Chapter Four

DISCUSSION OF RESULTS

4.1 Overview

This chapter focuses on discussing the results obtained after applying the steps and methods outlined in chapter three. Furthermore, a comparison of the performances of the model deployment on a computer system and also on the Raspberry PI is outlined.

4.2 Bird Detection using the model

The model deployed was tested with the evaluation data as stated in chapter three and the detection of birds works really well. The figure below is an image frame from the evaluation data with detected birds.

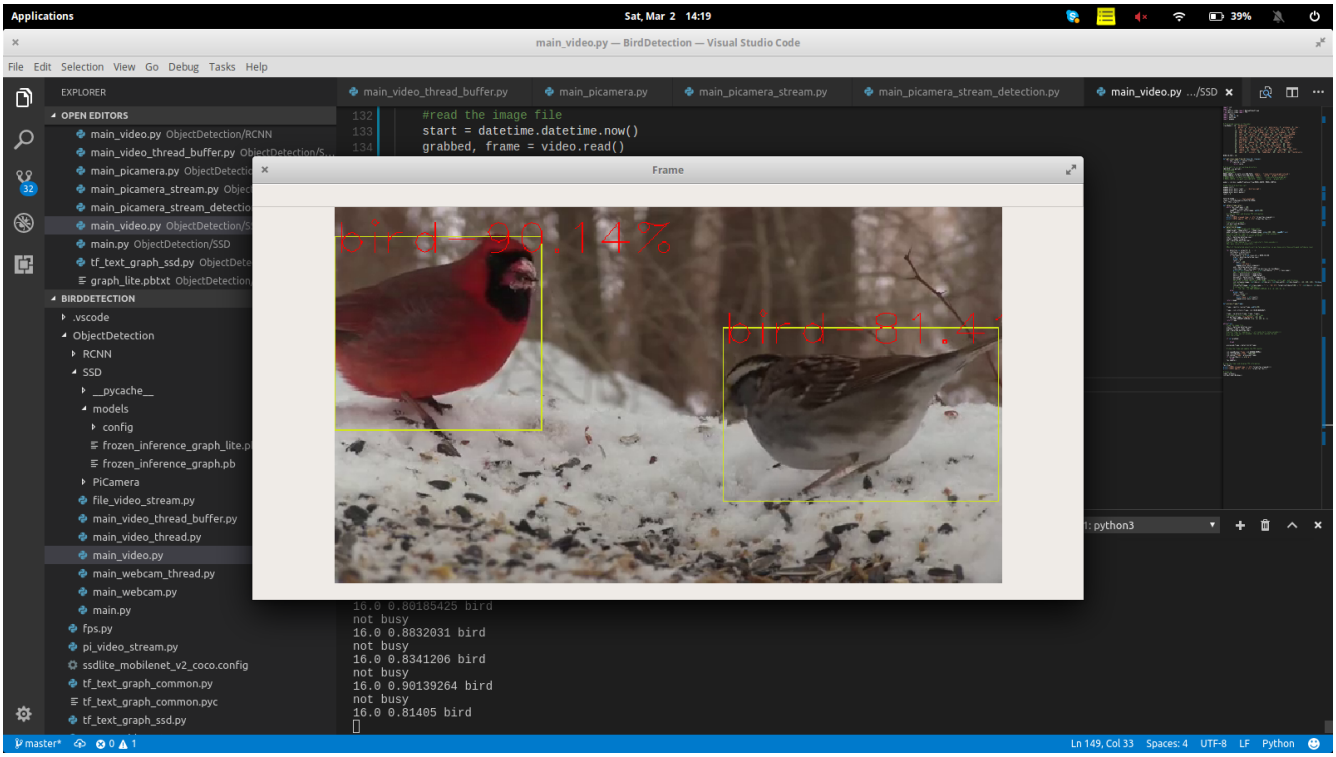

Fig. 4.1 Image frame with birds detected

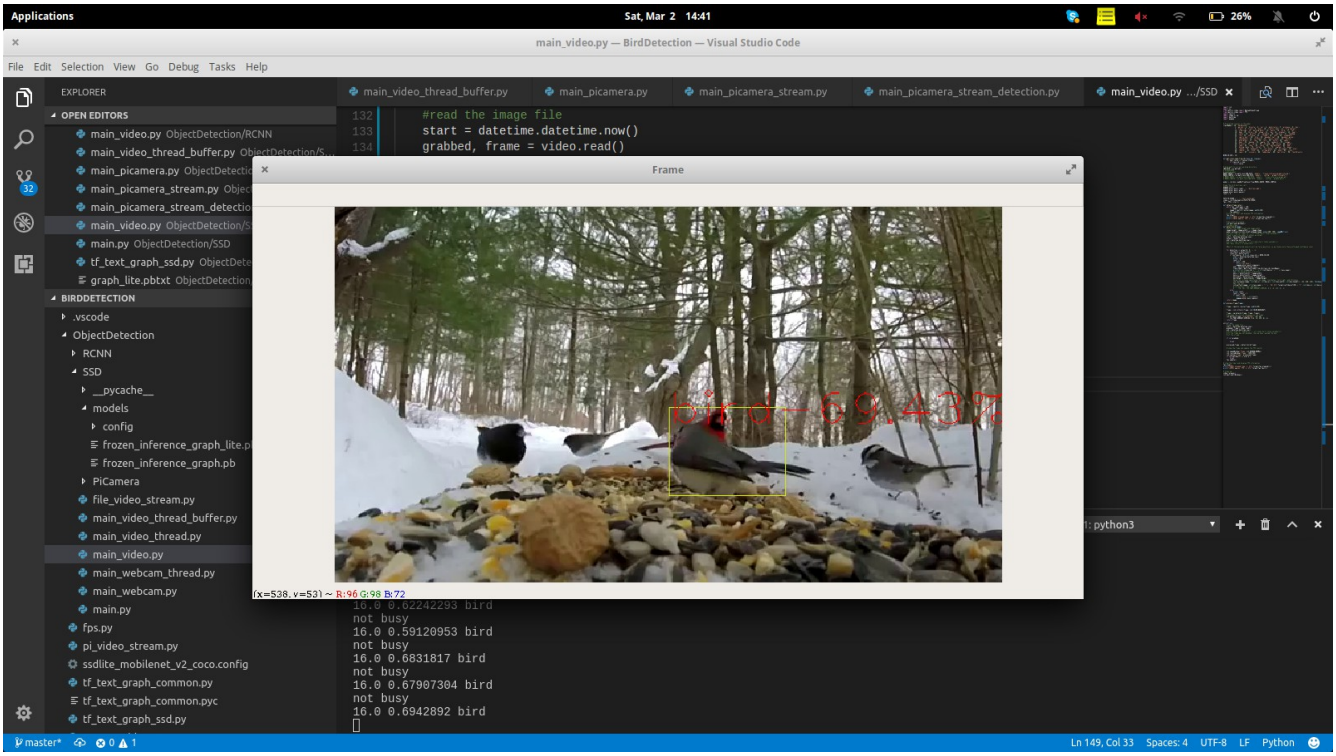

Fig. 4.2 Image frame with a single bird detected

However, the bird detection model did not work well with very small birds and birds whose distance are more 5 meters from the camera. This is expected as the SSD Mobilenet Model used in this research work are known to be less accurate with small objects (Huang, 2017). For an application where model speed is not the most important consideration, a model such as Faster R-CNN model could provide better accuracy (Huang, 2017). The figures below show image frames of poor detection when birds are too small or far from camera.

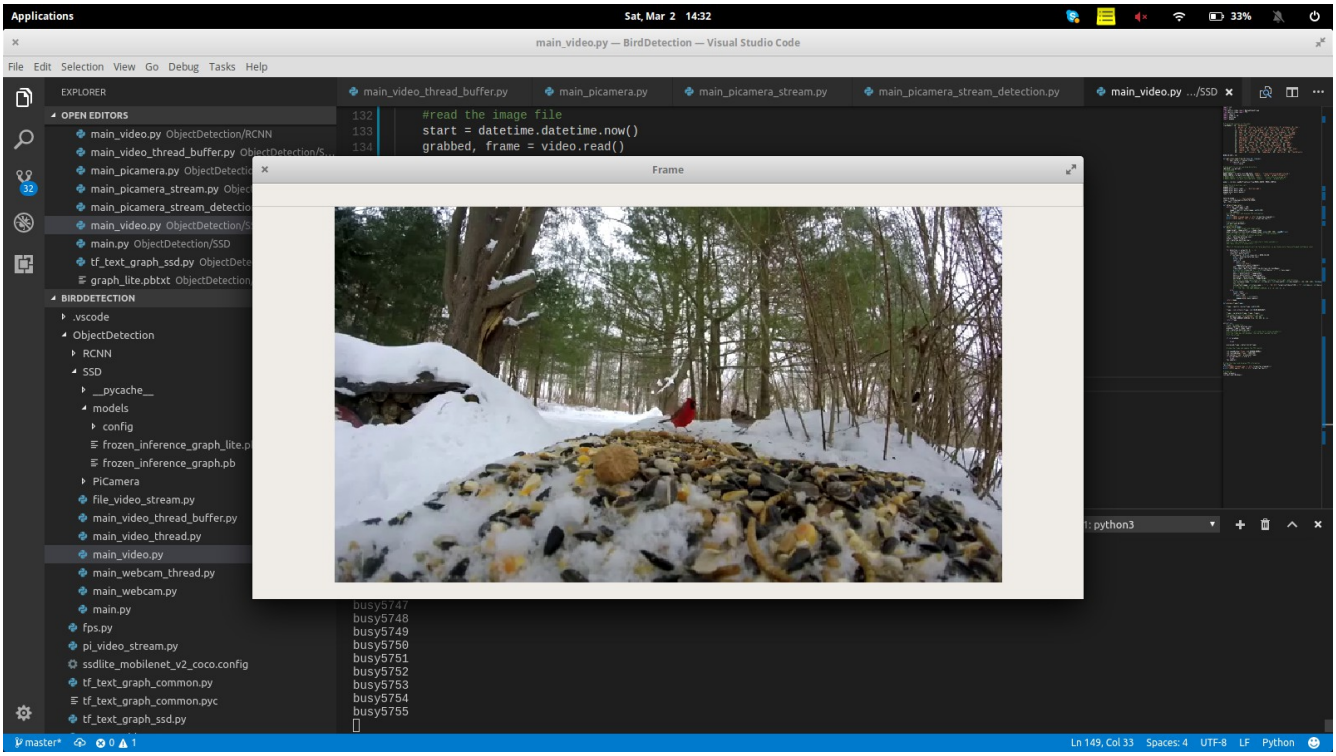

Fig. 4.3 Image frame with birds detected

The bird detection model was subjected to the evaluation data and the bird distress call sound was played automatically by the system when birds are in view of the camera and the sound paused when the bird are out of view of the camera. The distress call sound

4.3 Performance of the Model

The SSDlite Mobilenet model used for the detection purpose has its standard speed of detection(inference) at 27 milliseconds (Rathod, 2017).The performance of the model on the computer system and the Raspberry PI is now discussed. A summary of the results obtained for the evaluation metrics proposed in chapter 3 are explained below:

Environment	**No of frames Processed**	**Total time taken(seconds)**	**Frame Per second (FPS)**
Computer	2729	390.28	6.99
Raspberry PI	2400	3065.7	0.78

Table 4.1: Frame rate from review of detection results.

Based on table 4.1, The frame rate of the processing pipeline when the model is deployed to the computer system is at **6.99 FPS** which is considerably good for real time objection. The frame rate of the processing pipeline when the model is deployed to the Raspberry is at **0.78 FPS**. This decrease in

performance can be attributed to the low processing power of the Raspberry PI and its limited RAM size (1GB).

Environment	**Total Inference Time (ms)**	**No. of frames**	**Average Inference Time (ms)**
Computer System	4785.739	50	95.715
Raspberry PI	43869.212	50	877.384

Table 4.2: Inference time from review of detection results.

The SSDlite Mobilenet model used for the detection purpose has its standard speed of detection (inference) at 27 milliseconds (Rathod, 2017). Based on table 4.2, the speed of inference when tested on the computer system is **95.715 millisecond** which is considerably higher than the standard speed of the model (27 milliseconds). This difference could be attributed to the Graphical Processing Unit (GPU) power of the computer system as deep neural network like the SSD Mobilenet model used in this research work works better on device with good GPU capability. Furthermore, according to the model zoo documentation, the performance of the model may be slightly slower than the standard speed of the model (Rathod, 2017). The speed of inference performance of the bird detection model on the Raspberry PI at **877.384 milliseconds** is even slower. This is largely due to the low computational power of the Raspberry PI.

Environment	**Total True Positive**	**Total False Negative**	**Recall**
Computer System	40	24	0.625
Raspberry PI	40	24	0.625

Table 4.3: Recall from review of detection results.

The Recall metric as stated under evaluation metrics in methodology is a measure of percentage of relevant objects that are detected with the detector. 50 frames were used to obtained the recall result. Coincidentally but yet interesting to note that, both the Computer System and the Raspberry PI has the same recall value at **0.625 (62.5%)**. This shows that both has the same level of reliability in terms of detecting birds in any given image frame. However, the inference time as discussed earlier is what differs.
The reliability of bird distress call sound generation entirely also depends on this metric as every time the model predicts accurately, the bird distress call sound is also generated and stopped automatically when no bird is detected.

Rathod V & Wu N (2017) TensorFlow detection model zoo (documentation).

URL:https://github.com/TensorFlow/models/blob/master/research/object_detection/3

doc/detection_model_zoo.md. Cited December 27, 2018.

Huang, J.; Rathod, V., Sun, C.; Zhu, M.; Korattikara, A.; Fathi, A; Fischer, I.; Wojna, Z.; Song, Y.; Guadarrama, S. (2017) Speed/accuracy trade-offs for modern convolutional object detectors. CVPR 2017