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, ME, PhD, Assistant Professor AI&DS Department.**

Name of the Students with Register Numbers:

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Signature of the Guide

Signature of the Project Coordinator

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 behaviors in real-time by analyzing 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 behaviors 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 behaviors or hazardous conditions are detected. By combining robust object detection with semantic rules matching, it helps prevent accidents and ensures compliance with safety standards.

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 & 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.

Defense Report

Defense – I   Date:

Major Queries:

1.

2.

3.

4.

5.

Suggestions:

1.

2.

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Defense – II   Date:

Major Queries:

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Suggestions:

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Defense – III   Date:

Major Queries:

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Suggestions:

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Progress Report

1. Monthly Work Plan

Month/Week	I Week	II Week	III Week	IV Week
September	Dataset Collection & Exploration	Dataset Annotation (Bounding Boxes, Object Class)	Preparing Safety Rules Text Data	Initial Dataset Cleaning and Splitting
October	ResNet-101 Feature Extraction Setup	Region Proposal Network (RPN) Integration	Testing Anchor Box Generation	Training RPN for Object Detection
November	Embedding Vector Setup (Object Classes)	Integrating Safety Rules with Glove Embeddings	Cosine Similarity-based Rule Matching	Rule-Based Annotation Testing
December	Object Detection Network Training	Testing Object Class Predictions	Adding Attribute Classification Module	Validating Bounding Box Predictions
January	Integrating Image Annotations	Rule-Based Image Annotation Refinement	Testing Combined Network Outputs	Hyperparameter Optimization
February	Model Training with Annotated Data	Evaluating Object and Attribute Classes	Integrating Feature Fusion for Text Data	Fine-Tuning Safety Rule Predictions
March	Conference Paper Drafting	Journal Paper Drafting	Journal Paper Completion	Project Report Drafting
April	Project Report Correction	Project Report Completion		

2. **Fortnightly Reports**

Mon/Week	Report-I (date)	Report-II (date)	Sign of Guide	Sign of Project Coordinator
Dec				
Jan				
Feb				
Mar				

3. Conference/Symposium Attended

Date:

Conference/Symposium Name:

Host Institution:

4. Journals Published:

Name of the Journal: