Real Time Vehicle Detection using Movidius Neural Compute Stick

K. Banumathi, B. Bharathi, S. Daisy Deve Priya, P. Gogulalakshmi

***Abstract*:- Object detection is one of the important parameters in autonomous cars. While detecting the vehicles we have to consider many parameters such as high accuracy to ensure safety, real time inference speed, small model size and energy efficiency.**

In this project we propose a new hardware named Movidius Neural Compute Stick which has the convolutional neural network of caffe framework for vehicle detection to satisfy all the above requirements. It will provide the output as bounding boxes around the vehicles with the class probabilities. The main objective of our project is to detect and classify the vehicles with increase in accuracy in terms of probability, speed and reduced processing time.

Keywords: Movidius, Caffe, Autonomous Cars, Convolutional Neural Network, Bounding Box, Probability.

INTRODUCTION:

Vehicle detection means finding or analyzing of the vehicles whether there is vehicle present or not. After analyzing vehicle classification is another part which means what type of vehicle it is (car,bus,bike,etc.). Vehicle detection and classification is one of the important parts in autonomous cars. As a human it is easy for us to detect and classify the vehicle by simply seeing it. But while thinking from driverless cars it is not that much easy. That we are going to implement in our project how the driverless car will detect and classify the vehicle. Our project not only helpful for the driverless car it can also usefully in the avoidance of traffic in highways by implementing the same in traffic surveillance camera. Through that we can count the number of vehicles to control the traffic. But we are focusing mainly for autonomous cars. To implement this totally there are three stages are needed. First one is training stage which means train the machine by giving many sample images to analyze the vehicles. The second stage is inference which means comparing the original image with the sample images. The final stage is deployment which means implement that in day to day life.

In these three stages training stage will take a long time as we have to train all possible images of millions. It does the work more complex. To reduce this complexity in our project, we are using a hardware named Movidius neural compute stick with the inbuilt of training stage. Previously many methods had implemented to detect the vehicles. But those past methods had followed the technique of vehicle recognition. Vehicle recognition means comparing the given images with the sample images directly.

It is the drawback that if the input images of the car is manufactured in India and the sample images of a car trained to the machine is manufactured in America then it will not produce the result as 100 percentages it is a car even though it is a car. The reason is while comparing both the images it will not perfectly. So it may produce some flaw in the output. To overcome this, we are using the technique of vehicle detection using new hardware. In this it will compare given vehicle images with the already trained parameters of that vehicle. While comparing with parameters we will get more probability and better accuracy.

Therefore, our main contribution in this project is,

To reduce the complexity with the inbuilt training stage this in turn will reduce the processing time and increase the speed.

To get more accurate by increasing the probability by using vehicle detection technique instead of vehicle recognition.

METHODOLOGY:

Real time vehicle detection and classification system is developed by the following soperations. To achieve a successful vehicle detection and classification we use the following methodologies.

Studying literature on different vehicle detection and classification methods.

Studying the existing methods for vehicle detection and classification.

Analysing and comparing with existing methods with proposed method.

Implementing the proposed system of vehicle detection and classification.

The performance of the system was executed for our desired output. The video was captured by digital camera and properly detected and classified the vehicles.

RELATED WORK

The need for vehicle detection and classification has been more important in security, autonomous vehicle systems and intelligent traffic systems and many other categories. Various vehicle detection algorithms have been proposed currently. Vision based technology is one of the best method for vehicle detection as it has more advantages which means it will be more convenience and less cost if we use the installation of camera for vehicle detection instead of using hardware detectors. So video based system is a good choice in reality. There are lot of approaches have developed for video based systems.

NilakornSeenouvong et al[1] proposed a method for vehicle detection and classification based on virtual detection zone(VDZ) which consist of following steps foreground extraction, vehicle detection, vehicle feature extraction, vehicle classification. At first the Gaussian mixture model is used to detect a moving vehicle. And then the correct foreground objects will be obtained by using several techniques including region of interest selection, adaptive

morphological operation, and contour processing. Then vehicle features will be calculated when the centroid of a vehicle is on the VDZ. Finally vehicles are classified by using K-nearest neighbor classifier.

Youpanhu et al [2] proposed an algorithm for vision based vehicle detection and classification. They have proposed a method based on combined Haar features and HOG features to detect and classify vehicles into two types whether it is vehicle or non vehicle.

Bichenwu et al [3] proposed a method for vehicle detection and classification using convolutional neural network which has the architecture of SqueezeDet framework. In the inference stage it will compare the images by totally 57 frames per second. These convolutional layer provides output layer to compute bounding boxes with class probabilities.

XingchengLuo et al [4] proposed a method of deep convolutional neural network model for vehicle recognition and face recognition. In this they have used the deep convolutional neural network which is no less than 9 layers. Caffe deep learning framework is used to verify the proposed algorithm.

et al [5] proposed an image-based Vehicle Analysis using Deep Neural Network: A Systematic Study. They used YOLO software to detect and classify the vehicles.

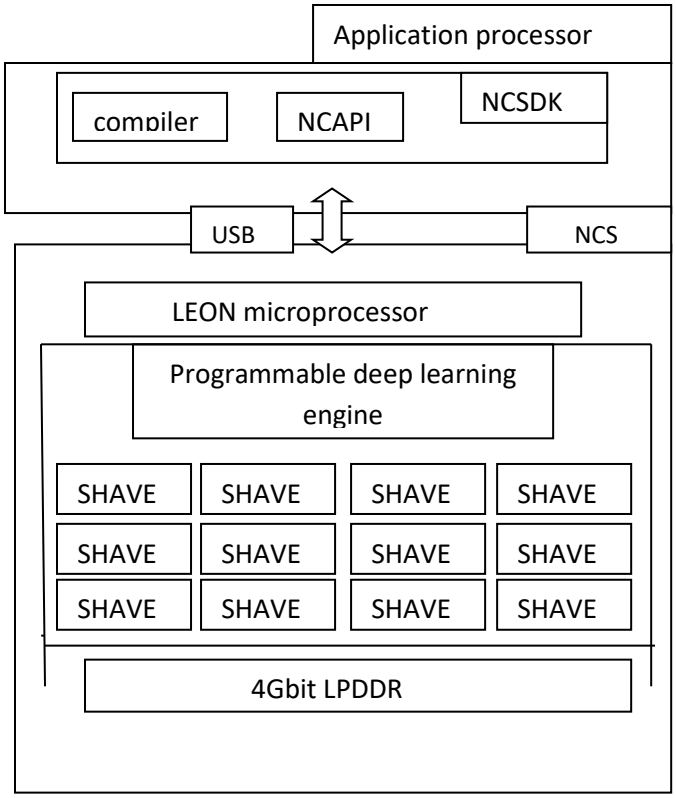
PROPOSED SYSTEM:

Vehicle detection is one of the important considerations while deploying in autonomous cars. In this project we use the hardware namely Movidius NCS. The main objective of this project is to detect and classify vehicles in order to increase accuracy and reduce processing time.

MOVIDIUS NCS

Movidius NCS is a type of hardware in the form of USB drive. This hardware is launched by Intel. It is used for object detection, object classification, facial recognition, natural language processing. The training stage involved inside the hardware. Billions of parameters of images loaded in this hardware and we can compare the parameters of images with the original image. The video is given as an input. Number of frames is considered as a video. Now this hardware is designed only to support caffe software. The operating system which will support this movidius hardware is only LINUX operating system.

ARCHITECTURE



DESCRIPTION:

LEON MICROPROCESSOR:

LEON Microprocessor is a 32 bit microprocessor. It can be designed for embedded applications. It provides low complexity and power consumption with high performance.

SHAVE PROCESSORS:

SHAVE(Streaming Hybrid Architechure Vector Engine) processor contains wide and deep register files coupled with a Very Long Instruction Word (VLIW) for code-size efficiency. VLIW packets control multiple functional units which have SIMD capability for high parallelism and throughput at a functional unit and processor level. Each of these units can be launched in parallel in a single instruction packet.

NCSDK:

NCSDK consists of set of tools to help deployment and development for real-time applications. This software development kit contains three command line tools such as mvNCCompile, mvNCProfile, mvNCCheck.

mvNCCompile:

mvNCCompile command line tool converts the frames of video into graph file format.

mvNCProfile:

mvNCProfile command line tool converts the graph file format into text format. The text format contains statistics of layer by layer. It is very helpful to determine how much time spent on each layer.

mvNCCheck:

mvNCCheck command line tool compares the NCS results and expected framework results.

4Gbit LPDDR:

Low power dual data rate (LPDDR) is a modified form of dual data rate for SDRAM. It provides low power consumption. The supply voltage is reduced from 2.5V to 1.8V.

OPEN CV

OpenCV is an open source library for supporting computer vision, machine learning and image processing. It is released under BSD and so it is used for academic and commercial purpose. It supports a lot of algorithms related to computer vision, image processing and machine learning and it grows up day by day. Because of improving computational efficiency and real time applications, OpenCV was designed. This library currently supports many programming languages like C++, Python, Java etc and can possible on different platforms like Windows, Linux, OS X, Android etc. In this project we use Python language and Ubuntu 16.04 platform. Movidius Neural Compute Stick supports OpenCV. Python is considered as a general purpose language and proposed by Guido van Rossum. Because of its simplicity and readability, it became very popular now-a-days. OpenCV supports more than 2500 algorithms. Single Shot Detector(SSD) algorithm used for object detection in OpenCV. MobileNet is a deep neural network and used for object detection. The combination of single shot detector algorithm and MobileNet gives a efficient way for deep learning object detection.

EXISTING Vs PROPOSED SYSTEM

Generally vehicle detection in autonomous cars consists of three stages namely training, inference and deployment. In training stage training a model by giving lot of sample images will take a long time. In existing systems[1],[2],[3],[4],[5], they used these techniques only. But in our proposed system, we are going to introduce a new hardware with in-built of training stage. It will reduce a processing time. In the existing systems the vehicle detection will take place by the method of vehicle recognition that is by comparing the sample image with the input image directly. But in our proposed system object detection will take place by the method of vehicle detection. That means it will compare the images by considering its parameters instead of compare the image directly. As we are using vehicle detection method it increases the accuracy in terms of probability.

Existing Features

- SqeezeDet framework is used.
- There is no such hardware to implement training stage as we have to implement manually.
- Network is required.
- More complex.

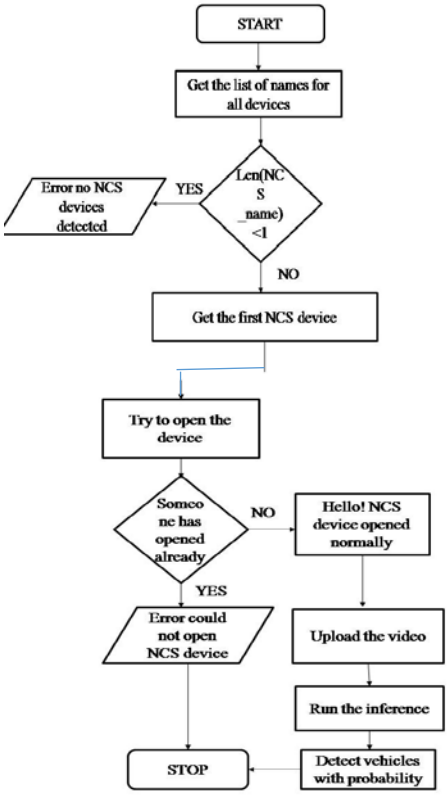
Proposed Features

- Caffe framework is used.
- No need of giving training stage manually as we use hardware.
- No network is required.
- Less complex.

PEOCEDURE:

Step 1: Install Ubuntu 16.04 operating system.
Step 2: Install NCSDK(Neural Compute Software Development Kit) and NCAPPZOO(Neural Compute Application Zoo).
Step 3: Check NCS device is inserted or not through Ubuntu commands.
Step 4: Upload the video.
Step 5: Run the inference
Step 6: Detect vehicles with probabilities.

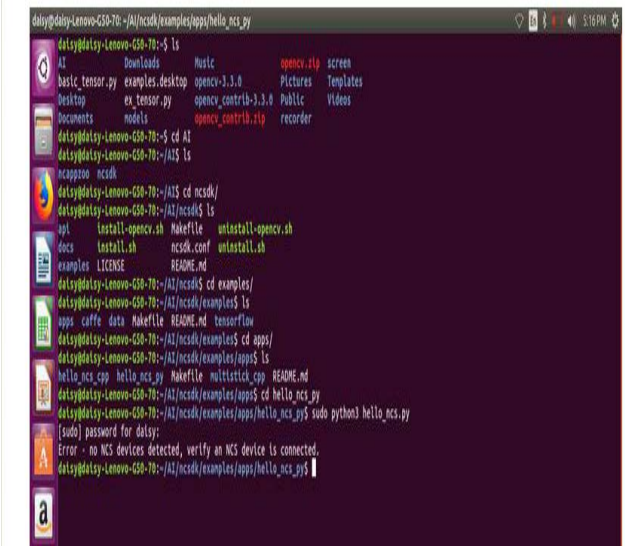
FLOWCHART



RESULT AND ANALYSIS:

We are going to demonstrate our project by using application processor with the insertion of neural compute stick (It will be like a USB drive). Before implementing the process of vehicle detection and classification the important step is to check whether the NCS devics is inserted or not. It will be checked by giving ubuntu commands in terminal window as shown in figure.

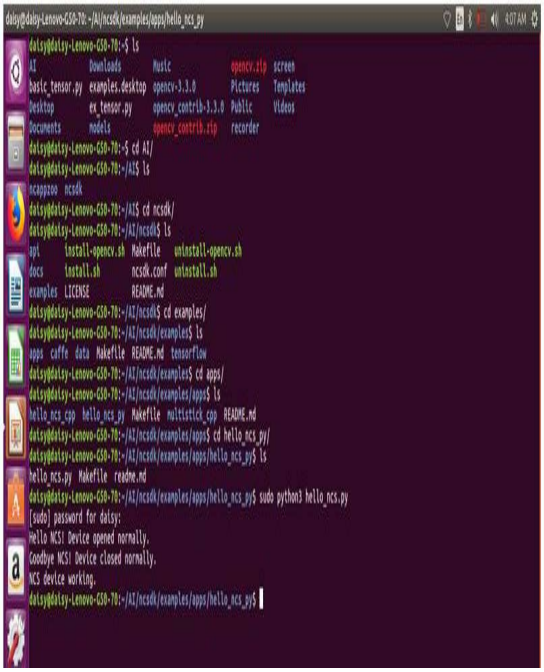
Case 1: When NCS is not inserted



From the above figure, it shows the output as "**Error-no NCS devices detected, verify an NCS is connected**".

Case 2: When NCS device is inserted

From the below figure it shows the output as **"Hello NCS Device opened normally.", "Goodbye NCS Device closed normally." "NCS Device working**".

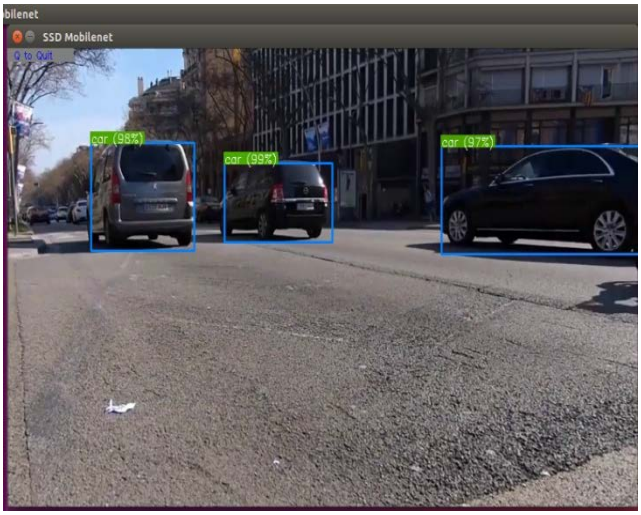


INPUT

Input will be given is any video file which have been taken in a highway road.

OUTPUT

Finally the output will be shown by inserting bounding boxes over the vehicle and producing the car classification with the probability as shown in figure.



It can also detect the persons not only vehicles as shown in below figure. By using this hardware we can detect any kind of objects.

CONCLUSION:

In this paper we have presented a vehicle detection and classification system. We proposed a one hardware namely as Movidius Neural Compute Stick. While driving autonomous cars object detection is the most important part. By implementing this project we have successfully satisfied all the requirements such as low processing time, small model size, high accuracy interms of probability and energy efficiency. The results obtained output as bounding boxes with high class probabilities.

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