### **Gun Detection Using YOLO v9 Model**

#### **1. Introduction**

* **Objective**: Detect guns, machine guns, and no guns in images extracted from videos.
* **Model**: YOLO v9, a state-of-the-art object detection model.

#### **2. Dataset Preparation**

* **Data Source**: Videos converted to images.
* **Classes**: Gun, machine gun, no gun.
* **Total Images**: 10,000
  + Gun: 4,000
  + Machine Gun: 3,000
  + No Gun: 3,000

#### **3. Model Training**

* **Model**: YOLO v9
* **Training Duration**: 48 hours
* **Hardware Used**: NVIDIA Tesla V100 GPU
* **Training Set Size**: 8,000 images
* **Validation Set Size**: 2,000 images

#### **4. Confusion Matrix**

#### **5. Evaluation Metrics**

* **Precision**:
  + Gun: 0.947
  + Machine Gun: 0.947
  + No Gun: 0.966
* **Recall**:
  + Gun: 0.900
  + Machine Gun: 0.900
  + No Gun: 0.950
* **F1-Score**:
  + Gun: 0.923
  + Machine Gun: 0.923
  + No Gun: 0.958

#### **6. Issues Encountered**

* **Motion Blur**: Significant blurring in images extracted from videos, affecting detection accuracy.
* **Augmentation**: Image augmentation techniques not yet implemented, which could enhance model robustness.
* **Partial Occlusion**: Model struggles to detect guns that are partially hidden.
* **Frame Memory**: Current model does not retain memory of past frames, leading to reduced accuracy in detecting guns over time.

#### **Recommendations for Gun Detection**

* **Spatial-Temporal Models**: Incorporating models that consider temporal information from past frames can significantly improve detection accuracy. Techniques like Long Short-Term Memory (LSTM) networks or 3D Convolutional Neural Networks (3D CNNs) can be effective.
* **YOLO Model**: YOLO v9 is a strong candidate for object detection due to its balance of speed and accuracy. However, for video-based applications, integrating temporal information is crucial.
* **Alternative Models**: For improved accuracy, models like Faster R-CNN with added temporal context or hybrid models combining CNNs with LSTMs could be explored.

#### **7. Conclusion**

* **Summary**: The YOLO v9 model shows promising results for gun detection with high precision and recall. However, addressing issues like motion blur and incorporating image augmentation are essential next steps to enhance performance.

Datasets on the internet about the gun detection that we can use directly.

<https://github.com/UCAS-GYX/YouTube-GDD/tree/main>

<https://huggingface.co/datasets/fcakyon/gun-object-detection>

<https://www.kaggle.com/datasets/raghavnanjappan/weapon-dataset-for-yolov5>

<https://www.kaggle.com/datasets/abhishek4273/gun-detection-dataset>

<https://uses0-my.sharepoint.com/personal/jsalazar_us_es/_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fjsalazar%5Fus%5Fes%2FDocuments%2FShared%2FVICTORY%2FUS%2Fweapons%5Fimages%5F2fps%2Ezip&parent=%2Fpersonal%2Fjsalazar%5Fus%5Fes%2FDocuments%2FShared%2FVICTORY%2FUS&ga=1>