



Helmet and harness detection in industries using AI and IOT

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ABSTRACT

Worker safety is a critical concern in industrial sectors such as construction, manufacturing, and maintenance, where accidents often occur due to the absence or improper use of personal protective equipment (PPE) like helmets and safety harnesses. Manual monitoring of PPE compliance is time-consuming and prone to human error. To address this issue, this project proposes a Helmet and Harness Detection System using Artificial Intelligence (AI) and Computer Vision with the YOLOv8 deep learning model.

The system captures live video streams from surveillance cameras installed at industrial sites and processes them in real time to detect whether workers are wearing helmets and harnesses. YOLOv8, being a state-of-the-art object detection model, provides high accuracy and fast inference speed, making it suitable for real-time safety monitoring applications. The model is trained on a labeled dataset containing images of workers with and without safety gear to accurately classify compliance and violations. When a violation is detected, the system automatically generates an alert or notification to the safety supervisor through a connected dashboard or IoT device.

This AI-based approach enhances workplace safety, reduces dependency on manual supervision, and ensures continuous monitoring of PPE compliance. By integrating YOLOv8 with IoT infrastructure, the system provides a reliable, scalable, and efficient solution to prevent workplace accidents and promote a culture of safety in industrial environments.

Keywords: Helmet detection, Harness detection, Industrial safety, Artificial intelligence, Computer vision, Deep learning, Object detection, YOLO.



CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Worker safety is a major concern in industrial environments such as construction sites, factories, power plants, mining areas, and maintenance operations. These workplaces often involve hazardous conditions, where accidents can occur due to the absence or improper use of Personal Protective Equipment (PPE) such as helmets and safety harnesses. Despite strict safety policies and regulations, many incidents still happen because of human negligence, lack of supervision, or non-compliance with safety standards. Ensuring that every worker adheres to PPE rules is a challenging task, especially in large industrial zones where continuous manual monitoring is neither practical nor efficient.

To address these challenges, this project proposes a smart and automated Helmet and Harness Detection System using artificial intelligence (AI) and computer vision techniques. The system aims to automatically detect workers in real-time video streams and verify whether they are wearing helmets and safety harnesses. By leveraging advanced deep learning algorithms like YOLO (You Only Look Once), the system can accurately identify workers and classify their compliance status. The use of AI not only reduces dependency on human supervisors but also ensures 24/7 monitoring of safety practices within the workplace.

The proposed system works by capturing video input from industrial surveillance cameras, processing the frames using a pre-trained object detection model, and identifying the presence or absence of helmets and harnesses. If any worker is found without the required safety gear, the system immediately generates alerts or notifications to the concerned authorities. These alerts can be visual, audio-based, or transmitted through a network to a centralized control unit.

This real-time feedback mechanism enables supervisors to take quick corrective actions and prevent possible accidents before they occur.

Moreover, the integration of this system can significantly improve overall workplace safety culture and operational efficiency. It helps organizations ensure strict compliance with occupational health and safety (OHS) regulations, thereby reducing the likelihood of injuries and fatalities. The data generated from the detection system can also be used for safety audits, reporting, and analysis, contributing to better decision-making and risk management.

Implementing a Helmet and Harness Detection System powered by AI and computer vision not only promotes automation but also aligns with the modern concept of Industry 4.0, where intelligent technologies enhance productivity, efficiency, and safety. This system serves as a preventive measure, ensuring that every worker follows safety protocols and that industries maintain a zero-tolerance policy towards safety violations.

In conclusion, the proposed system offers an innovative solution to one of the most pressing issues in industrial safety—monitoring PPE compliance. By combining the power of artificial intelligence, deep learning, and real-time video analytics, this project helps create safer workplaces, reduce accidents, and strengthen the overall safety infrastructure of industries.



1.2 Problem Definition

In many industrial workplaces, workers often neglect to wear helmets and safety harnesses, leading to serious accidents and injuries. Manual monitoring of PPE compliance is inefficient and error-prone. Therefore, an automated system using the YOLOv8 model is needed to detect and alert when workers are not wearing helmets or harnesses, ensuring real-time safety monitoring and accident prevention.

CHAPTER 2

LITERATURE SURVEY

[1] MOHAMMAD Z. SHANTI et al. proposed that safety helmets and safety harnesses play a crucial role in protecting workers on construction sites. In this research, a safety monitoring detection model was developed using DETR architecture. The model was trained on a custom dataset consisting of images of helmets and harnesses. To assess its reliability, the model underwent a comprehensive testing phase across five different scenarios: (1) RGB images (2) Grayscale images (3) Blurring effect (simulating foggy conditions) (4) Dusting effect (simulating sandy conditions), and (5) Drone-captured images. These tests ensured the model's ability to perform accurately under varying color and weather conditions. In this research, four key evaluation metrics were used to measure the model's performance: precision, recall, F1 score, and confidence. The model achieved high scores across all metrics, with precision values of 0.99 for helmets and 0.971 for harnesses, recall values of 0.92 for helmets and 0.91 for harnesses, F1 scores of 0.95 for helmets and 0.94 for harnesses, and confidence levels of 95.5% for helmets and 94 % for harnesses. A comparative analysis was conducted against three models: the previously designed YOLOv3, and two newly trained models using YOLOv8 and Deformable DETR architectures. The baseline DETR model outperformed all models in nearly all evaluation metrics and scenarios, The strong performance of the DETR model demonstrates its potential as an effective safety monitoring tool in construction environments. For future research, DETR could be explored as a monitoring tool for detecting all PPE items on construction sites.

[2] OLUFEMI ABIODUN ABRAHAM et al. introduced the SYNBDM and LUM algorithms for electricity theft detection in smart homes, utilizing fine-grained appliance consumption data to distinguish between normal and malicious usage. By employing uniform manifold approximation and projection (UMAP) to identify varied data distributions across different homes, our algorithm effectively leverages aggregated power consumption patterns for robust anomaly detection. Our tests on a real building appliance dataset demonstrated high performance, even with anonymized data, highlighting the algorithm's capability to balance effective theft detection with customer privacy. Though highly effective, we noted that unsupervised learning models require further refinement to better handle the complexities of real-world attack data. Our findings underline the potential of machine learning in enhancing energy security and stress the importance of incorporating appliance consumption patterns in electricity theft detection. This approach offers significant benefits to both consumers and energy providers, aiming for more efficient and secure energy management in smart homes.

[3] Colin Fredynand et al explain about riding motorcycles without wearing a helmet is the violation of an important traffic rule – 'Mandatory Wearing of Helmet by motorcyclists. The mortality rate is higher in two-wheeler accidents as compared to that of others. The current systems include conventional methods that involve police officers observing violators by patrolling the roads or via traffic surveillance cameras. This requires a lot of time and manpower. It is impossible to catch and impose fines on every violator using these methods. This paper proposes a method for helmet detection and license plate recognition to detect and identify the two-wheeler riders without helmet and thereby penalizing them. Object detection using YOLOV4 is the main concept involved. Object detection is performed at different levels to identify the helmet law



violator and their license plate number. Using a License Plate Recognition API, the license plate number is then extracted. A database is maintained that consists of details of two-wheeler owners. An email consisting of violation details and a link to pay the penalty is sent to the helmet law violators. An interface is developed using Tkinter that can be used by the administrative officer to check for violators in the videos provided as input and also to monitor the entire process.

[4] P. Nirupama et al proposed system is very much capable for detecting helmet in all certain situations with high level of accuracy. Here the system has been tested with various frames and result is effectively obtained with minimal error rate. Tensor flow and Keras are two main packages that allow to train a system with certain circumstances that affect the accuracy at very good extents. The proposed system can be practically implemented in various places such as school, colleges, offices, shopping mall, marts and various public places that mandate the person to use the helmet with their family and friends at better safety concerns. System can be enhanced in future by testing various samples and can be trained for other situations where traditional systems may become failed.

[5] Tasbeeha Waris et al introduced an intelligent transportation system (ITS) is an advanced application that supports multiple transport and traffic management modes. ITS services include calling for emergency rescue and monitoring traffic laws with the help of roadside units. It is observed that many people lose their lives in motorbike accidents mainly due to not wearing helmets. Automatic helmet violation detection of motorcyclists from real-time videos is a demanding application in ITS. It enables one to spot and penalize bikers without a helmet. So, there is a need to develop a system that automatically detects and captures motorbikes without a helmet in real time. This work proposes a system to detect helmet violations automatically from surveillance videos captured by roadside-mounted cameras. The proposed technique is based on faster region-based convolutional neural network (R-CNN) deep learning model that takes video as an input and performs helmet violation detection to take necessary actions against traffic rule violators. Experimental analysis shows that the proposed system gives an accuracy of 97.69% and supersedes its competitors.

[6] Neha D. Kewate et al explain motorcycle accidents have been growing day by day throughout the years because road safety is often neglected by riders worldwide leading to accidents and deaths. The demand for a transparent, quick and hassle-free traffic violations management systems with the support of E challan has been the need of the day in a vast country like India with large motor vehicles with limited police enforcement infrastructure. The proposed system not only disciplines the commuters and the traffic police officials, but also can enhance the level of compliance and thereby arrest revenue leakage to the governmental agencies. The paper proposes an automated E challan generating system that works with the existing vehicle database capable of detecting helmet and non-helmet bike rider and provide online interface to the offenders for payment of traffic fines whenever they are captured by the system as non-helmet bike rider. The prototype enables the traffic police to seek online identification of the driver as well as the vehicle and the E-challan system supports the offenders to enable the payment through the link transmitted to his e mail ID for complying with the requirements of fine payment. Further the police officials are tracked and logged for enabling a performance assessment.

[7] Elham Soltanikazemi et al developed a helmet violation detection system utilizing a YOLOv5 model fine-tuned by the genetic algorithm. We employed different methods of selecting frames to address the issue of imbalanced data during training. Our model is sufficiently robust to handle real-world low-quality images with complicated backgrounds. Through evaluating our model on a challenging dataset, which provides an accurate representation of real-world images, we proved that our work can positively affect the safety of motorbike drivers and their passengers by automatically detecting the violation of not wearing a helmet. Moving forward, our future work will be on amassing additional training data to enhance the overall performance of our system, ensuring its suitability for real world implementation.



[8] Maros Jakubec et al introduced helmets are one of the most critical road safety precautions for two-wheeled participants (motorcycles, bicycles, and e-scooter) and not wearing protective helmets might cause severe or catastrophic injuries. The primary method for detecting helmets is currently a sequence of Convolutional Neural Network algorithms. To accomplish road safety, detection precision, forecast speed, and deployment simplicity are crucial factors. Traditional object detection techniques frequently fall short of achieving balanced effects in all domains. This research proposes a helmet detection application based on the most recent YOLOv7 algorithm with an attention-based improvement mechanism. The model's performance has been evaluated on a set of helmet test images with an average precision (mAP@0.5) reaching 91.4 %. As results indicate, high detection precision and low computational demands are achieved, making the model suitable for real-world deployment. Therefore, the proposed model can contribute to the solution of the problem involving helmet detection on two-wheeled vehicles.

[9] Dewashish Tarale, et al describe in this project we were able to detect the helmet with their confidence score. Through this project we can detect many other objects people who are wearing seat belts or not. This project can be further extended to detect the number plate of the cars or bikes. From this project were able to detect the multiple persons on bike these can help us to detect children who are hidden away by their parents when they sit on the bikes.

[10] Sanika Gajarishi et al explain a Non-Helmet Rider Detection system is developed where a video file is taken as input. If the motorcycle rider in the video footage is not wearing helmet while riding the motorcycle, then the license plate number of that motorcycle is extracted and displayed. Object detection principle with YOLO architecture is used for motorcycle, person, helmet, and license plate detection. Web API is used for license plate number extraction if rider is not wearing helmet. Not only the characters are extracted, but also the frame from which it is also extracted so that it can be used for other purposes. All the objectives of the project are achieved satisfactorily.

[11] Mrs. V. Veena et al. Secure helmet wearing detection is a mighty task for look-after surveillance in power substation. In this we can avoid accidents using algorithm. For future purposes we can use hardware parts. Suggesting potential areas for future enhancements or research. This could include improving the detection of specific helmet types, extending the system to detect other safety gear, or exploring alternative object detection algorithms.

[12] M. Saravanan et al narrate the number of motorcycle accidents has increased rapidly due to different causes. Helmet is a one of the major safety equipment that helps to reduce the fatal accidents even though many of the motorcyclists are not used that. Currently many researchers have focused on traffic violator detection but they are yet to identify the violated person details as it requires high resolution cameras and expensive sensors for number plate extraction. This research article is focused on comprehensive study on the development of an automated helmet violation detection with number plate extraction in real time. This study divides the dataset into rider with helmet, rider without helmet, passenger with helmet and passenger without helmet classes, and four training model was created to detect helmet in rider and passengers. The proposed model was constructed in three stages to attain high accuracy with a vast amount of training dataset. In the first stage, the helmet was detected in the input image using the deep learning object-detection model. In the second stage, if the helmet identification confirmed in the input image, then the entire motor cyclist image is segmented based on object segmentation model. In the third stage, number plate training model is deployed into the same object detection and object segmentation model to identify and segment the license plates in the motorcyclist image. This study primarily incorporates the Mask Region based Convolution Neural Networks (Mask R-CNN) for object detection and segmentation Further, it incorporates the three different deep neural



networks like Dense Block Network (DenseNet-121), Residual Network (ResNet-101) and Inception Residual Network architecture V2layers (Inception Res Net V2) to create accurate helmet violator detections with more extensive information. The experimental results indicate that this comprehensive helmet violator detection study improves the helmet detection accuracy by 6.2 %.

CHAPTER 3

SCOPE OF THE PROJECT

Scope of Helmet and harness detection in industries using AI is explained below

The scope of Helmet and Harness Detection in industries using Artificial Intelligence focuses on improving workplace safety through automated monitoring and real-time detection of safety compliance. The system utilizes computer vision and deep learning techniques to identify whether workers are wearing essential protective equipment such as helmets and safety harnesses in industrial environments.

The system is designed to work with CCTV cameras or surveillance systems to continuously monitor workers in real time. It can detect safety violations instantly and generate alerts, reducing the need for manual supervision and minimizing human error. This ensures strict adherence to safety regulations, especially in high-risk industries such as construction, mining, oil and gas, and manufacturing.

The scope also includes integration with IoT-based systems and centralized dashboards, allowing supervisors to monitor multiple locations simultaneously. The system can store data related to safety compliance and violations, which can be used for analysis, reporting, and improving workplace safety policies.

Furthermore, the system is scalable and can be deployed across small worksites to large industrial plants. It can be adapted to different environmental conditions, lighting variations, and worker movements. Future scope includes integration with advanced AI models for improved accuracy, edge computing for faster processing, automated machinery control during safety violations, and enhanced data privacy and security measures.

Reference URL : <https://www.flytbase.com/blog/ai-powered-helmet-detection-construction-safety>



CHAPTER 4 METHODOLOGY

The methodology for Helmet and harness detection in industries using AI is developed under waterfall model architecture as shown in the below figure 1.

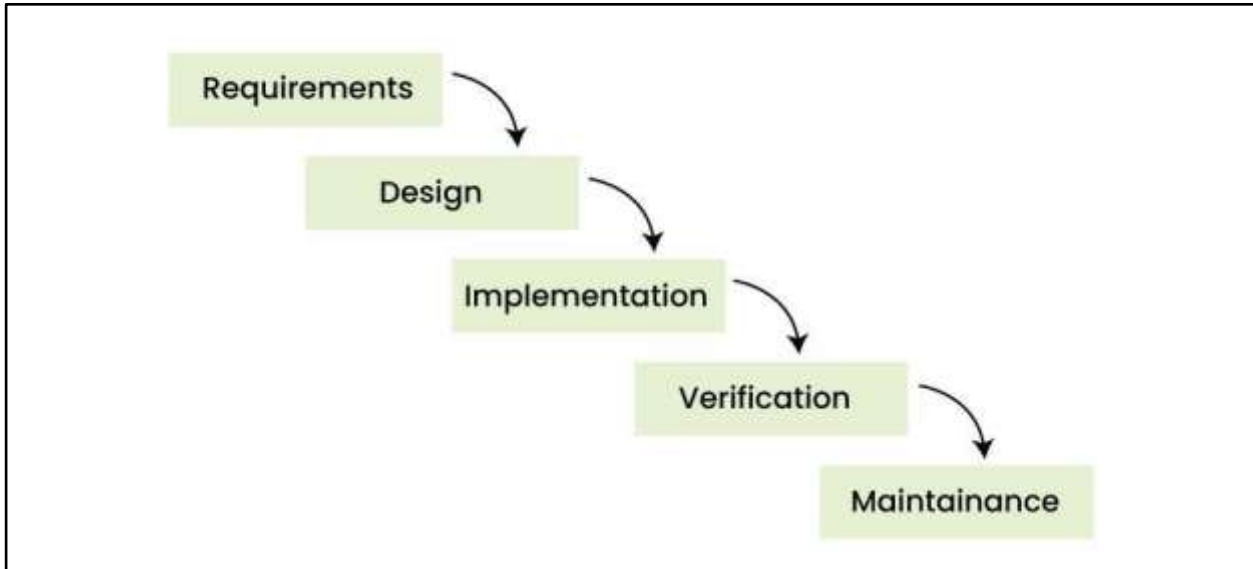


Fig 1 : Water fall model Architecture

The sequence phases in water fall model according to our project are mentioned below.

4.1 Requirement Analysis – Here requirement analysis are done based on following points

- ✓ Base paper for Helmet and harness detection in industries using AI

4.2 System Design: The System Helmet and harness detection in industries using AI is designed by using the following hardware and software

Minimum Hardware Specification:

- CPU : core i5
- RAM : 8 GB
- HDD : 500 GB
- Camera :48MP

Software Specification:

- Coding Language : Python
- Development Kit : SDK
- Front End : Tkinter
- Development IDE : Spyder



4.3 Implementation:

Proposed system is designed by using the following modules

❑ **Module A: Preprocessing**

- Input: Captured video frames.
- Process: Frames are resized, filtered, and enhanced to remove noise and improve clarity for accurate detection.
- Output: Clean and preprocessed images.

❑ **Module B: Image Normalization**

- Input: Preprocessed Image
- Process: Pixel values are scaled to a uniform range (0–1) to ensure consistency and improve model performance.
- Output: Normalized images ready for model training.

❑ **Module C: YOLO v8**

- **Input:** Normalized dataset
- **Process:** The YOLOv8 model is trained on the dataset to detect specific objects or behaviors such as helmet usage, harness wearing, or illegal hawking. The model learns spatial and contextual features for high-accuracy detection.
- **Output:** Trained YOLOv8 detection model.

❑ **Module D: Decision Making**

- Input: Live video frames and model output.
- Process: The system analyzes detection results; if illegal hawking is identified, it triggers alerts and sends notifications through IoT or WhatsApp.
- Output: Real-time alert generation for authorities.

4.5 Deployment of the system:

The developed software is deployed in the laptop of above mentioned configuration with the help of the mentioned software.

4.6 Maintenance of the system:

As this software is tested for the quick recovery, so maintenance of the system is not a challenging task. This is because the tools and the software used are open source, so there is no question of licensing the required software.



CHAPTER 5

DETAILS OF DESIGN, WORKING AND PROCESSES

5.1 DETAILS OF DESIGN

5.1.1 Data Flow Diagrams

5.1.1.1 DFD level 0

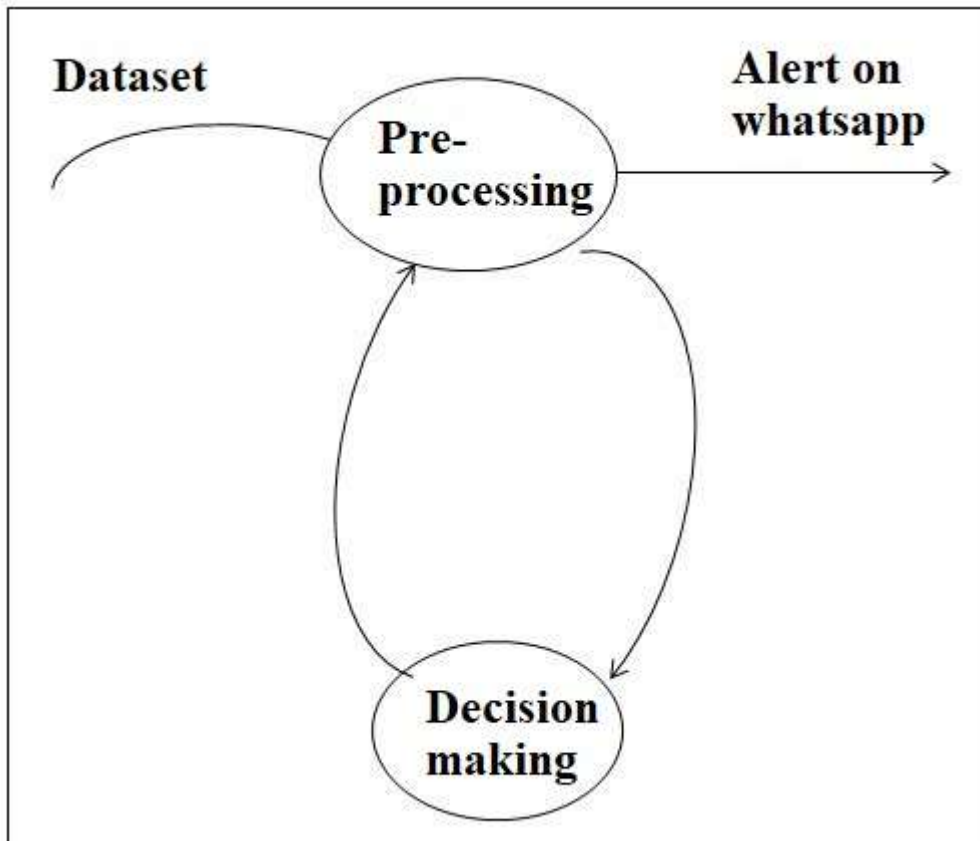


Fig 2 DFD level 0

The DFD 0 diagram for the data flow diagrams describes the flow of the approach. The DFD diagram provides the simplest flow wherein the dataset is provided to preprocessing and then decision making is applied to get alert on whatsapp



5.1.1.2 DFD level 1

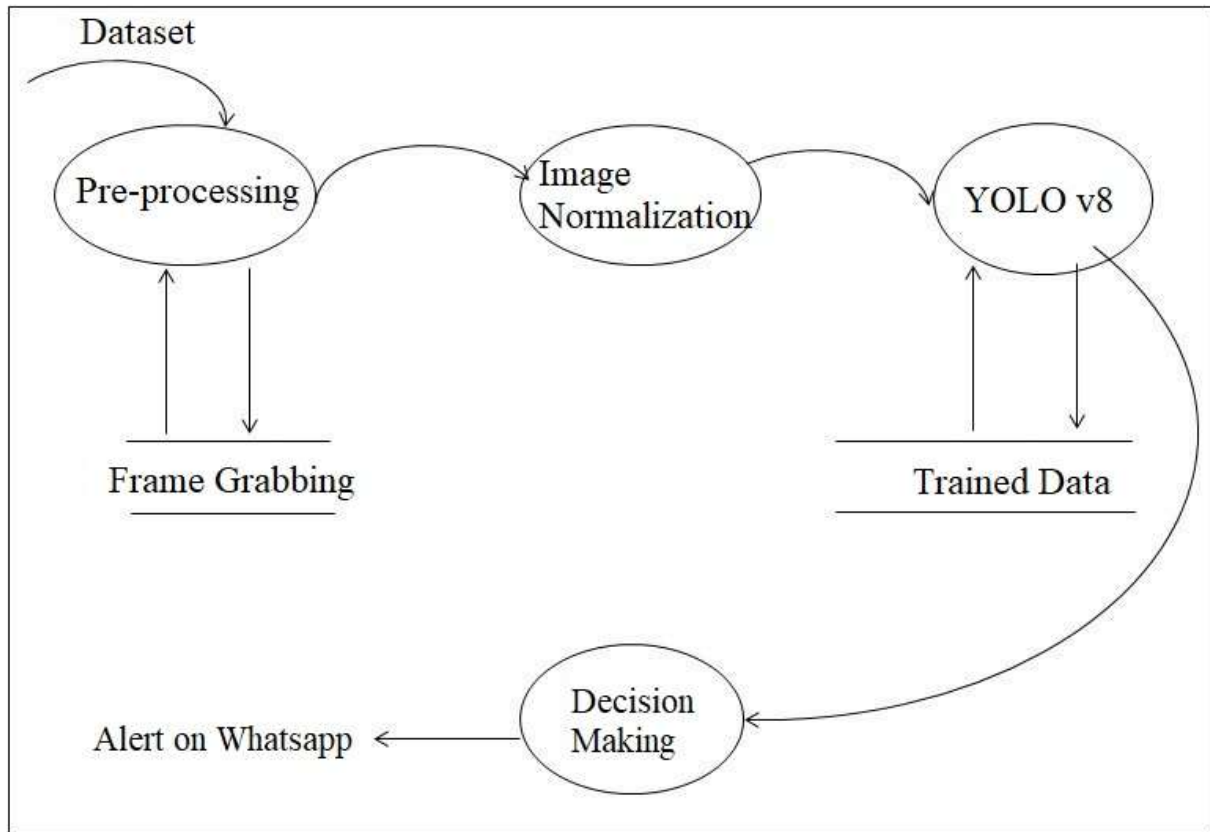


Fig 3 DFD level 1

The DFD 1 diagram provides even more details wherein the dataset is provided to preprocessing and then frame grabbing is done. After which preprocessing result is provided to image normalization, then YOLO v8 is applied to get trained data which implements the decision making to get alert on whatsapp.



5.1.1.3 DFD level 2

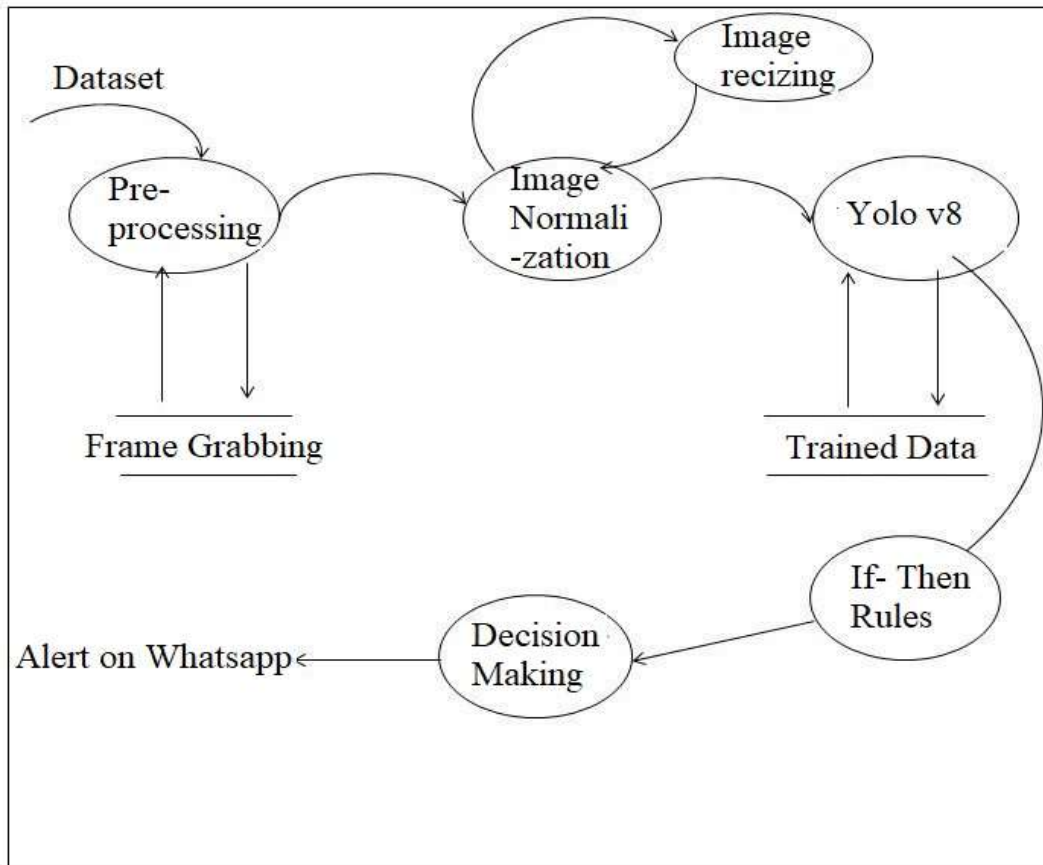


Fig 4 DFD level 2

The DFD 2 diagram is the most detailed wherein the dataset is provided to preprocessing and then frame grabbing is done. After which preprocessing result is provided to image normalization and image resizing is done, then YOLO v8 is applied to get trained data after which if-then rules is performed which implements the decision making to get alert on whatsapp.

5.1.2 Activity Diagram

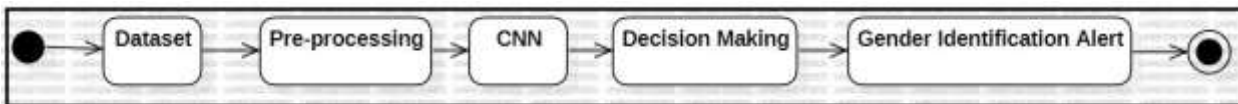


Fig 5.1 Activity Diagram

The Activity diagram lists the various activities performed in the proposed system wherein the start state is initiated and the dataset, preprocessing, image normalization, decision making, and alert on whatsapp and the system reaches the stop state.



5.1.3 Usecase Diagram

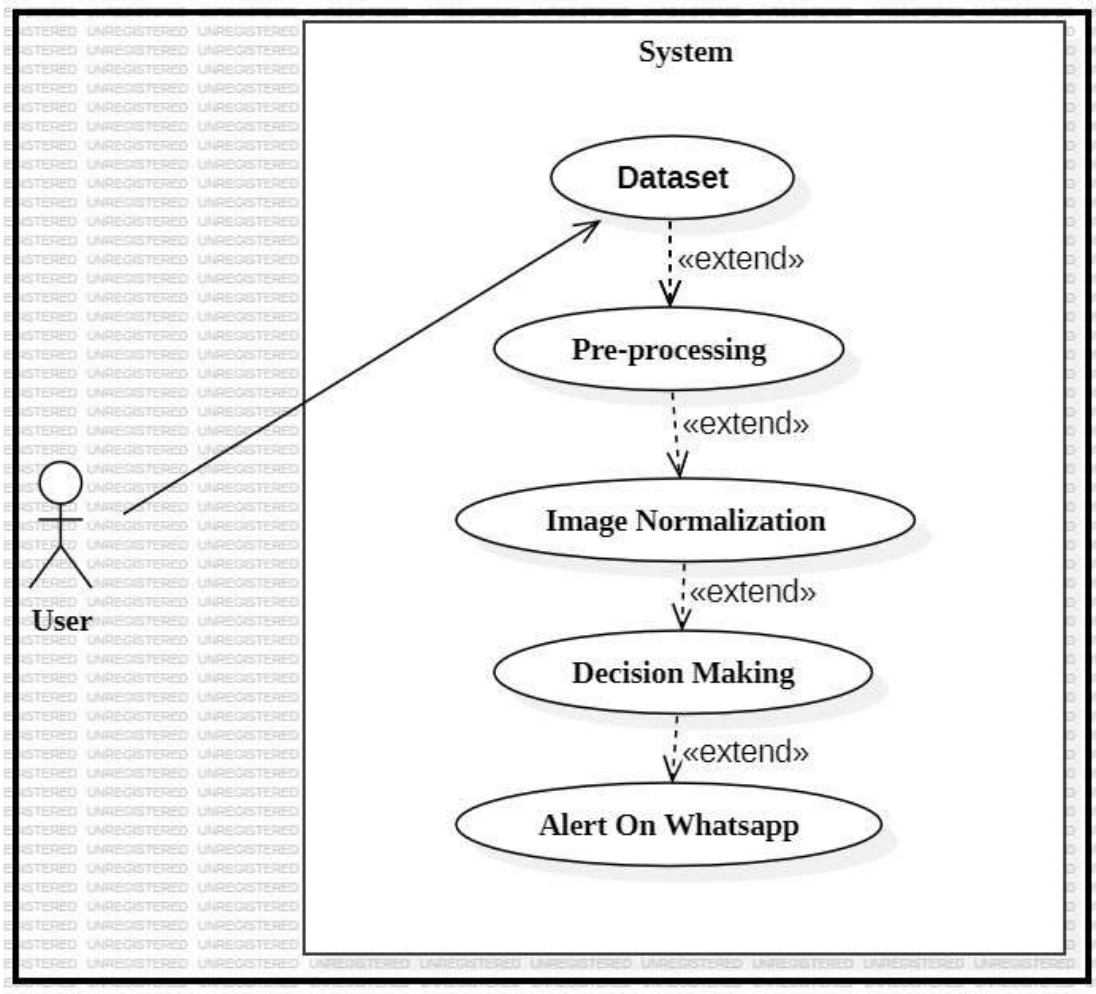


Fig 6 Usecase Diagram

The Use case Diagram depicts the various use cases that are performed by the user in the proposed model. The use cases include dataset, pre-processing, image normalization, decision making, alert on whatsapp.

5.1.4 Sequence Diagram

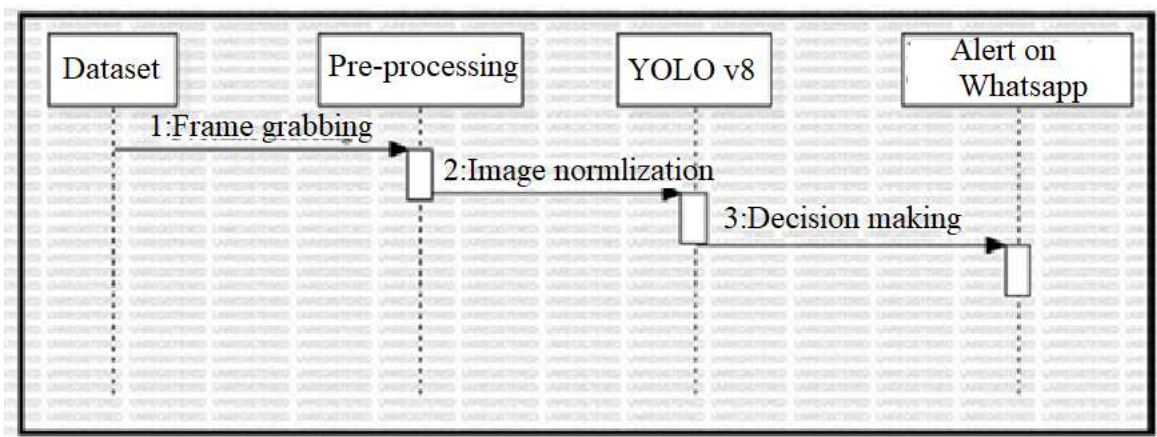




Fig 7 Sequence Diagram

The sequence role diagram provides a sequence of the approaches as well as the various roles performed in the intermediate. In this dataset is provided to frame grabbing, after which pre-processing, is performed and result goes to image normalization then YOLO v8 is applied and perform the decision making to get alert on whatsapp.

5.1.5 Component Diagram

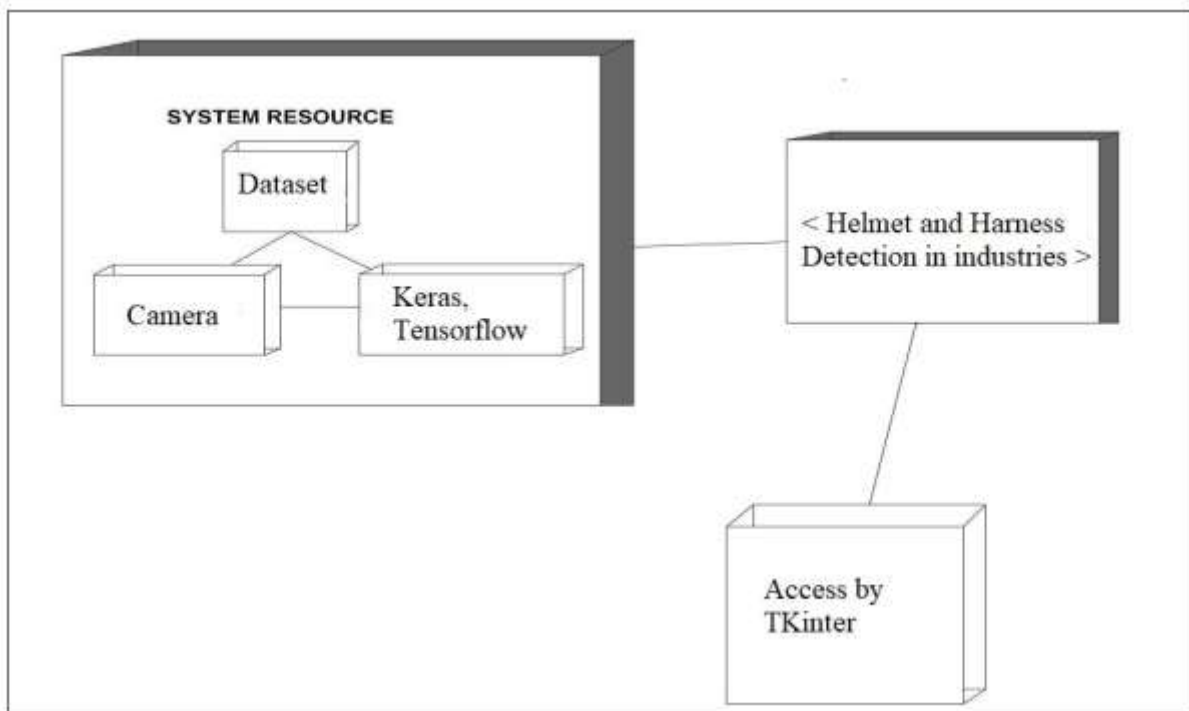


Fig 8 Component Diagram

The component diagram illustrates the important components in the proposed system. In our approach the important components consist of the dataset which is interlinked with pre-processing and YOLO v8, these two modules are further linked to the decision making alert on whatsapp.



5.1.6 Deployment Diagram

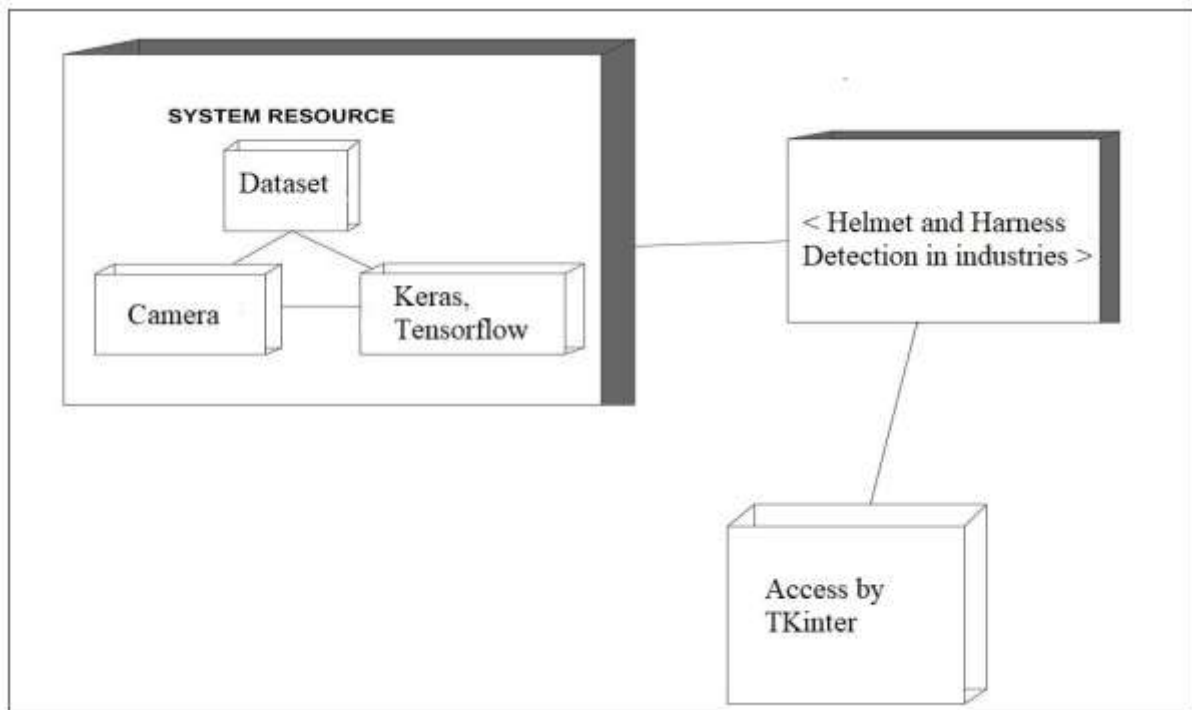


Fig 9 Deployment Diagram

The deployment diagram illustrates the important resources that are utilized for the deployment purposes. In our approach the system resources consist of dataset, camera and the keras, and tensorflow libraries along with the Illegal Hawkers detection and alert generation system using YOLO v8.

5.1.7 Package Diagram

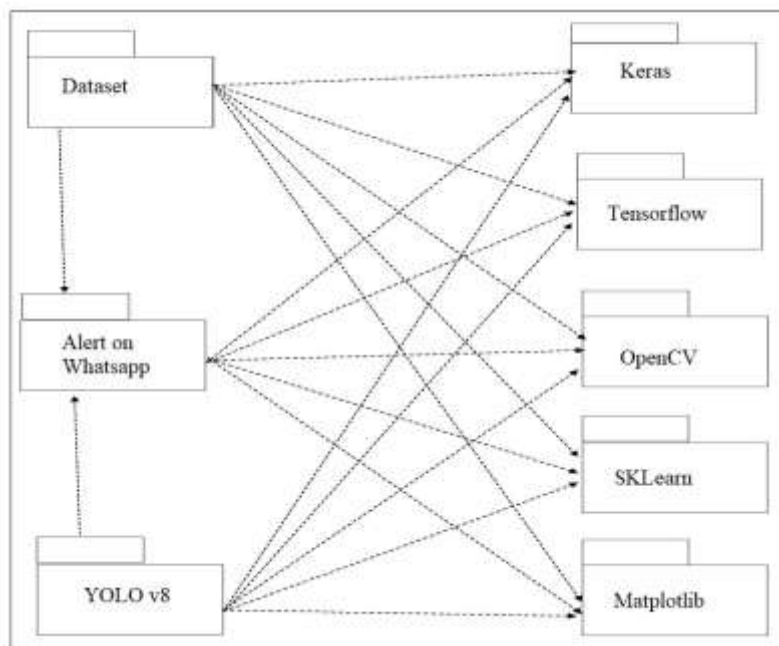


Fig 10 Package Diagram



The package diagram lists the important modules and the relevant packages that are interconnected with each other. The important modules include, dataset, Gender identification alert and Decision Making and the packages include Keras, Tensorflow, OpenCV, SKKLearn, Matplotlib.

5.1.8 State Transition Diagram

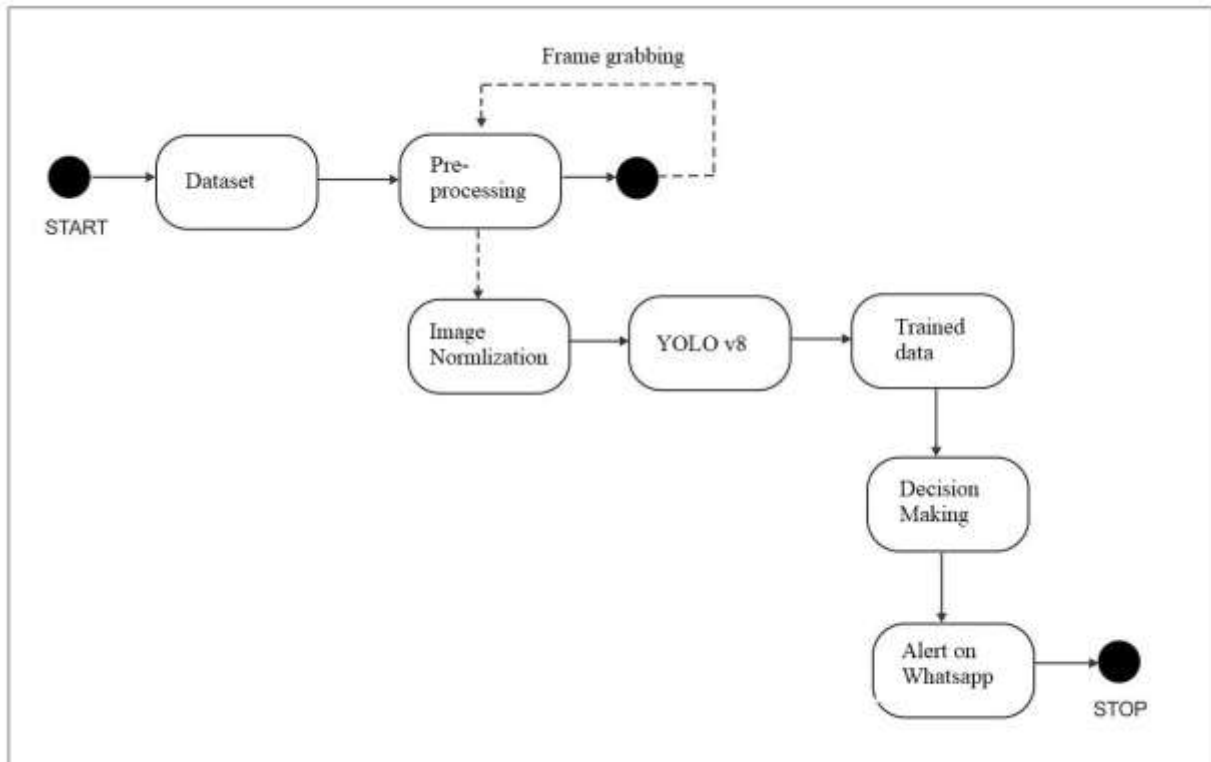


Fig 11: State Transition

The state transition diagram provides the various states that the proposed system goes through. Initially the start state wherein the dataset is provided to preprocessing and then frame grabbing is done. After which preprocessing result is provided to image normalization and image resizing is done, then YOLO v8 is applied to get trained data after which if-then rules is performed which implements the decision making to get alert on whatsapp and then reaches the stop state.



5.1.9 Action Plan

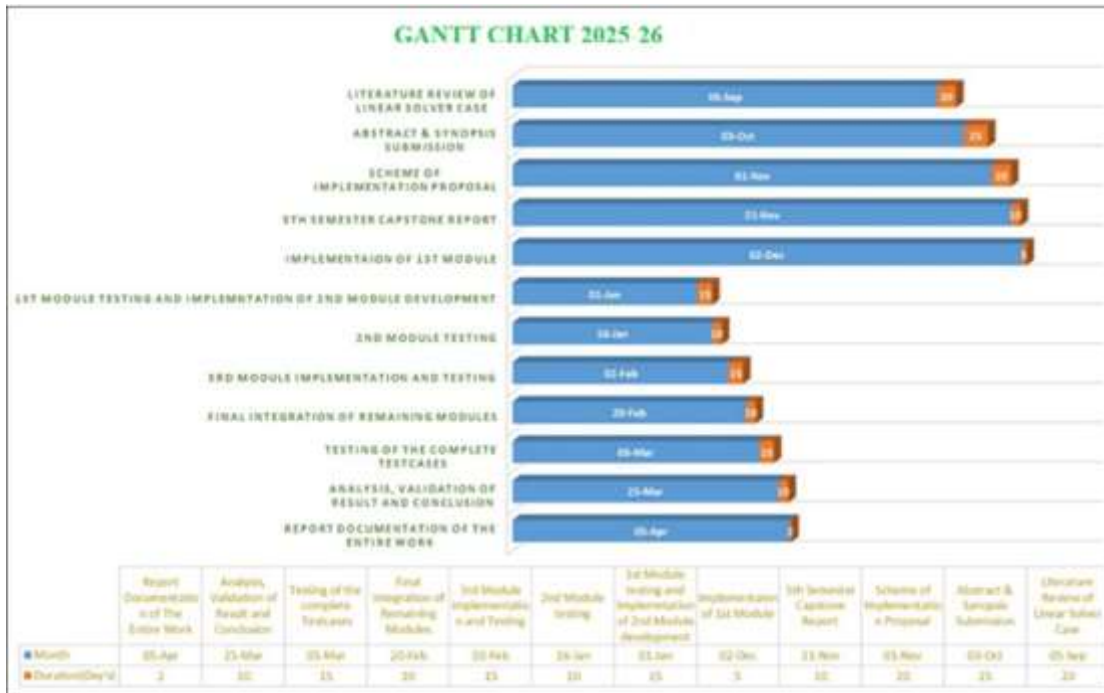


Fig 12: Action Plan

5.2 WORKING AND PROCESSES

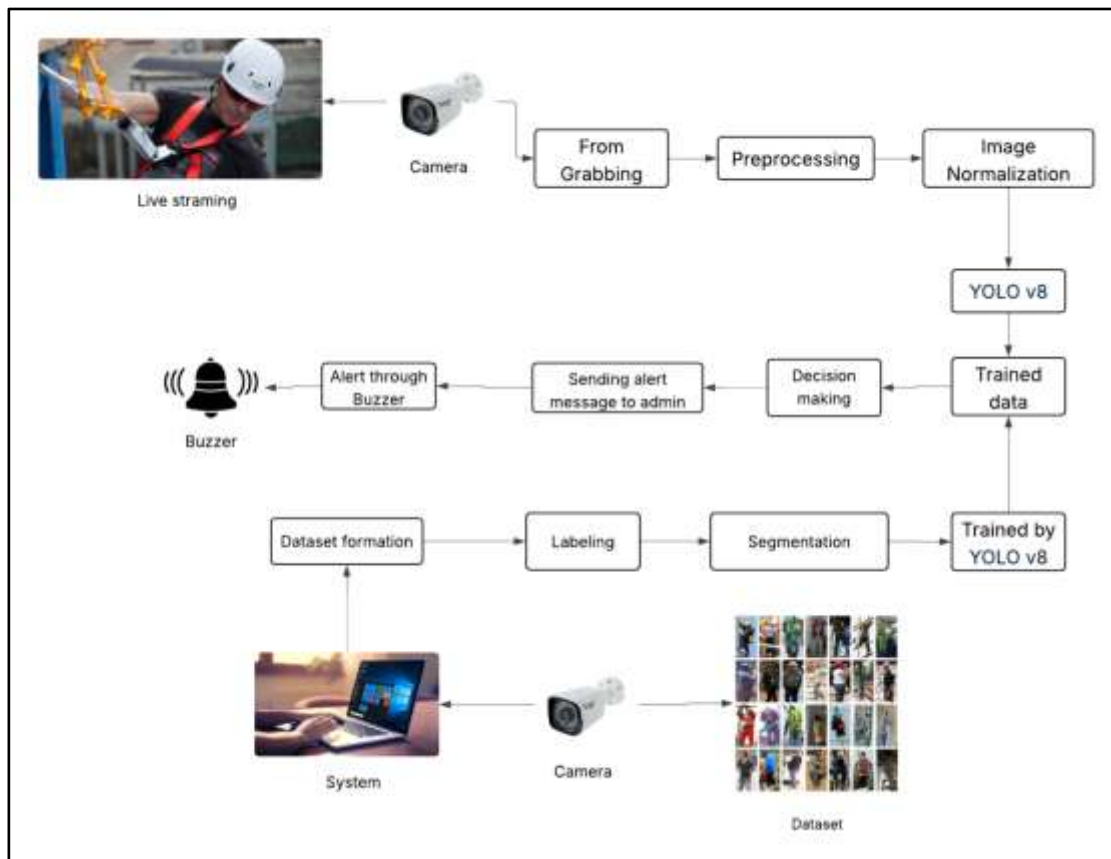




Figure 13 System Overview

The proposed methodology for Helmet and harness detection in industries using AI is depicted in the figure 13. And the steps that involve in this process is broadly explained with the below narrated steps.

Step 1: Dataset preparation: The first stage of the system is to gather training photographs from a variety of helmet & harness. With the help of the OpenCV package and the Python computer language, we were able to capture approximately 264 photos depicting the helmet & harness detection. For the goal of training the proposed system to identify and detect helmet & harness using Deep Learning, the collected photos are separated into training and testing datasets.

Step 2: pre-processing – Applying preprocessing techniques, such as rescaling with a factor of 1/255, allows the Keras Python library to build an Image Data Generator object. For both the training and testing datasets, the photos are scaled to 150×150 pixels and processed in 64-item batches with the categorical class mode set. Next, the suggested system is trained for 25 epochs with a deep learning to successfully detect helmet & harness.



Model Architecture for YOLOv8

Step 3: Helmet & Harness Detection – This step of the process involves detection of helmet and harness in the photograph. It can be precisely identified using the input image by the procedure. To effectively identify with helmet & harness and without helmet & harness in images, the region recognition module employs the YOLOv8 approach.

Getting the Roboflow dataset and installing Ultralytics to run the YOLOv8 model are the main steps in training the system to identify helmet & harness. After connecting Roboflow with an API token, the dataset for helmet & harness detection can be downloaded in YOLOv8 format from the dataset URL.

The dataset that was downloaded is thoroughly scanned in order to get a list of all the files that are in the subdirectories. The number of files in the folder can then be found by consulting the file list. The dataset includes approximately 264 photos pertaining to detect. After sorting and shuffling the files in the training, validation, and testing directories, the photos are grouped and shifted to enhance the model's training performance.

The YOLOv8 model is prepared for the object detection job after the Roboflow dataset and dataset have been successfully integrated. After 50 training epochs with 416-image batches and 32-batch sizes, the detection algorithm is run using the learned weights. You can test and deploy the YOLOv8 model when training is finished by saving the project run files and trained weights in ZIP format to the specified directory.



Step 4: Helmet & Harness detection and Alert – Here, we link the mobile phone's camera to the laptop using the DroidCam app, and then we use a Python program to record both live video and still images. This phase involves using the trained YOLOv8 model file (.pt) that was obtained in the previous stage to identify helmet & harness in the frames of the live broadcast. To find areas with little or no helmet & harness, the trained model makes predictions.

By utilizing the Pywhatkit library, the detected frames are constantly checked for helmet & harness. Once a without helmet & harness is recognized, the picture is saved and forwarded to the appropriate authority via alert The decision-making module notifies the appropriate authorities of the identified helmet & harness region through an appropriate alert message, allowing them to take the required measures for helmet & harness monitoring.

CHAPTER 6

RESULT AND APPLICATIONS

6.1 RESULTS

PLEASE PUT THE SCREENSHOTS OF YOUR PROJECT HERE AND CONTINUE THE FIGURE NUMBERS

(PUT AS MUCH AS CAN)

6.2 Applications

- ✓ Real-Time Safety Monitoring
- ✓ Accident Prevention
- ✓ Smart Surveillance Systems
- ✓ Safety Audits and Reporting

6.3 TEST CASES

6.1.1 Performance Testing

The system performance is evaluated based on accuracy in detecting helmet & harness from input satellite images.

6.1.2 System Testing

The system is tested by processing large sets of satellite images to ensure stability and consistent detection under varying loads.

6.1.3 Recovery Testing

The system can be restored quickly after failure by reinstalling dependencies and redeploying the model with saved configurations.

6.1.4 Security Testing

6.1.4.1 Stress Testing

The system is tested with high volumes of image data to identify its breaking point and ensure it handles overload conditions effectively.



6.1.4.2 Unit Testing

Individual modules like image preprocessing, model training, and prediction are tested separately for correct functionality.

6.1.4.3 Black Box Testing

The system is tested by providing input images and verifying accurate helmet & harness detection without analyzing internal processes.

6.1.5 Integration Testing

All modules are integrated and tested together to ensure seamless operation and correct end-to-end helmet & harness detection results.

6.1 Test Cases and Test Results

6.1.2 Test Cases

ID	TEST CASE	INPUT	PASS CRITERIA
DS_DLD	Dataset Downloading	Dataset URL	Dataset has been downloaded from the given Roboflow URL
D_TRAIN	YOLO v8 Training	Dataset	Required parameters are set to train the YOLO V8 Model
YOLO_TEST	YOLOV V8 Testing	Frames from the Input Video	The video frames are tested for the helmet & harness and they are marked and showed to the user. Along with the alert.

Table 9.1: Test Cases

CHAPTER 7

CONCLUSION AND FUTURE SCOPE

An effective way to enhance worker safety in industrial environments is by implementing a Helmet and Harness Detection System using Artificial Intelligence. The system utilizes deep learning and computer vision techniques to automatically detect whether workers are wearing proper safety equipment such as helmets and harnesses in real-time. This reduces the need for continuous human supervision and minimizes human error in safety monitoring.

The use of AI-based models ensures high accuracy and reliable performance even in challenging conditions such as varying lighting and complex industrial environments. The system can instantly generate alerts when safety violations are detected, enabling quick response and preventing potential accidents. By ensuring



compliance with safety regulations, this approach significantly improves workplace safety and reduces the risk of injuries, especially in high-risk industries like construction, mining, and manufacturing.

Additionally, real-time processing and minimal data storage can help address privacy concerns while maintaining efficient monitoring. This system demonstrates the potential of AI-powered surveillance in enhancing industrial safety and operational efficiency.

With further advancements, the system can be improved by incorporating more advanced deep learning algorithms to enhance detection accuracy and robustness. The use of edge computing can enable faster processing and reduce latency, allowing quicker decision-making. Integration with multiple cameras can provide wider coverage and more comprehensive monitoring of large industrial sites. Future improvements may also include integration with IoT systems, automated machinery shutdown during safety violations, and advanced analytics for worker behavior.

Moreover, enhancing data security and privacy protection measures will be essential for ethical implementation. With continuous development and proper deployment, this technology has the potential to become a standard safety solution across various industries.

CHAPTER 8

APPENDIX

8.1 Helmet and harness detection in industries using AI

- ✓ <https://www.flytbase.com/blog/ai-powered-helmet-detection-construction-safety>
- ✓ <https://www.viact.ai/iot/smart-helmet>
- ✓ <https://etasr.com/index.php/ETASR/article/view/10868>
- ✓ <https://www.mdpi.com/2072-4292/15/2/347>

CHAPTER 9

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