**Mepco Schlenk Engineering College**

**Department of Artificial Intelligence and Data Science**

**Project Progress Track sheet**

**Project Title:** Integrating Deep Learning for Safety Management in Construction: Semantic Image-Rule Matching for Unsafe Behavior Detection Using YOLO-ESCA

**Project Guide:** Dr. P.Swathika , PhD, (AP(Sr.G))

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**Project Description:**

This project presents an effective approach to improving safety management on construction sites by integrating deep learning with semantic analysis. The primary goal is to detect unsafe behaviours in real-time by analysing objects and activities captured in images or video feeds and matching them with predefined safety rules.

At the core of the system is YOLO-ESCA (Enhanced Safety Compliance Analysis), a customized version of the YOLO (You Only Look Once) object detection model. YOLO-ESCA has been fine-tuned using datasets like MS COCO 2020 and real-world images from construction sites. It has been optimized to quickly and accurately detect construction-related objects, activities, and personal protective equipment (PPE).

To align the detected behaviours with safety compliance, the system integrates Glove (Global Vectors for Word Representation) to embed safety rules into contextual vectors. These vectors allow the system to understand the meaning of safety rules, which are then matched with the detected objects and activities using cosine similarity. This enables accurate identification of safety violations.

The system works in real-time, providing alerts whenever unsafe behaviours or hazardous conditions are detected. By combining robust object detection with semantic rule matching, it helps prevent accidents and ensures compliance with safety standards.

In summary, this project combines deep learning and semantic analysis to enhance safety monitoring on construction sites. With YOLO-ESCA for accurate object detection and GloVe embeddings for understanding safety rules, the system identifies safety violations in real-time using cosine similarity. This approach provides an efficient and proactive solution for improving safety compliance and reducing risks in construction environments.

**Reference Papers:**

**1. Computer Vision and Deep Learning to Manage Safety in Construction: Matching Images of Unsafe Behavior and Semantic Rules**

* **Authors:** Weili Fang, Peter E.D. Love, Lieyun Ding, Shuangjie Xu,Ting Kong and Heng Li.
* IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, VOL. 70, NO.12 DECEMBER 2023

**2. YOLO-ESCA: A High-Performance Safety Helmet Standard Wearing Behavior Detection Model Based on Improved YOLOv5**

-Authors: Peijain Jin, Hang Li,Weilong YAN AND JINRONG XU

-IEEE Access, vol. 12, pp. 23854-23868, 2024

3.Cross-modal attention with semantic consistence for image-text matching

-Authors: X. Xu, T. Wang, Y. Yang, L. Zuo, F. Shen, and H. T. Shen

-IEEE Transaction , Neural Networks., vol. 31, no. 21, pp. 5412 5425, Dec. 2020

4.Faster R -CNN : Towards real - time object detection with region

proposal networks

-Authors:S. Ren ,K.He,R.Girshick, and J. Sun

-IEEE Transaction. Adv. Neural. Process. Syst., 2020, pp. 91–99.