UNIVERSITY of SOUTH FLORIDA

CIS 4930/CIS 6930 Hardware Accelerators for Machine Learning

Pedestrian Detection with CPU Vs GPU Architecture

Group 7 CPU

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Introduction on CPU & GPU-Implementation

Problem Statement: Detecting pedestrians is crucial for the advancement of smart vehicles. Traditional methods often struggle with environmental factors and fail to achieve real-time accuracy.

CPU-While CPUs are not very effective for data-intensive applications, they are very ideal when considering the cost. CPUs generally become less effective when handling complex mathematical data, which might increase the training time.

GPU-When engaging with neural networks, GPUs serve as the primary backbone for deep learning, given that the majority of tasks are designed for parallel processing.

Implementation and Architecture in the CPU

INRIA benchmark dataset –Complex Images, Objects including junctions, and hence its viability for a real-time application

Feature Extraction: Histogram of Oriented Gradients (HOG) method.

HOG algorithm is executed by partitioning each image into small regions (cells) and computing histograms of orientation within each cell.

The SVM model will be trained in CPU on the HOG features,while will help in deciding the hyperplane for the Separation.

Inference Phase

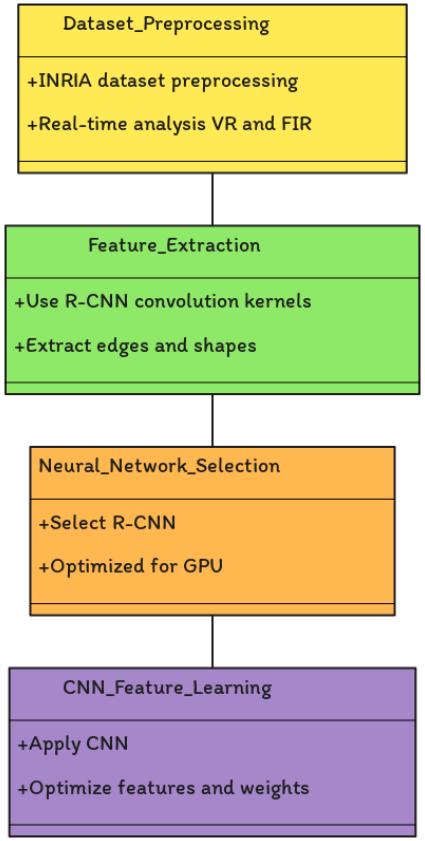
The raw images were processed to separate objects from the background, and HOG features were computed from the processed images using the CPU. Next, new images will be created to extract Histogram of Oriented Gradients (HOG) features. Then, a trained SVM model will scan through the images using the CPU to detect pedestrians.

Apply the non-maxima suppression to tune the accuracy

Implementation and Architecture in GPU

Inference:

Convolutional Neural Networks (CNNs) were employed for feature extraction via backpropagation, providing input for a kernel Support Vector Machine (SVM) to discern non-vulnerable road users (VRUs). Model optimization involved tuning hyperparameters, notably adjusting batch size, to maximize accuracy.



Results

False Alarm Rate: The models ability to avoid misclassifying the non-pedestrian objects

Processing Speeds: As we can see that the processing speed of the of the GPU is much lower than that of the CPU even with the fine tuning in the CPU model

	CPU	GPU
Accuracy	95.4%	97.2%
False Alarm Rate	0.1%	0.05%
Processing Speed	312 µs	65 µs

Conclusion

- The CPU performing a fixed window search within a specified region, rather than checking the whole range of locations and scales, is primarily in object detection tasks, especially when using methods like the Histogram of Oriented Gradients .
- By restricting the search to a predefined region of interest, computational resources are conserved, helps in minimizing false positives.
- GPU-Detection accuracy equaled 97.2 % while the false positive rate equally was 0.05% per image frame.
- Both the models CPU and the GPU implementations perform well, but in terms of the speed the GPU is much faster than that of the CPU

THANK YOU

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