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Multi-Sensory Learning for Autonomous Navigation System for Visually Impaired

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Abstract—India has the largest blind population in the world. The complex Indian environment makes it difficult for the people to navigate using the present technology. In-order to navigate effectively a wearable computing system should learn the environment by itself, thus making visually impaired adapt to the environment. The traditional learning algorithm requires the entire percept sequence to learn. This paper will propose algorithms for learning from various sensory inputs with selected percept sequence; analyze what feature and data should be considered for realtime learning and how they can be applied for autonomous navigation for blind, what are the problem parameters to be considered for the blind navigation/protection, tools and how it can be used on other application.

Keywords— autonomous navigation, low cost, multi sensory learning.

I. INTRODUCTION

India has the largest population of visually impaired [1] [2]. With complex environment in India it makes it difficult for the visually challenged people is high. They can navigate with very less degree of freedom. Everyone cannot be enlightened with eye transplantation. So we move towards other solution that can be usable at all environments. In this paper we focus on the computational solution to the problem. There are computational solutions has been up to some level where one can navigate using the GPS. All the other system is explicitly trained for navigation. But those systems cannot be applied to the Indian environment where the situation is highly uncertain. Processing higher level of uncertainty for pattern identification requires high computational power. To tackle this problem special chips (such as IBM's Synapse) have been developed. But at the same time traditional microprocessor chips has mastered the rational thinking process but they are less suitable for the pattern recognition. The alternate proposal is to use traditional processor and algorithm but by selecting the particular feature in data. The navigation system used by the visually impaired people requires data connectivity and it can be used via GPS connection and they cannot be used on various circumstances. Since the response of the system should be quick in case of intruder detection system or malicious stranger appears near visually impaired. Processing of the images and the audio signal by itself is an exhaustive

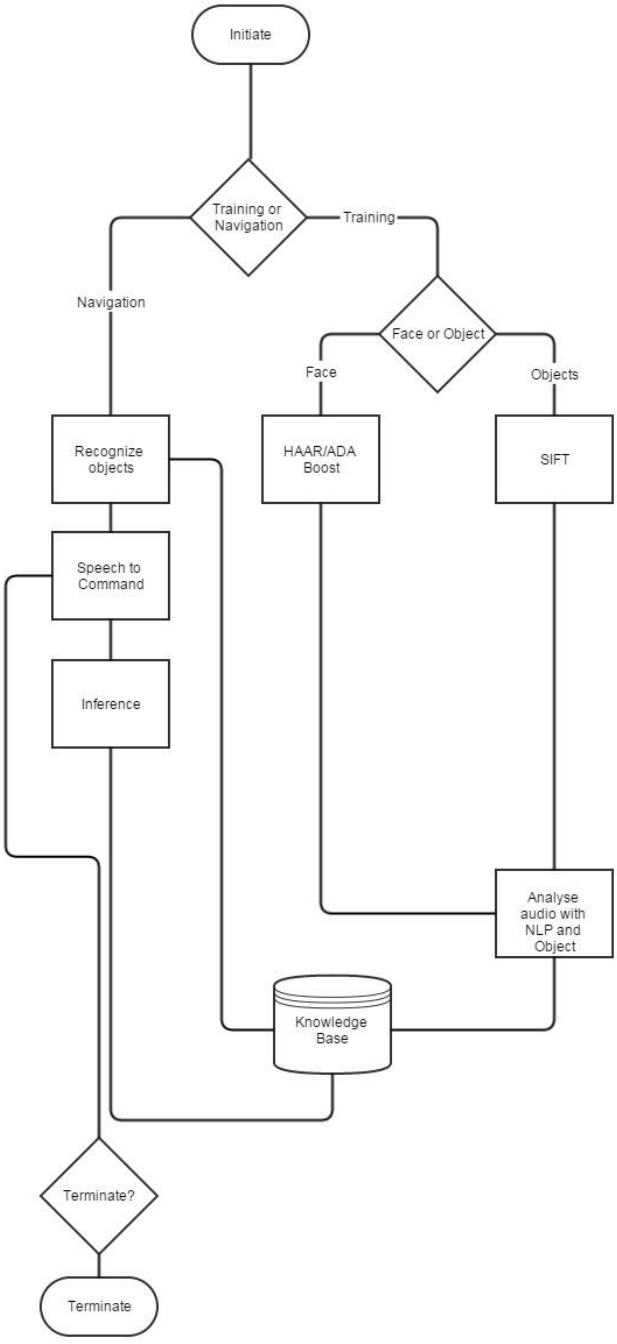

Figure 1 – Flow Chart

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task. So the system will be trained with the patterns that are required to look for so that they can identify them on the future.

II. Multi-Sensory learning

The main concept of this algorithm is to combine various data from the various sensors in pairs and validating the necessary information on the results and associate the data and learn to derive new conclusion. The first challenge is to filter the various information that is required for the processing. The second challenge is the representation of the features that are derived from the various sensors. Then storing the information in a compressed format in repository. The recognized objects are represented with the feature vectors and they are stored in the knowledge base for the feedback input. The system also analyzes the data using apriori algorithm. The system penalizes itself every time when it finds a True-Negative features and then automatically corrects itself, making it better to identify better in the future.

A. Voice Interface

It is included with a voice interface to interact with the user. The navigation using smart phones are too complex and costly solutions. The voice based interface makes it interactive with the user. But the problem that hinders the application is not having an effective noise filter. With clear high definition microphone and effective filtering process with Notch filter [3] we can understand what the user says with the help of Natural Language Processing. The user can command the system with the different voice commands and interact with the system as they navigate. Since the conversion of speech-to-text is an extensive work it is implemented using the WSR (Windows Speech Recognizer) for automating, the real implementation is done using the embedded version of the Dragon Speech software. It can be used extensively for the effective filtering and conversion of the speech-to-text.

B. Training

After initiation a person should train the system for the environment. This is done by specifying the voice commands over the microphone. By placing the objects to be trained in front of the camera the user can describe about the object in natural worlds. The description about the object (whether they are usable by hands, obstacle that can be moved or obstacle) with these details we can use it for effective navigation in the travel. The system uses SIFT algorithm to identify those objects and HAAR for facial recognition. The facial recognition can be used to detect whether the person talking to the user is known to him or not which can improve to find the person while walking near the vicinity. The Training mode differs from the Navigation mode where the speech and images are correlated dynamically. The feature vector of the object and the text extracted from the data and they are stored in the database as central repository and this repository can be used in the future for navigation of the user. The trained repository can be used by other nodes for saving the time. The voice of the user is particular and they need to be trained specific for the device. It needs to be trained with language and slang so the system can detect the text easily.

C. Navigation

The most important part of the system is to effectively navigate the user from one destination to another. With the help of GPS the user can get into approximate location but with the help of image processing the user can be exactly guided with where to move and turn. A user might ask “find hotel Shiva” then the system need to read the banners in the camera and image is analyzed for the text and the location is given if they are found within a particular time.

D. Avoiding audio spamming

Since there is large number of objects in the frame is detected and same objects can occur again in the other frame, when the system detects such objects then they are responding with spammy information to the user. If there is more than one similar object then we group them together and count the number of objects that are present in the frame, if the same object appears on the multiple frames then the system waits for particular time then the response can be given to the user.

III. Results

The implementation of the trained system with the

Figure 2 – System Demo

Other Applications

1. IP Cam integration

IP cameras are almost everywhere and each one of them contains motors to rotate about certain axis. Even with this type of camera the intruder can bypass them easily. With this solution we can track the sounds and watch over them easily with by rotating them.

2. Advance researching

With this algorithm we can understand better on where the users look? How do they navigate through the web pages?

IV. Conclusion and Future work

This system takes a step forward in understanding a better environment with very less computational power. This can have high impact on the computational intelligence in the future.

The system can be accompanied by deep learning for the best results. Further the system is added with the deep learning

algorithm and combines various sensors for the effective navigation.

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