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Blind Guidance using Smart Cap

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Abstract - *Science and technology always try to make human life easier. The people who are having complete blindness or low vision faces many difficulties during their navigation. Blindness can occur due to many reasons including disease, injury or other conditions that limit vision. The aim of our paper is to develop a map for blind which will guide them from their source to destination. The paper shows design and implement a smart cap which helps the blind people to direct the path freely by experiencing their surroundings. The scene around the person will be captured by using a camera and the objects in the surrounding will be detected. The earphones will give a voice output describing the detected objects. The architecture of the system includes the processor Raspberry Pi 3 /Jetson nano, camera, earphones and a power source. The processor collects the frames of the surroundings and convert it to voice output. The device uses TensorFlow API, open-source machine learning which is invented by a team called Google brain, which is for the object detection and classification. TensorFlow helps in creating Models based on machine learning which are capable of identifying and classifying one image from multiple objects. Thus, details corresponding to various objects present in one frame are obtained using TensorFlow API. A Text-to-speech Synthesizer (TTS) software is used for converting the details of the detected object (in text format) to speech output.*

Key Words: Raspberry Pi 3 / Jetson Nano, Camera, TensorFlow API, Text-to-speech Synthesizer, Google brain.

1.INTRODUCTION

There are 285 million People among the whole world's population who are unable to see. Living independently for such people is hard. Going out alone is not as easy for them as compared to us. To overcome this and make them confident for being independent, we are making smart cap. Smart cap will help a user to understand the directions and reach the desired place. Also, user will be able to understand the things kept around person like fruits, vegetables etc. The main purpose behind this project is to make and provide a better life for blind people and to help those people in disastrous situations.

2. MOTIVATION

This office work would now not have been feasible without the guidance and the assist of several folks that in one-way or other contributed and prolonged their treasured assistance within the education and completion of this study. The writer is very thankful to all the researchers on this ever-growing field who have contributed their time and knowledge. I respect all my friends whose direct and indirect contribution helped me a lot to accomplish this survey of tracking down visually impaired people and problems faced by them. I would thank all the teachers and non-teaching team of workers for cooperating with me and providing valuable recommendation and assets which helped me inside the completion of this work. Last but no longer the least. I would really like to thank my circle of relative's members, who taught me how to build up all the components by taking the care of user too. This project would have become impossible without the contribution, cooperation and support of my teammates. They supplied me enormous support at some stage in this implementation directly and indirectly.

3. RELATED WORK

- Brain Port V100 (Wicab Inc, 2017)
- Eye cane (Watrin, 2014)
- Vision smart glasses (University of Oxford, 2014)
- Screen readers (American foundation for the blind 2007)
- Smart braille watches (Pulvirent, 2017)

3.1 Brain Port V100 (Wicab Inc, 2017): -

Functionality: - It is an electro-Tactile device assisting for mobility and detection of object.

Limitation: - Cannot be used to recognise text and sign.

3.2 Eye cane (Watrin, 2014): -

Functionality: - Wide angle and covers up to 5 meters.

Limitation: - limit in identifying obstacles.

3.3 Vision smart glasses (University of Oxford, 2014): -

Functionality: - Enhanced awareness about surrounding.

Limitation: - can be used only by people with partial blindness.

3.4 Screen readers (American foundation for visually impaired people 2007): -

Functionality: - It is an interface between user, its OS and the computer programs.

Limitation: - Limited use for computer and any other electronic devices.

3.5 Smart braille watches (Pulvirent, 2017): -

Functionality: - displays the time in brail language and gives notifications.

Limitation: - limited number of notifications and functionalities.

4. THE PROPOSED SYSTEM

With object detection it is possible to categorize the various images by comparing with their actual data sets and label it. It is a bounded box framing the objects.

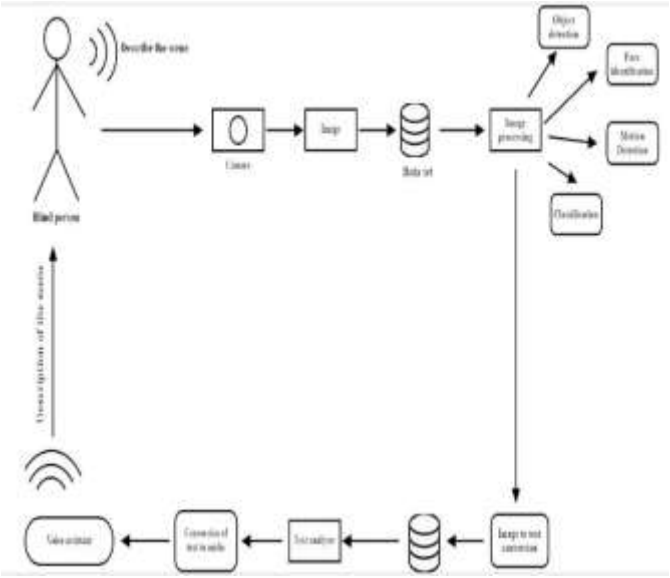

Figure 4.1: System Flow

The system gets power by the provided batteries and it has a backup of power bank.

A camera is placed on the cap which captures the scene continuously through 30fps. The image is compared with the trained data set. The image is processed and then classified into various groups. In this object detection, face identification, motion detection and classification can be done.

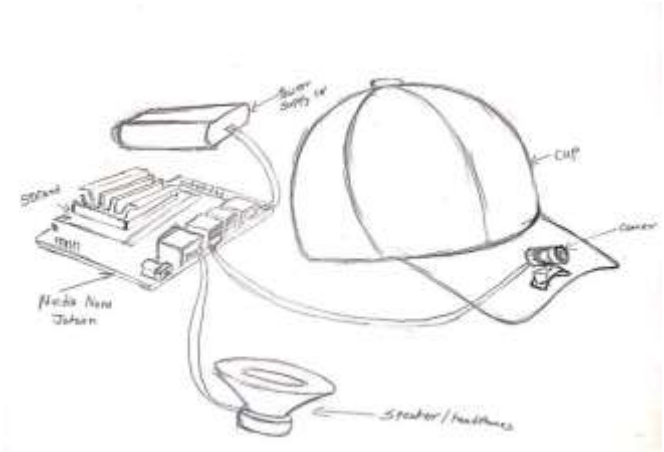

Figure 4.2: System Architecture

The process starts with the camera. First, the camera will click the picture of the surrounding. It describes the scene to the user on the command of user. The voice assistant gives the commands. The image captured by the camera is converted in to grey scale with the use of algorithms. The data is handled properly, parametric reduction, optimal feature identification is performed. The image is processed and differentiate with the available data set. The image is detected when it is matched with stored dataset. Further the image is converted into text format. Then, the scene is described through voice assistant. The text is analyzed and scene is described while converting from voice-to-text format. Navigation system is added to navigate the direction which takes you up to destination. It also guides you about obstacles and potholes.

Canny edge detection:

It's an edge detection algorithm. it uses wide number of images for comparisons. The object can be easily detected by comparing its edges with given data set and thus one can classify the images. The algorithm named Canny-edge detection, when compared with rest algorithms and their operations, it performs better, under all circumstances.

Why Canny Edge Detection Algorithm?

- Detection: The probability of detecting the actual real edges is more. Thus, minimizing the falsely detecting edges.
- Localization: There must be minimum gap between real edge and detected Edge.
- Number of results: One edge should not give more than one detected edge.

Steps in Canny Edge Detection Algorithm five sequential steps:

1. Smoothing

The image taken by camera may noisy. The noise reduced by filter which applied on image pixels.

$$S = I \times g(x, y) = g(x, y) \times I$$

Where,

$$g(x, y) = x = \frac{1}{\sqrt{2\pi}\,\sigma} \times e^{-\frac{x^2+y^2}{2\sigma^2}}$$

2. Finding gradients.

$$\nabla S = \left[\frac{\partial}{\partial x}S \quad \frac{\partial}{\partial y}S\right]^T = \left[S_x \quad S_y\right]^T$$

$$|\nabla S| = \sqrt{S_x^2 + S_y^2}$$

$$\theta = \tan^{-1}\frac{S_y}{S_x}$$

3. Non-maximum suppression
4. hysteresis thresholding

Example: -

Figure 4.3: Example of CNN

Convolutional Neural Networks and Image Classification:

The convolutional neural network (CNN) is a class of deep learning neural networks. CNNs represent image recognition. They are used for analyzing visual images. It frequently works in background for image classification. They're fast and they're efficient.

Working:

CNN is based on pattern recognition. Convolutional neural network is used to find patterns in an image. By convoluting a picture and finding patterns in it. CNN identifies lines and corners in its first few layers. We can study and find more patterns by using neural networks complex features and further, this feature shows CNN are really good for identifying objects in images. The main aim is filtering, done by convolutional layer. While training the image, the weights change, density everything is evaluated. And so, when we evaluate an image, the weights are compared with available pattern to figure out if the object matches previous records. Combinations of different weights in the network is used for forecasting the content.

5. RESULTS AND DISCUSSIONS

This project categorizes blind people as partial and fully blind, and works for both. The developed cap could be used in any circumstances and atmospheric conditions, provided that battery must be fully charged.

5.1 Advantage:

- Smart Cap is suitable for disaster / emergency situations.
- Easy for those people who live alone.
- Auto Detection of objects.
- Smart Cap easily navigate the paths and detect obstacles.
- Smart cap boosts Confidence to user to walk on the busy roads.
- It is a non-paper system.
- Smart cap converts text to speech, thus making user to understand the content on the paper.

6. CONCLUSION

The right way of using technology is when everyone is able to experience and use this. This project work could be boon for those 285 million blind people who are yet to experience the surrounding where we live-by. We tried to make these people confident to live in our society independently and work on their own. Those people could start working on their own in any field of the society. This device provides a real-time navigation and narrative system. Our project will make use of green technology, which is friendly to environment. This work is a proof of our future work, we are hoping to make a standalone version with additional assistive service for the blind persons.

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