Improved Image Pre-Processing for Sharpened Object Detection in Image

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Introduction

This project primarily focuses on ways to get better object detection using deep neural networks, which will help in identifying the tanks and other armoured vehicles across different weather conditions.

Motivation

While there is a lot of topographical data available for the DRDO by the Indian satellites but most are not usable due to the image quality and various weather and geographic conditions across India.These problems such as fog during winters or image distortion due to shadows in the image which decrease the efficiency of the computer vision algorithms can be reduced.

SCOPE of the Project

To create a model where there is Pre-Processing of the image done to improve features, these Pre-Processing are removal of fog, shadows and finding the dominant color to create image from basic color palette and further after the Preprocessing using the image to train the best convolutional neural network which detects the different vehicles across the different images with high level of confidence. While creating a model from scratch is not required only that find the best existing model which has least losses and trains faster on images.

Methodology

This project has made a certain novel approach to detection of objects in a manner that is able to get better results than any other deep neural network model and has a unique solution to a difficult and important problem.

The whole project consists of following components -
● Parsing the Asian Paints Library for the entire color palette offered by them
● Pre-processing the image for removal of fog
● Find the dominant colors from the image using hierarchical quantization
● Creating a Object Detection model to get inference of objects in the image to classify them as armoured vehicles
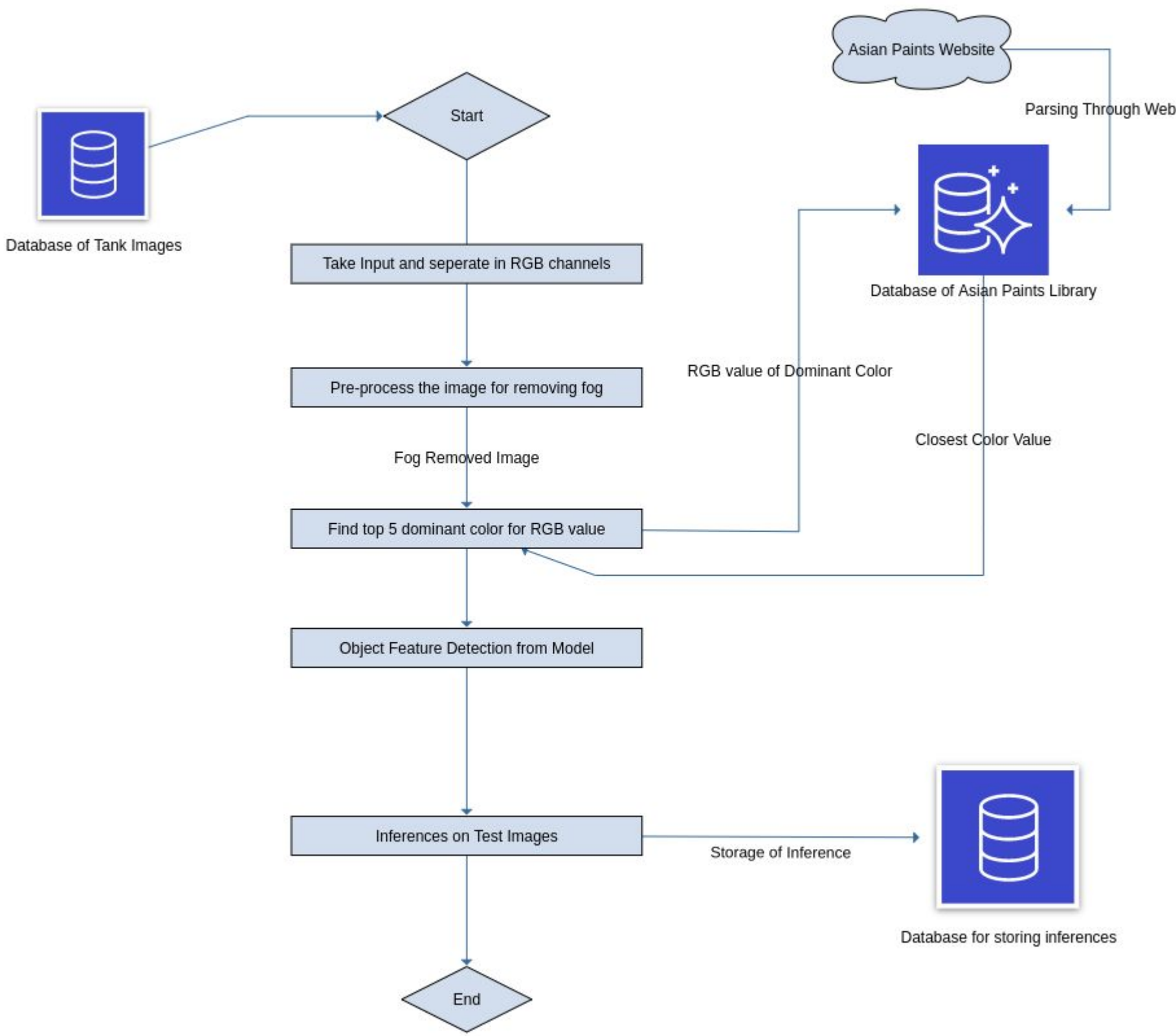
The project starts by taking a color pallete to generate the images only from a standard pallete of colors. Next its pre-processes the images in the feed to get better results in places where there is fog in the images, by removing it from the scene.

It further increases the test dataset by getting the dominant color from the images using the heirarchical qunatization and recreating the images with only the dominant colors in the image. This process can help in scenarios where the original dataset is very small and multiple images created through this method can help the model in training.

Next the ResNet Model is trained with the images for multiple epochs and large steps sizes to get better results. This helps in generating a model which is able to quickly and efficiently detect objects across different weather conditions.

Results

The results of different steps of the projects are shown below -
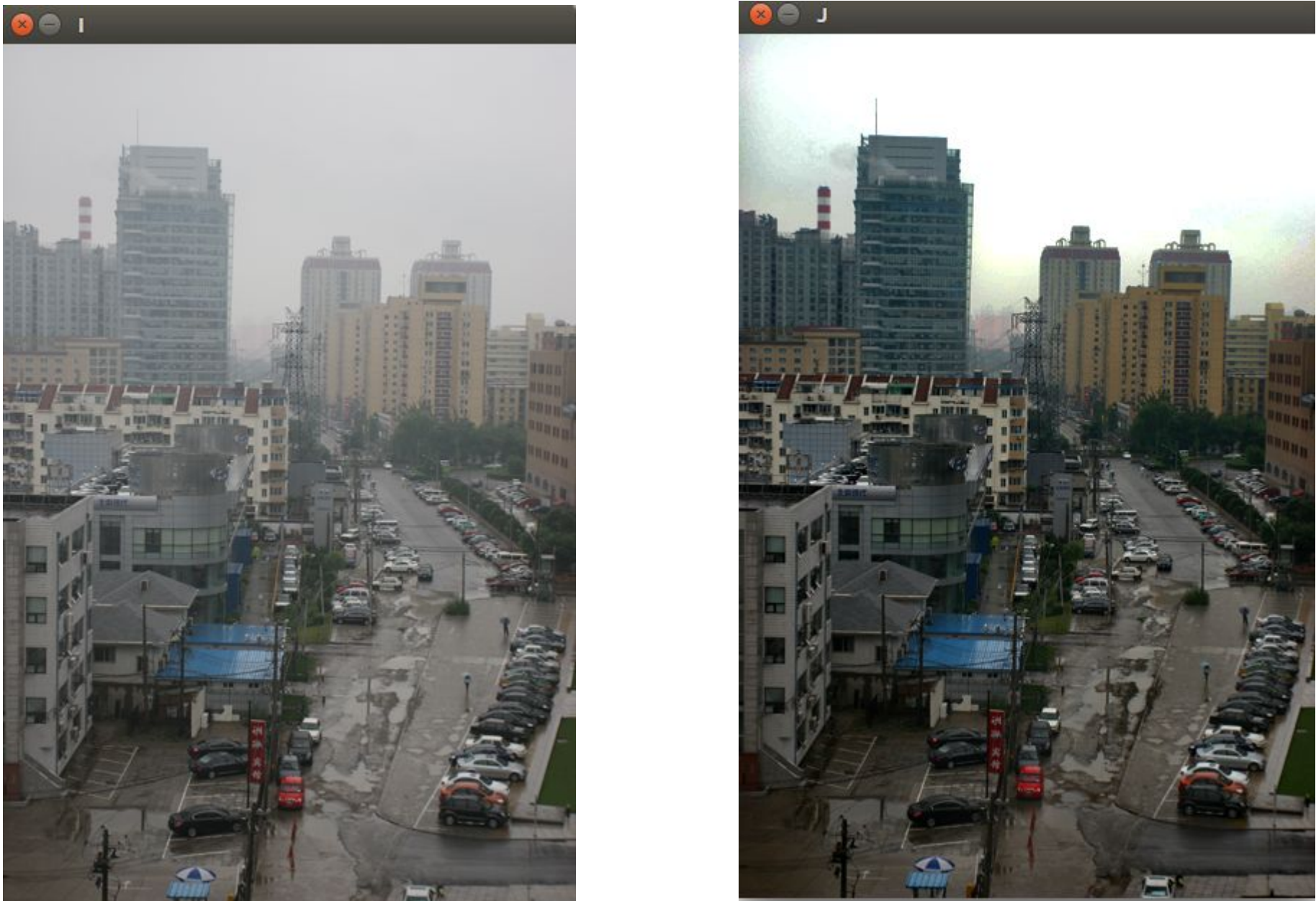
Fig - a) Input Image with Fog b)Output Image after fog removal

The above methodology of dark channel prior to get fog free images can be used in various different scenarios, and is used as pre-processing step in input to the model.
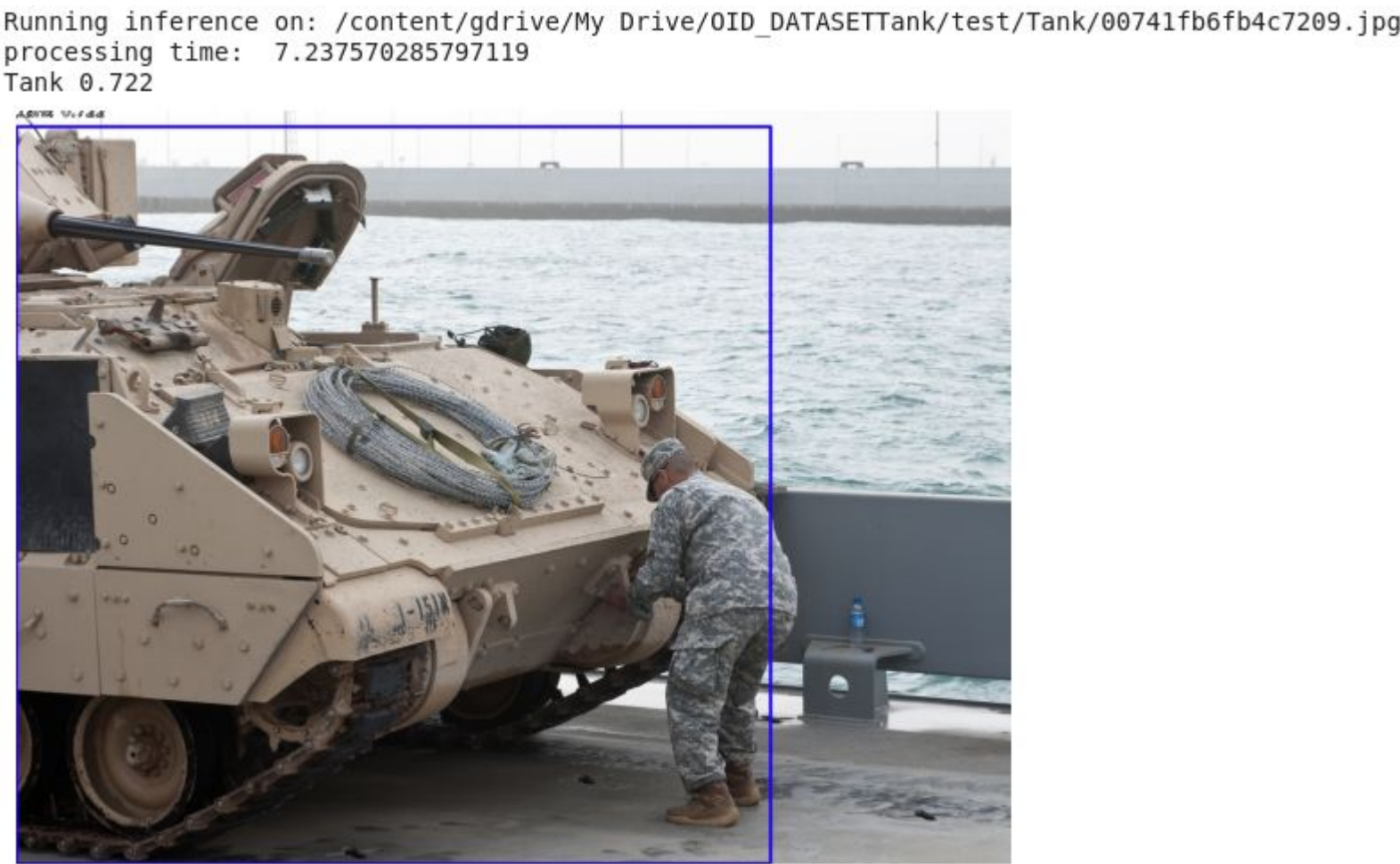
Fig - Model showing inference for input image with the confidence score and processing time taken for the image.

From the figure as shown above we can see the model is easily able to detect the armoured vehicle shown in the image despite there being slight trace amount of fog in input. The model is also able to classify the object belonging to Tank class with a confidence score of 0.722 which is very much above the threshold of 50% and it shows bounding box of blue color along the length of tank which is helpful in cases the image is very big in length and width, also for documentation and analyzing purposes.

The image takes about 7.2 seconds to process a high resolution image which is much better than the time taken by conventional neural networks such as VGG16 etc.

Conclusion

After the complete development of all the components of the projects. This project serves as an addition to the detection systems to detect armoured vehicles across a variety of landscapes. This project will help in reducing the workload of humans which have to spend more hours in classifying and analyzing the data very frequently and this project can be scaled at large. Using this project's components such as the removal of fog can help in detection of vehicles even in heavily dense fogged images which otherwise would make the model not able to detect or at worst overwhelm the system or simply mark for human read.

References

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