AASD 4016 Full Stack Data Science Systems

Students

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Project: GearCheckAI

Introduction:

The project aims to develop a computer vision-based solution for automating the detection of Personal Protective Equipment (PPE) in industries like construction, medical and customs.
Utilizing the YOLOv8 deep learning architecture, the system seeks to accurately identify and classify various types of PPE such as Protective Helmet, Vest, Dust Mask, Glove, Protective Boots.

- Key Features:

Real-time detection capabilities for continuous monitoring of PPE compliance.
Robust performance under diverse environmental conditions and varying camera angles.

- Expected Outcomes:

Increased efficiency in PPE inspection processes.
Enhanced workplace safety standards and reduced accident rates.

Data:

We're using a dataset from Roboflow, featuring diverse images of individuals wearing various types of PPE such as construction, medical and custom PPE.

- First labeled dataset from Roboflow for Construction PPE with 2197 total images of PPE.
  Class Labels: boots, gloves, helmet, vest
  https://universe.roboflow.com/hx-hezqh/ppe-detection-yfmym/dataset/1
- Second labeled dataset from Roboflow for Medical PPE with 1099 total images of PPE.
  Class Labels: coat, glasses, glove, mask
  https://universe.roboflow.com/lab-2mkrr/cgg-detector/dataset/3
- Third label dataset from Roboflow for Custom PPE with 44002 total images of PPE.
  Class Labels: fall-detected, gloves, goggles, hard-hat, ladder, mask etc.
  https://universe.roboflow.com/roboflow-universe-projects/personal-protective-equipment-combined-model/dataset/4

Past Projects:

COVID-19 PPE Dataset for Object Detection, Safety Helmet Detection, etc.

- Revealed a gap in automated PPE detection solutions.
- Existing methods lack robustness, scalability, and real-time performance.
- Previous attempts relied on traditional computer vision techniques, struggling with complex environments and varying lighting conditions.

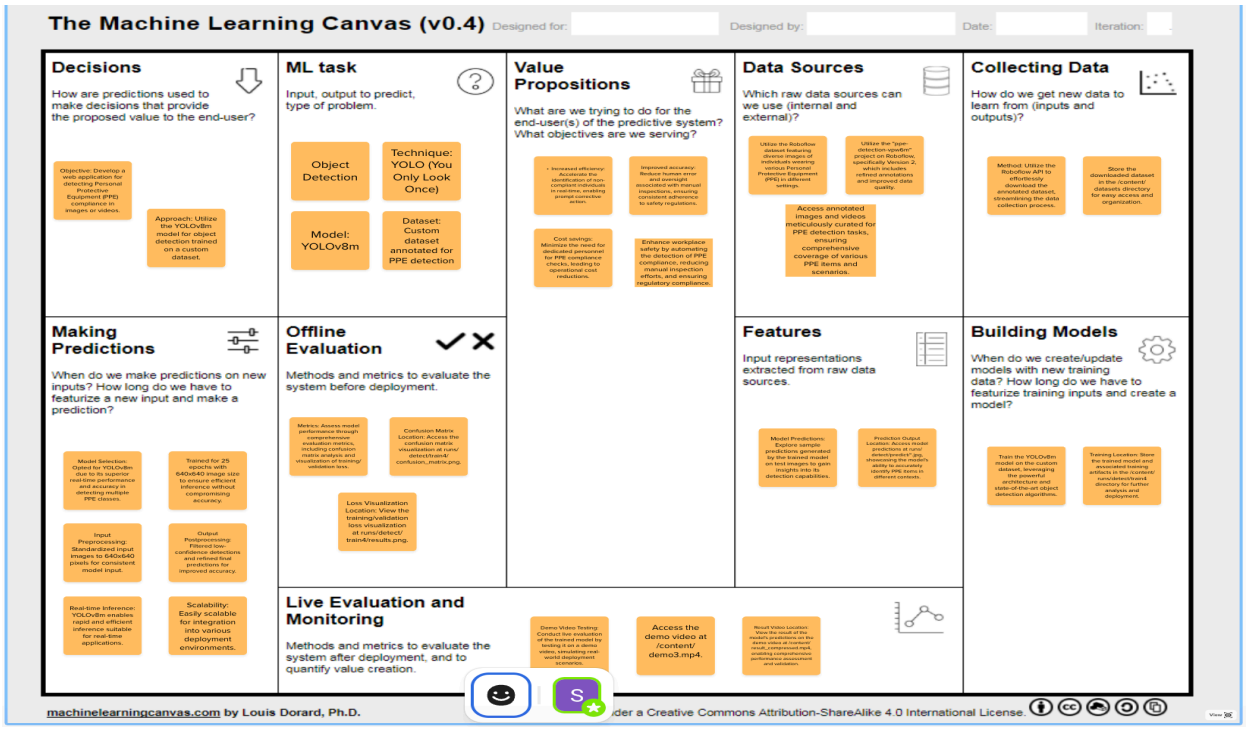
Drawbacks of Existing Solutions:

- Low accuracy, limited adaptability, and high computational requirements.
- Challenges like occlusion, small object detection, and class imbalance remain unresolved in many projects.

Our Project:

- Developed a single object detection model for various PPE types: fall-detection, safety helmets, masks, gloves, vests, coats, glasses, etc., tailored for construction, medical, and diverse industries.

ML Canvas:



Model Benchmark:

Data Preparation:

- Conducted preprocessing for image augmentation
- Ensured dataset balance across PPE categories to avoid bias.

Model Training:

- Used YOLOv8 architecture with transfer learning for PPE detection.
- Fine-tuned the model for enhanced performance on the custom dataset.

Evaluation Metrics:

- Achieved 75% accuracy in PPE item identification.
- Evaluated using precision, recall, and mAP50-95 metrics.

Key Achievements:

- Improved detection accuracy compared to traditional methods.
- Demonstrated robust performance in real-world environments.
- Validated effectiveness through benchmarking against existing solutions.

Model	Dataset	Epochs	Precision	Recall	mAP50-95
Yolov8m	Construction PPE	24	0.86859	0.8072	0.64982
Yolov8m	Medical PPE	49	0.75158	0.67678	0.37554
Yolov8m	Custom PPE	9	0.62304	0.64247	0.36837

Model Deployment:

Utilized Render for deploying the PPE detection model.

Deployment Files:

- Notebook: Used for model training and experimentation.
- Python Script (Yolo_Video_Detection.py): Contains code for real-time video detection.
- Main Script (main.py): Handles web application functionalities.
- Requirements.txt: Lists necessary dependencies for the project.

Conclusion:

- Successful development of an automated PPE detection system using YOLOv8, addressing critical safety concerns in workplace environments.
- Potential for widespread implementation across industries to enhance workplace safety, reduce accidents, and improve regulatory compliance.
- Continued research and development efforts to further improve model performance, scalability, and adaptability to diverse operating conditions.

Links:

Website: https://personal-protective-equipment-detection.onrender.com/home

Our Git repository: https://github.com/bilaldilbar54/Personal-Protective-Equipment-Detection-WebApp