A Smart Device - Helps the Blind to Cross the Road Safely

Priya Sridharan, Ritwika Ghosh

Abstract**:** ***Internet of Things has been a flourishing technology used in almost every aspect of modern lives to solve real-world problems. Computer vision, a state of the art technology which helps computers understand digital images, when combined with IoT can augment the existing solutions to make truly intelligent systems. Visually impaired people can use their power of hearing or guide dog to help them cross the road, but they are not much efficient and are prone to accidents as sounds subside and they cannot pace with the speed of a dog. Existing technologies which help blind people navigate do not have a viable mechanism for taking accidents and safety into account. Visually impaired people have enhanced touch abilities. Leveraging this skill, this paper aims at providing a solution that produces haptic feedback in the form of vibrations indicating the suitable time to cross the road. A camera provides live data of their surroundings, which detects the traffic signal and determines its colour with the help of computer vision. If the signal is red, an indication in the form of haptic feedback is produced using a vibrating mini disc motor, thus helping the visually impaired person to cross the road safely, thereby preventing accidents.***

Keywords: Deep learning. Image processing, IoT, Object detection, Smart environments.

I. INTRODUCTION

Avisually impaired person can use his power of hearing to listen to the sound of the vehicles and cross the road once the sound has become less intense or it subsides. This method fails in case of heavy traffic and the accuracy is not so good. A visually impaired person can use a guide dog to help him/her to cross the road but it turns out to be expensive. There are technologies existing that helps a visually impaired person to navigate from one place to another but doesn't take accidents and safety into account. We provide a device that detects the traffic lights and indicate the blind person in the form of vibrations. The concept of deep learning and IOT is employed. For traffic light detection, we have used image processing and deep learning. We have built a custom dataset of red traffic lights from scratch. A concept called transfer learning has been implemented, which is a machine learning paradigm where a developed model is reused by retraining it on a different set of data.

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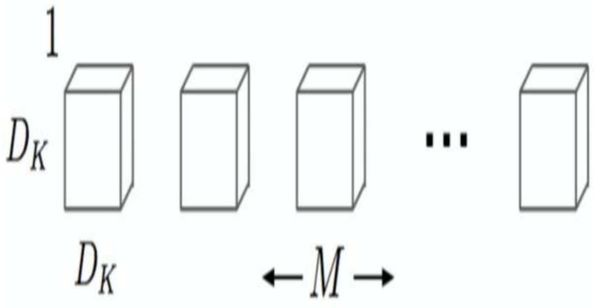
II. OBJECTIVE

This project aims at providing a device with haptic feedback that will help visually impaired people to cross the road safely. India has a road network of over 5,603,293 kilometres (3,481,733333325 mi) as on 31 March 2016. India has the second largest road network in the world. In 2017, about 4, 64, 910 road crashes took place out of which a massive 1.47 lakh people died in road deaths in India. India owes to huge road accidents by cause a death of living beings in every four minutes which is a major concern . Pedestrians are more subjected to the road accidents and they are without any external protection. Road accidents are one of the major problems in India. Visually impaired people populate about 285 million over the world. Out of which 39 million are said to be blind and 246 million said to have low vision. Visually impaired people are spotted most in developing countries which contributes to 90 percent worldwide.

III. PROPOSED WORK

People who are visually impaired have enhanced touch abilities. Taking it as an advantage, this device produces haptic feedback in the form of vibrations indicating the suidetection API to make the red traffic light detector. We have used the pre-trained model SSD MobileNet version 1, which was originally trained on 5 renowned datasets which includes iNaturalist Species Detection dataset accompanied by the COCO dataset and next the Kitti dataset along with the Open Images dataset and comes the AVA v2.1 dataset. It is a convolutional neural networks (CNN) architecture which uses depth wise separable convolutions, which performs two operations - a depthwise convolution and pointwise convolution. The algorithm used here is Single Shot Multibox Detector (SSD) which is ever faster than Region-CNN (RCNN). This model has been chosen because it is produces the fastest result which is important in our case as the detection needs to be done in real time. We have re-trained this model with our custom-made dataset of red traffic lights using transfer learning to convert it into a red traffic light detector. After training the model for around 1,000 epochs, we froze the TensorFlow inference graph and exported it. We have used OpenCV to access the webcam which detects red traffic lights in real time.

First, we made a custom dataset of red traffic lights from the internet which contained various images of red traffic lights in multiple numbers,
angles and structures. Then we used LabelImg to make bounding boxes over the part which contained the red traffic lights and label them, then making XML files with that
A Smart Device - Helps The Blind to Cross The Road Safely information. Then we converted the XML files to CSV files and made TensorFlow records. We modified the configuration files of our pre- trained model to suit our needs and retrained the SSD MobileNet V1 model on our dataset for over 1,000 epochs. We froze the inference graph when we noticed the learning curve became almost flat for quite a few epochs. Then we exported the frozen graph to our OpenCV module to detect red traffic lights in real time. For this purpose, we can map a



vibrating mini disc motor to the result obtained. Buttons can also be provided to turn on and off the device.

IV. FIGURES

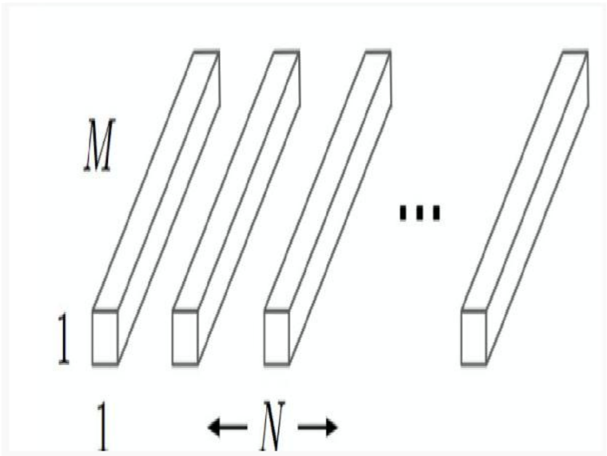


Fig. 1. Depth wise convolutional filters

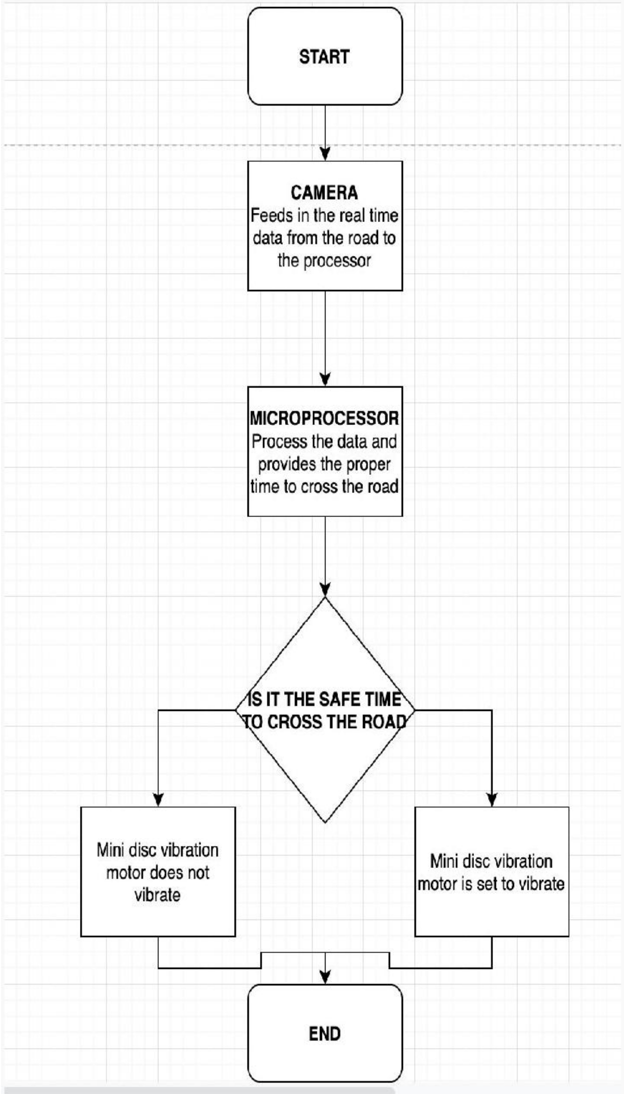


Fig. 2. Pointwise convolutional filters in the context of depth-wise separable convolutions

V. FUTURE ENHANCEMENTS

1) In the future , it can be integrated with voice assistants such as siri, google assistant etc to provide a voice support.
2) It can be developed to suggest pedestrian crossing nearby and can be enhanced by providing lights or any other indications to the drivers to be more careful to highlight that a visually impaired person is crossing the road and can be integrated with the existing navigation systems.
3) In the worst case scenario, if the person still meets with an accident or stops due to other reasons that might include heart attack or pain etc while crossing the road, notifications will be sent automatically and immediately to the nearby police stations, hospitals and family members(optional) along with the location using GPS.

VI. CONCLUSION

The model successfully detects red traffic lights with over 92% accuracy when tested against Udacity's traffic light dataset for self-driving cars.

We conclude our vision by providing a device which is comfortable and could help the visually impaired to cross the road safely thus enhancing the safety of everyone's life.

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