CRS Assignment Brief - Formative Assesment-2

| **CRS** | Artificial Intelligence |
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|  | Machine Learning and Deep Learning- |
| **Course Name** |  |
| **Type of Assessment** | Formative Assessment-2 |
| **Marks of Assessment** | 20 Marks |
| **Intended Learning Outcomes Assessed** | * Understand how computer vision techniques such as object detection and classification can be used to detect whether individuals are following safety compliance rules. * Gain practical experience in integrating AI models with user-friendly applications using tools like Streamlit for decision-making and real-time monitoring. |
| **Assignment title** | **Developing a Computer Vision-Based PPE Detection System using Machine learning and Deep learning**  **(FA-2: Building and Deploying the model)** |
| **Purpose/Rationale of the Assignment** | In continuation to FA-1 Students transition from planning to execution by applying their understanding of machine learning and computer vision to build a functional PPE detection system. By working through model selection, training, evaluation, and deployment, students gain hands-on experience in real-world AI workflows. This stage emphasizes critical skills such as object detection, performance evaluation, and user-centric deployment using Streamlit, enabling students to build AI systems that are both effective and accessible. |
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| **Scenario or Context** | In FA-1, students thoroughly explored the real-world problem of PPE compliance in construction sites. They analyzed user challenges, prepared and preprocessed the dataset, and visualized insights through a detailed storyboard created using Canva or Figma.  Now in FA-2, they will use those insights to select appropriate AI models, train and evaluate their systems, and deploy a real-time PPE detection dashboard that can assist site supervisors in monitoring safety compliance efficiently. |
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| **Task** | In FA-1, you explored the real-world problem of PPE compliance monitoring, analyzed the dataset, and presented your design plan through a visual storyboard. Building on that foundation, FA-2 focuses on bringing your design to life. You will now move into the development phase selecting appropriate machine learning models, training them to detect PPE items, evaluating their performance, and deploying a real-time PPE compliance monitoring system using Streamlit. By the end of this phase, you will have created a functional and interactive AI-powered dashboard that can detect, classify, and report worker safety compliance in construction environments.  **Note: Step 1,2,3 you have completed in FA-1 now let’s follow from below steps to build and deploy your Project.**  **Step 4: Model Selection- Choosing the Right AI Tool**  You’ll use object detection models to identify PPE from images:  Use YOLOv5/YOLOv8): It offers Real-time object detection,works directly with annotations, and pre-trained weights available. Also CNN Classifier for cropped person images to verify compliance.  **Step 5: Model Design and Training- Building Your AI System**  Train the YOLOv5 model to detect the presence or absence of each PPE item. You’ll also build logic to interpret results and assign a compliance level.   * **What the Model Should Detect:** * Presence of: Hardhat, Mask, Safety Vest * Absence of: NO-Hardhat, NO-Mask, NO-Safety Vest * **Add Compliance Logic:** * Green Box: All 3 PPE items detected * Yellow Box: One or two items detected * Red Box: No PPE detected   **Step 6: Model Evaluation and Testing- How Good Is Your Model?**  **After training, test your model using:**   * **Evaluation Metrics:** * Precision : How many detected objects were correct? * Recall : How many correct objects were detected? * F1 Score: Balance of Precision and Recall * **Test Data:** * Use your 30% test set * Test on new images not seen during training * **Show Visual Results:** * Save and share examples with bounding boxes * Display compliance classification for each worker   **Step 7: Model Deployment using Streamlit-Make It User-Friendly**  You’ll now convert your detection system into a working app using Streamlit cloud, a Python web framework.  **Streamlit Dashboard Features to be include:**   * Upload images * Run model inference to show detection and compliance * It should display: * Total workers detected * Compliant, Partially compliant, Non-compliant counts * Graphs or tables showing compliance trends * Violation alerts for supervisors   **Step 8: Monitoring and Maintenance**  No AI model is perfect at first. Here’s how you ensure continuous improvement:   * **Suggestions for Maintenance:** * Periodically add more data (especially edge cases or unseen environments) * Retrain the model with updated annotations * Changing PPE standards (e.g., gloves, face shields)   **Note:** This entire final project must be implemented using Python IDE, you may choose either Jupyter Notebook or Google Colab as your development environment. Once your model is trained and tested, you are required to deploy your final application using Streamlit Cloud. |
| **Checklist of evidence required** | * Link to your deployed project on Streamlit. (hosted on Streamlit Cloud) * Recorded Video including (screen recording): * Project overview * Dataset description * Sample screenshots of model predictions and dashboard. * Final evaluation metrics |
| **Assessment Criteria: 20 Marks**  **(Rubrics) Appendix - A** | |
| **Sources of information to support you with this Assignment** | <https://github.com/snehilsanyal/Construction-Site-Safety-PPE-Detection?tab=readme-ov-file>  <https://encord.com/blog/ppe-detection-using-computer-vision/>  <https://github.com/spacewalk01/yolov5-face-mask-detection> |

**Appendix A - Project Assessment:**

**Assessment Criteria: (Rubrics)**

| **Criteria** | **Distinguished (5)** | **Proficient (4)** | **Apprentice (3)** | **Novice (2)** | **Marks** |
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| **Model Selection and Compliance Logic**  **(5 Marks)** | Appropriately chosen model (YOLOv5/YOLOv8), clear compliance classification logic (Green/Yellow/Red). | Model chosen and logic implemented. Few issues with clarity. | Model selection present but logic incomplete or unclear. | Inappropriate model or logic missing. |  |
| **Training, Evaluation, and Results**  **(5 marks)** | Model trained with strong metrics (Precision, Recall, F1). Includes visual outputs. | Model trained and tested. Results shown. Minor visual or metric gaps. | Model trained but incomplete metrics or results. | Model not trained properly or lacks result evidence. |  |
| **Streamlit Deployment and Dashboard**  **(5 marks)** | Fully functional dashboard with image upload, detection results, compliance counts, alerts, and clean UI. | Working dashboard with most key features. Few minor gaps. | Dashboard functional but missing key components or visuals. | Deployment not done or Streamlit not working. |  |
| **Final Evidence Submission (Video + Link)**  **(5 Marks)** | Summary video and working Streamlit link submitted with clear explanations, visuals, and dashboard demo. | Video and link submitted with basic walkthrough. Slight lack of clarity. | Either video or link submitted but lacks clarity or completion. | Missing or non-working link or video. |  |
| **TOTAL** |  |  |  |  | **/20** |