CONFIGURATION MANUAL

MSc Research Project
Data Analytics

Joseph Raju Myla
Student ID: X23224444@student.ncirl.ie

School of Computing
National College of Ireland

Supervisor: Hicham Rifai

National College of Ireland

MSc Project Submission Sheet

School of Computing

Student Name:	Joseph Raju Myla……………………………………………………………
Student ID:	X23224444@student.ncirl.ie…………………………………………………………………
Programme:	DATA ANALYTICS…………………………………………… **Year:** 2024…………………..
Module:	MSC RESEARCH PROJECT………………………………………………………………………
Supervisor:	29 January 2025………………………………………………………………………………..
Submission Due Date:	………………………………………………………………………………………………………
Project Title:	**Enhancing Real-Time Fire Detection with RT-DETR and Optimized Dataset Preparation**
Word Count:	1181…………………………………**Page Count 12**…………………………………………..

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
<u>ALL</u> internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

Signature: Joseph Raju Myla

Date: 29/01/2025

PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST

Attach a completed copy of this sheet to each project (including multiple copies)	□
Attach a Moodle submission receipt of the online project submission, to each project (including multiple copies).	□
You must ensure that you retain a HARD COPY of the project, both for your own reference and in case a project is lost or mislaid. It is not sufficient to keep a copy on computer.	□

Assignments that are submitted to the Programme Coordinator Office must be placed into the assignment box located outside the office.

Office Use Only	
Signature:	
Date:	
Penalty Applied (if applicable):	

Configuration Manual

Joseph Raju Myla
Student ID: X23224444@student.ncirl.ie

1. Introduction

1.1 Brief Overview of the Project

This project implements a real-time fire detection system using the RT-DETR (Real-Time Detection Transformer) architecture. The system processes images and video streams to detect fire and smoke in real-time, delivering high-accuracy results with minimal processing latency. The implementation achieves performance metrics of 0.985 for mAP@50 and 0.949 for mAP@50-95, while maintaining true real-time processing capabilities of 16.6ms per image.

1.2 Purpose of the Configuration Manual

This manual is designed to:

1. Guide users through the complete setup and implementation process
2. Provide detailed configuration instructions for the RT-DETR architecture
3. Help users understand and optimize model performance
4. Serve as a reference for troubleshooting common issues

The manual covers:

- Environment setup and requirements
- Dataset preparation and organization
- Model configuration and training
- Hyperparameter tuning procedures
- Evaluation methods
- Inference and testing processes

2. System Requirements

2.1 Hardware Requirements

Minimum Specifications:

- GPU: NVIDIA T4 GPU with 15 RAM
- Storage: 50GB free space on Google Drive
- RAM: 32GB system memory
- CPU: Multi-core processor supporting CUDA operations

Recommended Specifications:

- GPU: NVIDIA A L4 GPU with 24 GB VRAM for larger batch sizes
- Storage: 100GB+ free space on Google Drive
- RAM: 64GB system memory for optimal performance

2.2 Software Requirements

Operating System:

- Any OS compatible with Google Chrome browser
- Google Chrome (Version 90+) recommended

Development Environment:

- Google Colab Pro(if T4 not supporting) subscription

- Google Drive account with sufficient storage
- Python 3.8 or higher

Required Libraries:

- Core Libraries: PyTorch 2.1.0, Ultralytics 8.3.40
- Image Processing: OpenCV 4.8.0, Pillow 9.5.0
- Data Processing: Pandas 2.0.3, NumPy 1.24.3
- Visualization: Matplotlib 3.7.1, Seaborn 0.12.2
- Additional Tools: TensorBoard 2.14.0

2.3 Environment Setup Requirements

Google Colab Setup

1. **Google Account Requirements:**
   - Active Google Colab
   - Sufficient Google Drive storage
   - Permission to mount Drive in Colab

3. **Network Requirements:**
   - Stable internet connection
   - Ability to maintain long-running Colab sessions
   - Access to Google services

3.Project Structure Setup

1. Main Project Directory:

   Create a folder structure in Google Drive as follows:
   - X23224444_JOSEPH_CONFIGMANUAL (main folder)
   - Dataset (for training data)
   - RT_DETR_results (for outputs)
   - RT_DETR_model.pt (trained model)

2. Dataset Organization:
   - train folder: Contains training images and labels
   - valid folder: Contains validation images and labels
   - test folder: Contains test images and labels

   Each subfolder should have 'images' and 'labels' directories

3. 1 Results Organization:

- processed_videos: For video inference outputs
- rt_detr_fire_smoke: For training results
- weights: For model checkpoints

3.2 System Verification

Essential Checks

1. GPU Verification:
   - Confirm GPU access
   - Verify VRAM availability
   - Check CUDA compatibility

2. Storage Verification:
   - Confirm minimum 50GB free space

- Verify access to model weights
- Check dataset accessibility

3. Environment Verification:
    - Validate library installations
    - Confirm drive mounting
    - Test read/write permissions

3.3 Troubleshooting Guide

Common Issues and Solutions:

1. Drive Mounting Issues:
    - Re-authenticate Google account
    - Check internet connection
    - Verify drive permissions

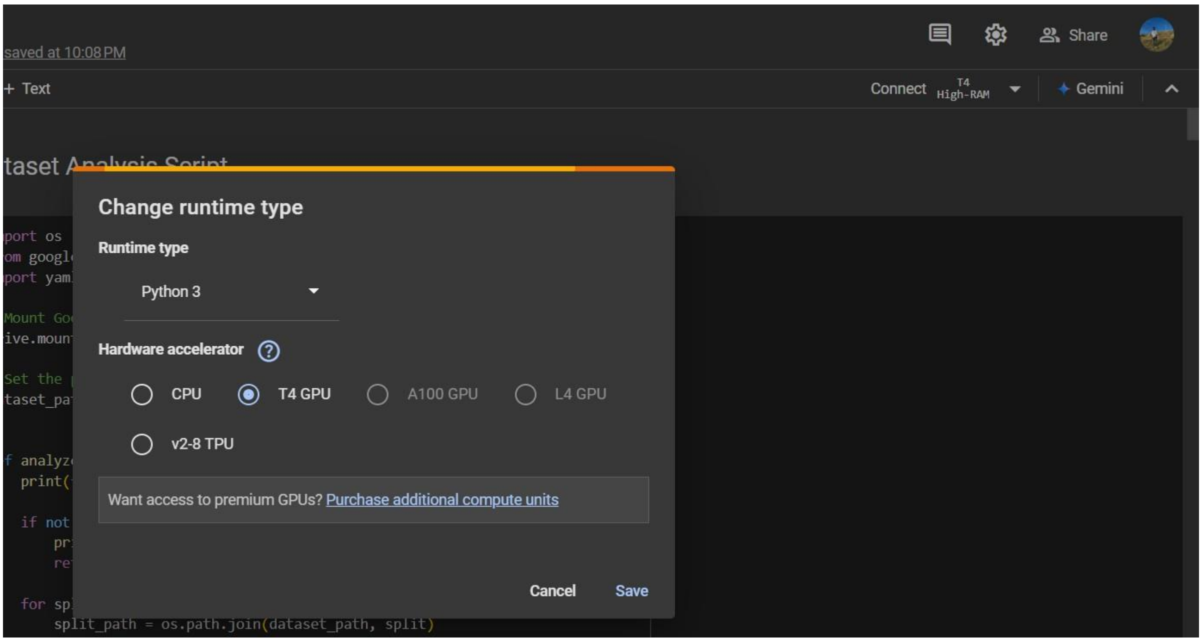
2. GPU Availability:
    - Verify Colab Pro+ subscription
    - Switch runtime type if needed
    - Restart runtime

3. Memory Issues:
    - Clear runtime memory
    - Reduce batch sizes
    - Verify file integrity

4 Setting Up Fire and Smoke Detection with Google Drive Integration

Step 1: Initial Colab Setup

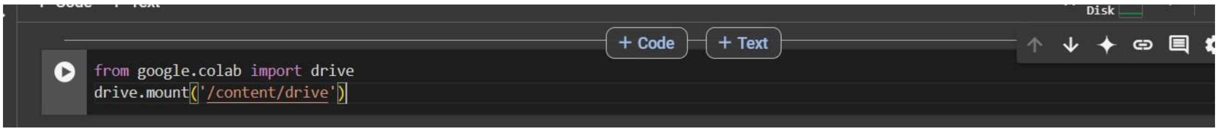
- Open a new Google Colab notebook
- Ensure you're logged into your Google account
- Enable GPU from Runtime settings for faster detection



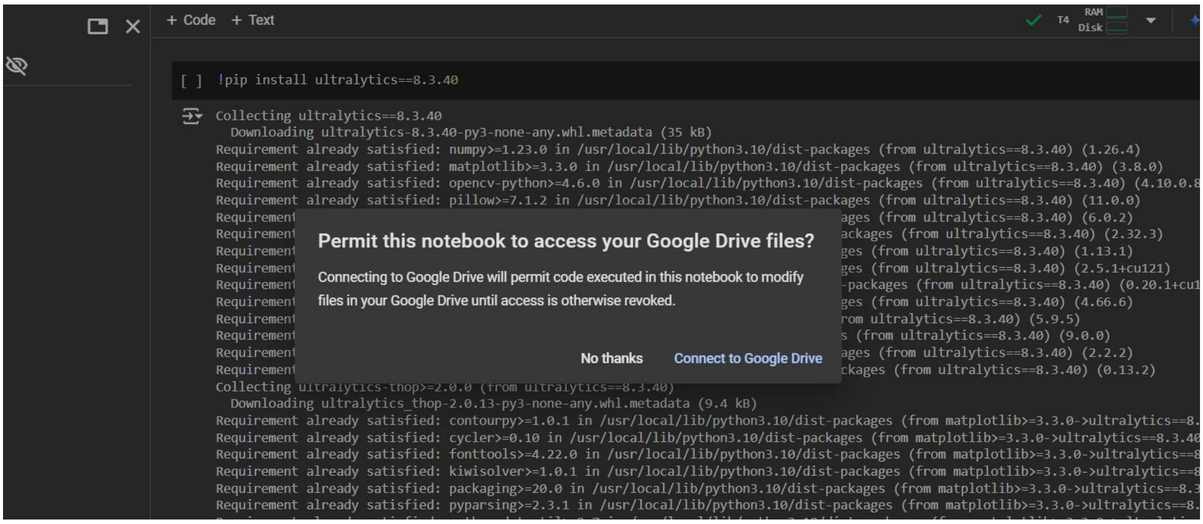
Select the T4 GPU

Step 2: Google Drive Integration

- Mount your Google Drive to access Joseph_best.pt model
- Connect to your Drive where the model is stored
- Grant necessary permissions when prompted



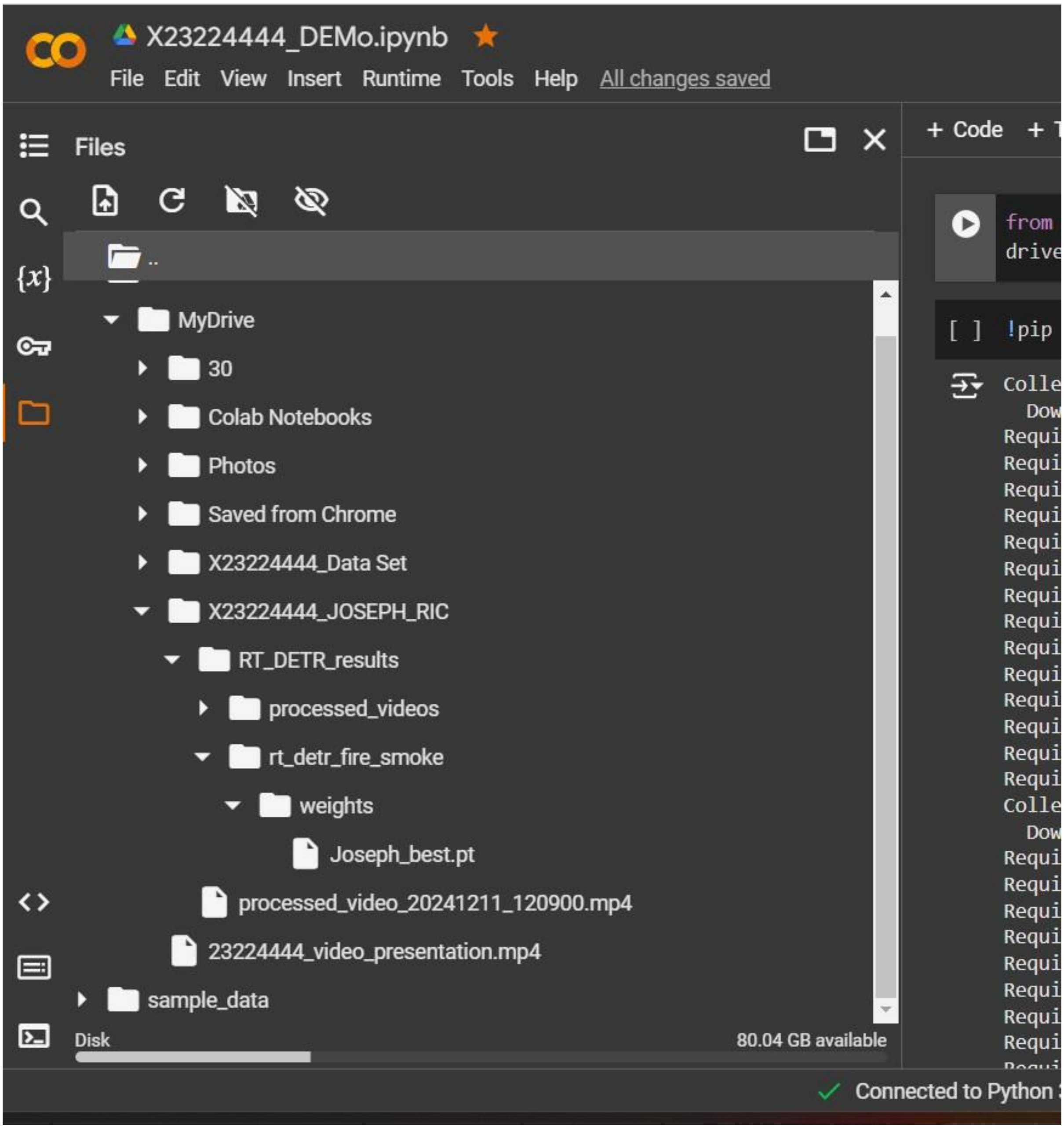
Run above cell and it will ask permission and provide the permission to access the saved model.



Step 3: Model Access Configuration

- Navigate to your model location in Drive
- Ensure Joseph_best.pt is in an accessible folder
- Set up proper path linking to Google Drive model location

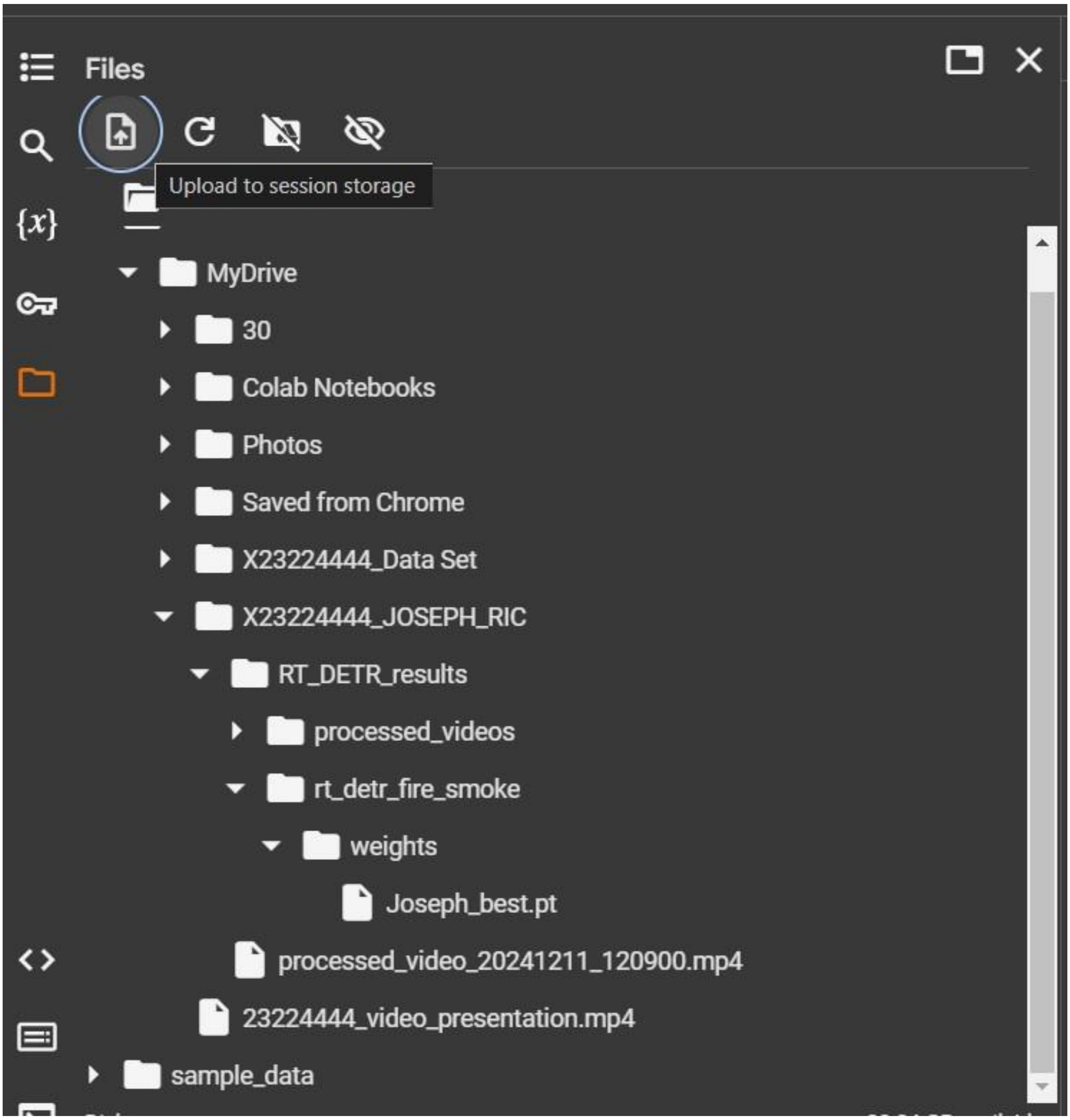
Check like below, are you able to see the directories of the google drive and model file from the navigation panel on the google collab



Step 4: Image Management in Colab

- Upload test images directly to Colab environment
- Images stay available during your active session

Use the below shown symbol on the left side of the colab and upload some images of the fire and smoke to test the trained model.



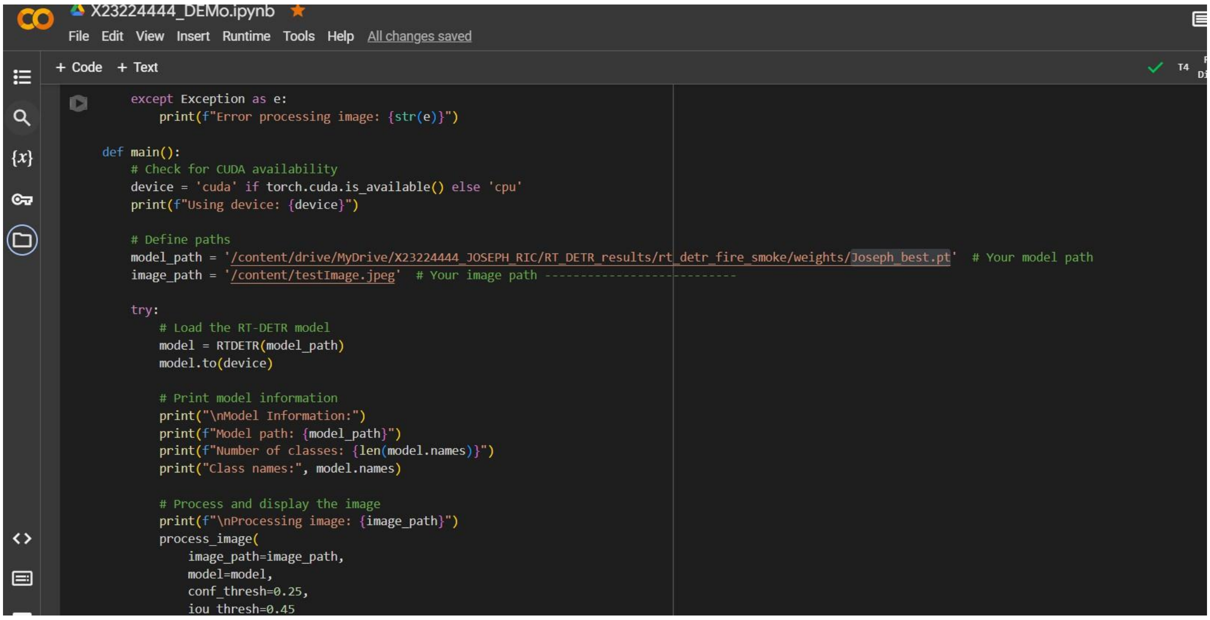
Step 5: Directory Structure

- Keep model path pointed to Google Drive location
- Set up results directory in Colab session

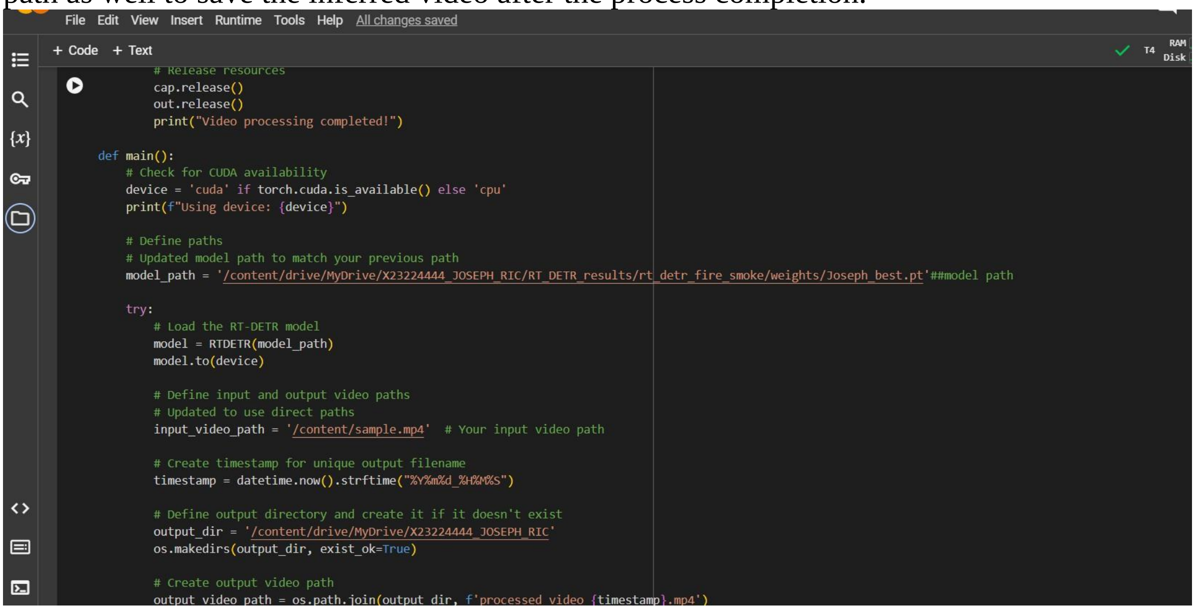
Step 6: Path Management

- Use Drive path for Joseph_best.pt model reference
- Configure local Colab paths for uploaded images
- Set up output paths in Colab session

Change the model path and image path according to the current directory of their availability.



And Same for the video inference as well applicable, change the model path and video path to run the inference using the trained model. And for the video update the output directory path as well to save the inferred video after the process completion.



Important Notes

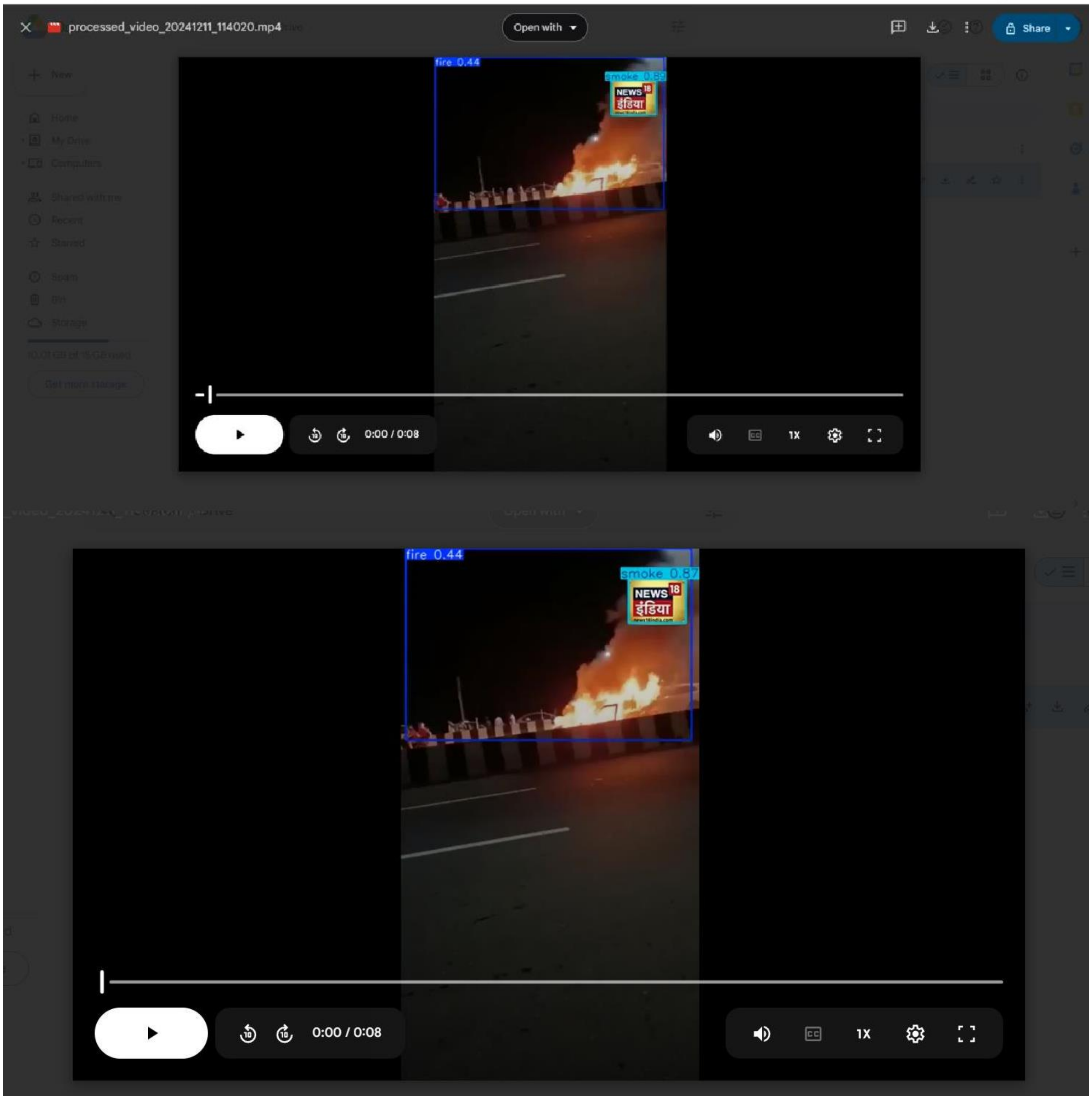
- Remember Drive mount point for model access
- Image uploads need to be repeated in new sessions
- Save important results to Drive before ending session

Best Practices

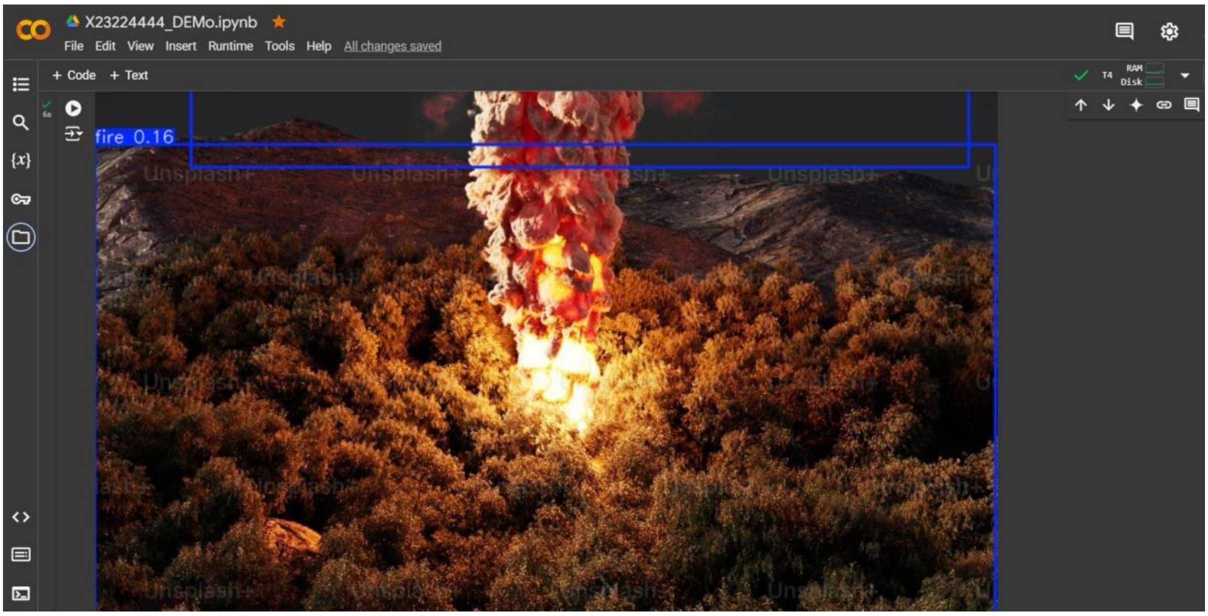
- Organize Drive folder structure for easy model access
- Use session storage for temporary image processing
- Maintain clear separation between Drive and session files
- Back up important detection results to Drive

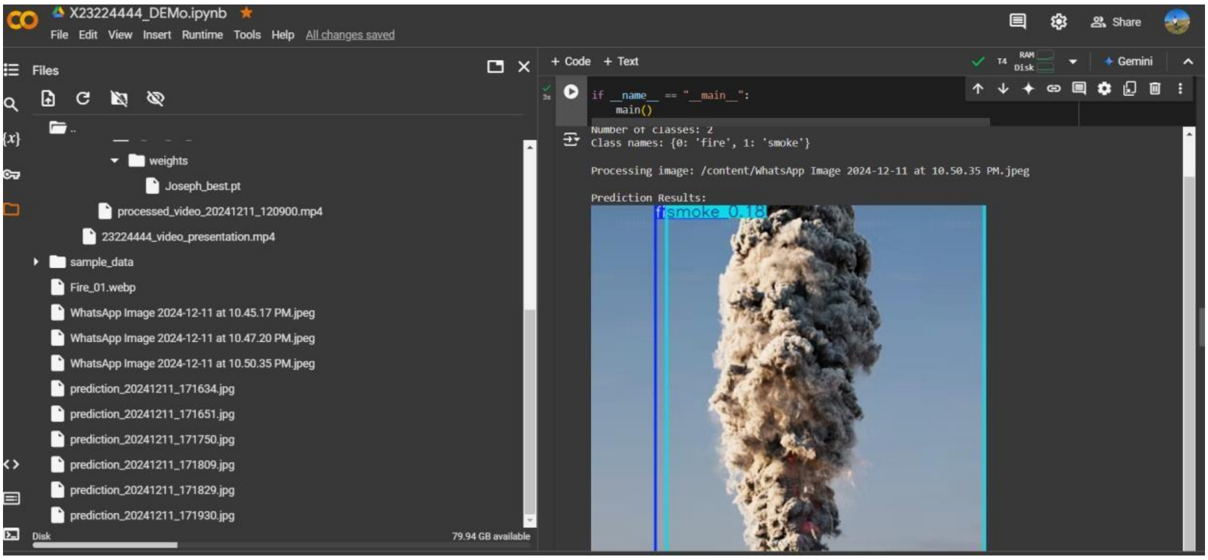
This setup combines permanent storage in Drive for your model with flexible session-based image processing in Colab.

1 Sample Results




fire 0.15
fire 0.17
fire 0.19
fire 0.18
fire 0.34
fire 0.23
fire 0.16
fire 0.20
fire 0.24
fire 0.23
fire 0.40
fire 0.21


X23224444_DEMo.ipynb
File Edit View Insert Runtime Tools Help All changes saved
+ Code + Text
T4
RAM
Disk
fire 0.16



References;
Ultralytics. (2024). RT-DETR (Realtime Detection Transformer). Ultralytics YOLO Docs. Retrieved from
Baidu Research. (2024). DETRs Beat YOLOs on Real-time Object Detection. CVPR 2024.
https://colab.research.google.co