proposed a blind stick using Arduino Mega, ultrasonic sensor. They have used four ultrasonic sensors for four directions i.e. left, right, front and down. If ultrasonic sensor senses an object, it will give its response through the buzzer.

Prof. Sushma Patwardhan, Miss. Divyata Karivadekar, Miss. Pratiksha Phadtare, Miss. Komal More, Miss. Swapnali Rabade (2022) [10] proposed a blind stick which is embedded with Arduino uno, vibrator, switch and sensor. If sensor senses the obstacle, the vibrator which is placed over the handle vibrates. Ultrasonic sensor detects obstacle ahead using ultrasonic waves.

Anish Aralikatti, Jayanth Appalla, Kushal S, Naveen G S, Lokesh S and Jayasri B S (2022) [11] proposed an android based mobile phone application for the visually impaired so that they can detect objects in their vicinity.

Annapoorani, A., Nerosha Senthil Kumar, and V. Vidhya. (2021) [12] proposed an object detection system using CNN, YOLO and python. Computer webcam has been used to capture an image and identify it with the help of YOLO framework.

S. TOSUN and E. KARAARSLAN (2018) [13] proposed an mobile application using OpenCV for image processing and TensorFlow for machine learning process.

Sr No.	Paper-Topic	Source-Year	Technologies Used	Accuracy
1.	"Smart Walking Stick for Blind Integrated with SOS Navigation System,"	IEEE-2018	Raspberry Pi, RPI Camera for video calling through android application	-
2.	Ultrasonic Blind Stick for Completely Blind People to Avoid Any Kind of Obstacles	IEEE-2018	Ultrasonic sensors are used to detect obstacles as well as water	-
3.	Smart Stick for the Blind and Visually Impaired People	IEEE-2018	MSP430 with ultrasonic sensor	-
4.	Ultrasonic Sensor Based Smart Blind Stick	IEEE-2018	PIC microcontroller 16F877A with ultrasonic sensor	-
5.	Smart Blind stick connected system using Arduino	IJRAR-*2019*	Arduino Uno with ultrasonic sensor	-
6.	Smart Stick for Blind People	IEEE-2020	Arduino with infrared sensor	-
7.	Multi-Functional Blind Stick for Visually Impaired People	IEEE-2020	Arduino uno with GPS and GSM	-
8.	WiFi and Bluetooth based Smart Stick for Guiding Blind People	IEEE-2020	RaspberryPI with Bluetooth RF module	-
9.	Smart Blind Stick Using Ultrasonic Sensor	Researchgate-2021	Arduino Mega with ultrasonic sensor	-
10.	Smart Blind Stick Using Arduino UNO	IJSRET-2022	Arduino uno with vibrator, ultrasonic sensor	-
11.	Real-time object detection and face recognition system to assist the visually impaired	Journal of Physics-2020	Android Application with YOLO embedded in it.	70%
12.	Blind-Sight: Object Detection with Voice Feedback	IJSRET-2021	Computer System with CNN such as YOLO and Google Text-to-Speech API	95.95%
13.	Real-Time Object Detection Application for Visually Impaired People: Third Eye	IEEE-2018	Android application with OpenCV for image processing and TensorFlow for machine learning	23.7 (Mean Average Precision)
14.	Robot eye: automatic object detection and recognition using deep attention network to assist blind people"	IEEE-2020	ZED stereo camera is used with YOLOv3 algorithm for object detection.	81.18 (Mean Average Precision)

15.	YOLO-v3 Based Currency Detection and Recognition System for Visually Impaired Persons	IEEE-2020	Yolov3 algorithm to detect bank notes	95.71%
16.	Object tracking and counting in a zone using YOLOv4, DeepSORT and TensorFlow	IEEE-2021	Algorithms such as YOLOv4, DeepSORT and tensorflow are used	60%

3. Conclusion

This paper is a comprehensive survey for smart blind stick. The different techniques recently implemented and completed experiments and studies in the domain got reviewed and analysed. To this end, we found that there are improvements which can be made by using Raspberry Pi for real time object detection using machine learning, only one ultrasonic sensor can be mounted on a servo motor to turn in different directions instead of 2 – 3 ultrasonic sensors. Arduino uno can be used along with GPS and GSM. Instead of buzzers, voice module playback can be used with built in message for object detection.

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