Smart E – Cane for the Visually Challenged and Blind using ML Concepts

Adam Filbert Ashwal[1], Kimberly Claudia Dsouza[2], Meghana S[3], Muhammad Hashim Iqbal Husain[4], Dr. Manju Devi[5]

[1,2, 3, 4]*Student, Dept. of ECE, The Oxford College of Engineering, Bangalore, Karnataka, India*
[5]*Professor and HOD, Dept. of ECE, The Oxford College of Engineering, Bangalore, Karnataka, India*

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Abstract - *Eyes are the organs through which one can recognize and identify the surroundings with. Sadly, there are people deprived of their sight. Sometimes, they can be effortlessly confused or obtain inadequate data because of which they can't complete their proposed work. This paper plans to show light on a proposed smart stick and wearable band which can offer help to the visually impaired in their movement by giving precise area subtleties and cause them to feel free. The Smart E–Cane will involve the essential and modern sensors for obstruction discovery and area-based input. The Smart E-Cane will also be able to detect a rise in surface level as the blind person is walking using machine learning and report back what kind of a raised surface is in front of him. This would be very useful when the person encounters an obstacle that is detected as a raised surface or object but doesn't specify whether it is stairs, or an inclination, or a misplaced rock. This Smart E-Cane gives assurance of independency along with security when it comes to walking without assistance from another person.*

Key Words: **E-Cane, Blind Stick, Machine Learning, GPS, IoT, Voice Assistance, Object Detection**

1. INTRODUCTION

Visual impairment or vision loss is a decreased ability to see to an extent that causes problems not fixable by typical means. The term blindness is for complete or nearly complete vision deficit.[1] The World Health Organization (WHO) gauges that 80% of visual debilitation is either preventable or reparable with treatment. Starting at 2015, 246 million had low vision and 39 million were visually impaired. [2] Hence there is a compelling need to find better and much advanced solutions to assist the less fortunate individuals who are deprived of their vision.

In the past, and recent years, there have been many advancements towards designing tools through smart phones, wearables, smart sticks, etc. With each new product being designed and developed, there are new features or upgrades being made that aid the visually challenged in a much better way. This paper, along with proposing a system, will also provide a review of the existing applications and models, to give a wider perception of what is in store and what can be, for better awareness and implementation.

2. LITERATURE SURVEY

A paper based on the recognition/identification of images in real-time. They identify, arrange and gauge the rough position utilizing raspberry pi as the processor that interfaces with the camera to catch the general condition. The capacity to make sense of specific obstructions, examined later, that are a crucial for the visually challenged person to be warned about was lacking in this paper.

Another paper we came across uses a voice play back framework through a mobile android application. Whatever the gadget detects and senses, it provides a criticism through the android application dependent on Natural Language Processing (NLP).

The concept of utilizing real time video processing is likewise applied. The video is processed through Google's Cloud Video Intelligence API, for better navigational guidelines. It is a rather cost-effective method for providing constant recordings.

An improvement of the smart walking stick, a device which is considered to be a robot cane, screens occasions and recognizes impediments just when placed on a level surface. The alarm is activated when the visually challenged person seems to lose balance and is detected to be falling down.

3. PROPOSED SYSTEM

3.1 Existing Systems

There are several existing frameworks that were designed in such a way that they stood out when it came to assisting the blind in moving from one place to another. Not merely do these systems help in travelling but additionally in distinguishing proof of objects that we use in daily life. They likewise provide the facility of voice to text conversion and vice versa to allow for a better interaction with the device. A few of them are briefly described below:

One application that allows for ease of wandering about is Google Maps. There is an element that furnishes individuals with the capacity to get progressively particularized voice direction and new types of verbal declarations for on foot trips. Google Maps proactively announces the correct route, the distance until the next turn and the direction one is walking in. As the individual approaches large intersections, a heads-up notification is received to cross with added

caution. Also, if they accidentally depart from their route, they get a spoken notification that they're being re-routed.[3]

A company which helps in assisting the blind using the most advanced technologies is an organization called Be My Eyes.[4] The manner in which this application works is sighted volunteers offer their vision to solve tasks to assist the blind and low-vision people. There are numerous ways a visually impaired can look for help through this platform. It helps them identify packages, identify colour, food, reading recipes, setting up gadgets, navigating, coordinating an outfit, getting support with Gmail, troubleshooting Skype, etc.

eSight, another product to assist the visually challenged, is advanced electronic glasses.[5] It uses a cutting-edge camera, smart algorithms and high-resolution screens, to create a crystal clear, real-time image of what is in front. It utilizes innovation to help distinguish faces, continue with normal work or secure positions, feel sure about new conditions. It is a lightweight gadget that gives ongoing input of the environment around the individual.

3.2 Methodology

The proposed framework includes various sensors and specialized ideas that help in making this framework a superior model. The use of machine learning concepts is an added advantage as the gadget will have the option to not just perceive and synchronize information of the environment yet in addition learn and store that information for future use. The project theoretical implementation is divided into obstacle detection and emergency notification. The machine learning concepts will be executed in the impediment identification part of the framework. Navigation in this proposed system will be based on google directions API. Different sensors are likewise included to upgrade the nature of the framework and provide better feedback and feeling of independence.

3.3 Obstacle Detection

The different segments that ought to be utilized for obstacle detection incorporate ultrasonic and infrared sensors to ascertain and gauge the separation among objects and the individual, and a magnetometer to recognize change in surface level, however not in the conventional ways. The integration of the information gathered from the sensors alongside the magnetometer information will be utilized in this prototype.

First is the utilization of the magnetometer to prepare the model to comprehend the normal inclination the stick will be positioned in. In this approach, model will initially be prepared to distinguish surface level. The information will be handled so as to recognize the items, for example, stairs, inclinations or pits, and so forth. There will be a scope of qualities that will be expressed as expected surface level.

After that will be a set of recorded values that will be founded on different surface level inclinations. Those values will be stored on cloud and integrated with the values recorded from the ultrasonic and IR sensors.

At that point there is the information gathered from the ultrasonic/IR sensors. Here, as the inclination of the magnetometer changes, the ultrasonic and IR sensors will likewise distinguish the estimation of the obstacles before the individual. Assume there is an inclination, the information from the three sensors set before the stick will rise linearly. Presently assume there are staircases before the stick, the sensors will distinguish the adjustment in a step rise. Hence the data is captured for many other obstacles and the machine forms an understanding of the correlation between the data. This will be done via the supervised learning.

The magnetometer will only be used as a reference. Later an addition of a camera which will be integrated along with raspberry pi will be present, to help in obstacle identification. This information will be contrasted and the information obtained from the cloud so as to make the framework increasingly dependable.

3.4 SOS Wearable Band

To help in emergency situations, we have proposed a wearable band that will have two buttons. One that will locate the position of the stick in case the visually challenged person is unable to figure out where he kept the stick. Another button that will send the person's location via IoT on the off chance that he is lost. It will likewise provide a voice feedback, expressing where precisely the individual is and will request for the destination to be entered and provide an audio feedback to direct him/her back home. It will likewise send the present location by means of IoT to the individual's emergency contacts in case they don't have a sense of security going back alone.

4. REPRESENTATION OF PROPOSED SYSTEM

The below framework depicted in figure 1 gives a comprehension of the connection of the various components in the framework. The primary processors will be the arduino, raspberry pi and Node MCU. The arduio will be utilized to interface the sensors while the node mcu will be used to implement the Smart Band and finally the Raspberry pi module will be utilised to implement the machine learning part of our framework.

The ultrasonic sensors will be used for obstacle detection and the feedback will be provided via a vibrator whose intensity will increase as the stick gets closer to the obstacle.
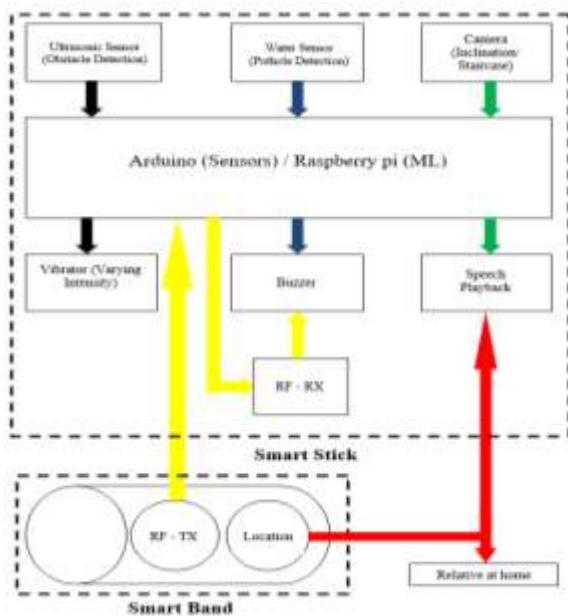
Figure 1

The water sensor will be used to detect wet areas, potholes containing water etc. and the feedback will be provided by a buzzer. This concludes the Smart Cane part.

The smart stick is combined with a smart band for added features such as safety and location tracking. It consists of two buttons. The first button is connected to an RF Transmitter, and the RF Receiver is mounted on to the smart stick. This feature would help the user to locate the smart stick in the near vicinity and the feedback is provided using the same Buzzer.

The second button is used by the user if they are in a situation where they find themselves lost. Here when the second button is pressed, it would send the location about the user to the concerned people at home as well as provide the location feedback to the user via speech playback.

Finally, one of the most important features of our project is to detect any raised surface level such as a staircase, ramp, inclined plane using Anomaly Detection which is one of the Machine Learning concepts.

One way to implement the feature is that there would be a device such as a Magnetometer which would be used to provide a range of reference values. While the camera continuously monitors to detect any raised surface level such as a staircase, ramp, inclined plane etc., if it does encounter any such surface it must send the data and the difference value has to be calculated. By having numerous data, using the concept of machine learning it should provide the user with a cautionary message via speech playback of the type of surface it may encounter before the user even steps on it.

Here the reference data provided by the Magnetometer is used against the sudden change in data provided by the camera. The difference value or the change in value when compared to the reference value is treated as an Anomaly and thus the concept of Anomaly detection is used. Along with this the machine learns from various data in order to give more accurate results, thus the machine learning part is also incorporated onto the stick.

5. CONCLUSIONS

The Smart E-Cane along with the Smart Band will provide the visually challenged with much of the important features than a modern-day blind stick.

The location tracking feature along with the detection of any raised surface level by machine learning will not only provide accurate results with huge number of data learnt but also allow a wide range of opportunities for future scope.

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