**📜 Project Report**

**📖 Introduction**

The **Nut & Bolt Detector** is a machine learning-based application designed to detect and classify nuts and bolts in images. It leverages **YOLOv8**, a state-of-the-art object detection model, and provides an easy-to-use interface through **Streamlit**.

**🔍 Problem Statement**

Manual sorting and identification of nuts and bolts can be time-consuming and prone to human error. This project automates the detection process using AI, improving efficiency and accuracy.

**🏗️ Methodology**

1. **Dataset Preparation:**
   * The dataset consists of labeled images of nuts and bolts.
   * Images are split into training and validation sets.
   * Labels are stored in YOLO format.
2. **Model Selection:**
   * We use **YOLOv8m**, a medium-sized YOLOv8 model, for detection.
   * A pre-trained model (yolov8m.pt) is fine-tuned using our dataset.
3. **Training Process:**
   * Data is structured in the **datasets/** directory.
   * A data.yaml file is created to define the dataset structure.
   * Training is executed for multiple epochs to optimize accuracy.
4. **Detection Pipeline:**
   * Users upload an image through the Streamlit UI.
   * The YOLO model processes the image and detects objects.
   * Bounding boxes and labels are displayed over detected objects.
5. **Deployment:**
   * The application is hosted using **Streamlit**.
   * Users can access it through a web interface without local installations.

**📈 Results**

* The model successfully detects nuts and bolts with high accuracy.
* Users can train a custom model with their dataset for better performance.
* The interactive UI enhances usability and simplifies the detection process.

**🚀 Future Improvements**

* Expand dataset for more diverse and complex object detection.
* Integrate model optimization techniques for faster inference.
* Deploy on cloud platforms for broader accessibility.

**📌 Conclusion**

The **Nut & Bolt Detector** demonstrates the effectiveness of AI in automating industrial processes. It simplifies object classification, reduces human effort, and enhances accuracy in nut and bolt detection.

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