**Project Title: “Weapon Detection in Surveillance Cameras”**

**Abstract:**

**Project Objectives:**

* To detect weapons like guns and knives from surveillance video frames using deep learning.
* To utilize the latest YOLOv12 architecture for improved detection accuracy and speed.
* To build upon the open-source Kaggle implementation for enhanced performance and reliability.
* To prepare for future integration with real-time camera systems and alert generation.

**Methodology:**

**Dataset Acquisition and Pre-processing:**

* The dataset, obtained from Kaggle, contains segmented frames annotated with weapon labels.
* All images are resized to **640×640** (as per YOLOv12 compatibility).
* Data augmentation techniques such as flipping, rotation, and brightness adjustment are applied to increase model robustness.

**Model Selection and Training:**

* YOLOv12 is selected due to its state-of-the-art detection performance and lightweight design.
* Training is conducted using the Kaggle notebook, leveraging transfer learning with pretrained weights.
* Training was performed on Google Colab with GPU acceleration for efficiency.
* Modifications were made to the YAML configuration and dataset structure to align with YOLOv12 requirements.

**Testing and Evaluation:**

* The model is evaluated using mean Average Precision (mAP), precision and recall.
* False positives are monitored and minimized through hyperparameter tuning and model checkpoints.

**Step-wise Solution Approach:**

**Step 1: Dataset Collection and Pre-processing**

* Kaggle’s "Weapons in Images Segmented Videos" dataset is used.
* Images are pre-processed and augmented to enhance generalization.

**Step 2: Model Selection and Training**

* YOLOv12 is implemented using the referenced notebook.
* Training setup includes configuring dataset YAML files, anchors, and hyperparameters.

**Step 3: Inference and Future Deployment**

* Inference is performed using OpenCV to test on new video frames.
* Future upgrades will support real-time detection pipelines using Flask or FastAPI, with integrated alert systems (e.g., SMS, email).

**Key Findings:**

* YOLOv12 provides superior accuracy and detection speed for weapon detection in segmented frames.
* The system, though currently offline, is well-suited for adaptation to live surveillance setups.
* The notebook implementation significantly accelerated development and served as a flexible base.

**References:**

[1] Jain, H., Vikram, A., Kashyap, A., & Jain, A. (2020). Weapon detection using AI and deep learning for security. In 2020 ICESC, IEEE.

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