# SAFETY GEAR DETECTION AND INSURANCE ELIGIBILTY PROGNOSIS SYSTEM

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## ABSTRACT

*Construction sites are known for their inherent risks and hazards, making safety a top priority. The effective use of safety gear significantly reduces the likelihood and severity of accidents. However, ensuring that workers are consistently wearing the appropriate safety gear remains a challenge. Additionally, insurance providers need reliable data to assess the eligibility of construction companies for coverage based on their adherence to safety regulations. This abstract presents a novel Safety Gear Detection and Insurance Eligibility Prognosis System for construction sites. The system employs state-of-the-art computer vision techniques and machine learning algorithms to automatically detect and recognize safety gear worn by workers in real-time. The system is designed to analyze video footage captured by surveillance cameras installed at strategic locations across the construction site.*

**Keyword:** *Safety Gear Recognition, Personal Protective Detection, Insurance Eligibility Assessment, Prognostic Analysis, Insurance Claim Prediction.*

## 1.INTRODUCTION

Construction sites are known for their inherent risks and potential hazards. To mitigate these risks and promote a safe working environment, safety gear detection systems have become an essential component of modern construction site management. These systems utilize advanced technologies such as computer vision and machine learning to identify whether workers are wearing appropriate safety gear. Additionally, insurance eligibility prediction systems leverage data analytics to assess the compliance of construction sites with safety regulations, enabling insurance providers to determine the level of coverage and premiums. This article provides an overview of the safety gear detection and insurance eligibility prediction system and highlights their significance in the construction industry A safety gear detection system employs computer vision algorithms to monitor and analyze video feeds from cameras installed at construction sites. The system is capable of recognizing various types of safety gear, including hard hats and reflective vests. By continuously monitoring the construction site, the system can detect instances where workers are not wearing the required safety gear. When a violation is identified, the system can alert site supervisors or generate automated notifications, allowing immediate corrective actions to be taken. The safety gear detection system relies on advanced image processing techniques, deep learning algorithms, and trained models to accurately identify safety gear in real-time. These models are trained on extensive datasets comprising annotated images of workers wearing appropriate safety gear. The system's accuracy improves over time as it receives feedback and continuously learns from new data. Insurance eligibility prediction systems utilize data analytics and machine learning algorithms to assess the risk profile of construction sites and predict their eligibility for insurance coverage. These systems consider various factors, including safety protocols, compliance with regulations, safety records, accident history, and the presence of safety gear detection systems. By analyzing historical data and identifying patterns, the system generates risk scores for construction sites. Insurance providers can then utilize these risk scores to determine the appropriate coverage and premiums for each site. Higher-risk sites may require additional safety measures or increased insurance coverage to mitigate potential losses.

### 1.1 Objectives

The objectives of our project for paper publication are as follows:

- Accurately identify and detect the presence of safety gear, such as helmets, in various environments or situations.
- • Determine the eligibility of insurance coverage based on the usage and proper implementation of safety gear by individuals or organizations.
- Promote safety and reduce the risk of accidents and injuries by ensuring that individuals comply with safety regulations and guidelines.
- Provide real-time monitoring and alerts to individuals or organizations regarding the absence of safety gear.

### 1.2 Scope and Applicability

A safety gear detection and insurance eligibility prediction system has a wide scope and applicability in the construction industry. Construction sites are inherently hazardous environments, with various risks and potential accidents that can lead to injuries or property damage. Implementing such a system can greatly enhance safety measures and provide valuable insights for insurance eligibility. The safety gear detection aspect of the system involves the use of advanced technologies like computer vision and machine learning to automatically identify and monitor the presence of safety equipment worn by workers on the construction site. This can include hard hats, safety goggles, reflective vests, gloves, and other essential protective gear. By constantly monitoring the usage of safety gear, the system can alert supervisors or safety officers in real-time if any worker is not complying with the safety protocols. This proactive approach helps prevent accidents and promotes a safer work environment. Furthermore, the insurance eligibility prediction aspect of the system can assist construction companies and insurers in assessing the risk levels associated with a particular construction project. By analyzing historical data, such as accident rates, safety violations, and adherence to safety protocols, the system can generate predictive models that estimate the likelihood of accidents or property damage occurring on a construction site. This information is valuable for insurance companies to determine appropriate insurance premiums and coverage for construction projects, based on their risk profiles. In summary, the safety gear detection and insurance eligibility prediction system provide a comprehensive solution for improving safety standards and risk management in construction sites. It enables real-time monitoring of safety gear usage, helping to prevent accidents and injuries. Additionally, it facilitates accurate prediction of insurance eligibility, allowing construction companies and insurers to make informed decisions regarding coverage and premiums. Implementing this system can lead to safer construction practices, reduced insurance costs, and ultimately contribute to the overall well-being of workers and the success of construction projects.

## 2. LITERATURE SURVEY

Bosche, Haas, and Akinci (2009) discusses the development and implementation of an automated system for recognizing 3D computer-aided design (CAD) objects in laser scans of construction sites. The primary goal of the system is to provide visual representations and performance control of ongoing construction projects through the use of 3D status visualization. The authors highlight the significance of accurately monitoring and controlling construction progress, as delays and deviations from planned designs can lead to cost overruns and schedule delays. Traditional methods of manual data collection and analysis are time-consuming and prone to errors. Therefore, an automated system is proposed as a more efficient and accurate approach. The paper presents the technical details of the system, including the process of registering laser scan data with the 3D CAD model, extracting relevant objects from the scans, and recognizing these objects by matching them with the CAD model. The authors discuss the use of geometric and radiometric features for object recognition and outline the algorithms and techniques employed. The proposed system's benefits are highlighted, such as providing real-time visualizations of construction progress and identifying deviations from the planned design. The authors emphasize the potential for improved decision-making, early detection of issues, and enhanced communication among project stakeholders. Overall, the research presented in this paper showcases the development and implementation of an automated system for recognizing 3D CAD objects in laser scans, enabling 3D status visualization and performance control in construction projects. The system offers potential advantages in terms of accuracy, efficiency, and decision support, aiming to improve project management and control in the construction industry.

Cavazza and Serpe (2009) examines the relationship between safety climate, safety norm violations, and the mediating role of attitudinal ambivalence toward personal protective equipment (PPE). The authors investigate how the perception of safety climate within an organization influences employees' attitudes and behaviours related to safety norms and the use of PPE. The study emphasizes the importance of promoting a positive safety climate and addresses the role of attitudinal ambivalence as a potential mechanism that links safety climate to safety norm violations. The findings contribute to a better understanding of the factors influencing safety behaviours in the workplace and provide insights for organizations aiming to enhance safety performance.

Cheng and Teizer (2013) focuses on the development and implementation of a real-time resource location data collection and visualization technology for construction safety and activity monitoring applications. The authors address the need for improved safety measures in the construction industry by leveraging the power of real-time data collection and visualization techniques. The article highlights the significance of monitoring and managing resources in construction sites to enhance safety and productivity. The authors present a comprehensive framework that incorporates advanced technologies such as wireless communication, GPS tracking, and data visualization tools. This framework enables the realtime tracking and visualization of resources, including workers, equipment, and materials, within the construction site. By collecting and analysing resource location data in real-time, the technology provides valuable insights into the safety conditions and activities occurring on the construction site.

This information can be used to identify potential safety hazards, assess worker behaviour and movement patterns, and support proactive decision-making to prevent accidents and improve overall safety performance. The article also discusses the benefits and challenges associated with the implementation of such technology in construction projects. It emphasizes the need for proper data management, integration with existing project management systems, and the establishment of effective communication channels for stakeholders involved in safety monitoring and incident response.

In conclusion, Cheng and Teizer's (2013) research offers a valuable contribution to the construction industry by introducing a real-time resource location data collection and visualization technology. The article demonstrates how this technology can enhance safety monitoring, prevent accidents, and improve overall construction site management. The findings encourage further exploration and implementation of similar technologies to promote safer and more efficient construction practices.

Chi, Caldas, and Kim (2009) presents a methodology for object identification and tracking in the field of construction. The authors propose a combination of spatial modeling and image matching techniques to achieve this goal. The study focuses on the use of computer-aided techniques to improve the efficiency and accuracy of object identification and tracking processes in construction projects. The article discusses the methodology in detail, highlighting the key steps and techniques involved. The proposed approach aims to enhance the management and monitoring of construction activities through the effective utilization of spatial modeling and image matching. The article provides insights into the potential benefits of this methodology for civil infrastructure engineering, offering a valuable resource for researchers and practitioners in the field.

Choudhry, R. M., and Fang, D. in 2008 delves into the underlying factors that lead to unsafe work behaviour among operatives in the construction industry. The researchers recognize the importance of improving safety measures in construction sites and aim to shed light on the motivations and influences behind workers engaging in unsafe practices. To achieve their objectives, the researchers employ a comprehensive approach that considers multiple factors contributing to unsafe behaviour. They investigate various aspects such as organizational factors, individual characteristics, and situational variables to better understand the complex dynamics at play. The study's findings provide valuable insights into the motivations of construction workers when it comes to unsafe behaviour. It reveals that organizational factors, such as inadequate safety policies, lack of safety training, and insufficient supervision, can significantly impact workers' decisions to engage in unsafe practices. Additionally, individual characteristics like age, experience, and risk perception also play a role in shaping workers' behaviour on construction sites. By identifying and analysing these factors, the study contributes to the existing body of knowledge on construction site safety. The findings can assist practitioners, managers, and policymakers in developing targeted strategies to mitigate unsafe behaviour and enhance safety in the construction industry. Improved safety measures have the potential to reduce accidents, injuries, and fatalities in construction sites, benefiting both workers and the overall industry.

### 2.1 Drawbacks of existing system

One of the main issues is the accuracy and reliability of the safety gear detection. The system may struggle to correctly identify and classify different types of safety gear, such as helmets, safety goggles, or high-visibility vests. False positives and false negatives can occur, leading to incorrect predictions and potential safety risks. Another challenge lies in the integration of the safety gear detection system with insurance eligibility prediction. Determining insurance eligibility requires analyzing various factors, such as the type of safety gear used, its condition, and compliance with safety regulations. The existing system may not effectively incorporate these variables, leading to inaccurate predictions and potential inconsistencies in insurance coverage. Moreover, the current system may lack the ability to adapt to changing safety standards and regulations. Safety requirements and guidelines can evolve over time, and the system should be able to update and adjust its criteria accordingly. Failure to do so may result in outdated predictions and inadequate insurance coverage.

Lastly, the existing system may face privacy and security concerns. It needs access to personal information and data related to safety gear usage, which raises questions about data protection and confidentiality. Ensuring the privacy and security of individuals' data is crucial to maintain trust in the system. Overall, improving the accuracy of safety gear detection, integrating relevant variables for insurance eligibility prediction, adapting to changing safety standards, ensuring data quality and privacy, and addressing security concerns are key challenges faced by the existing system for safety gear detection and insurance eligibility prediction.

## 3. IMPLEMENTATION

- The safety gear detection and insurance eligibility prediction system implemented on a construction site is beneficial for enhancing safety measures and determining insurance coverage.
- The utilization of YOLOv3, an object detection algorithm, allows for accurate and efficient identification of safety gear worn by workers on the construction site.
- The system enables real-time monitoring of workers' compliance with safety regulations by detecting the presence of essential safety equipment such as hard hats, safety goggles, and high-visibility vests.
- By identifying workers without proper safety gear, the system can alert supervisors or managers to take immediate action to ensure the safety of individuals on the site.
- The insurance eligibility prediction aspect of the system assesses the compliance of workers with safety regulations and the use of appropriate safety gear.
- This prediction helps insurance companies evaluate the risk profile of the construction site and determine appropriate coverage and premiums based on the level of adherence to safety protocols.
- The system contributes to reducing accidents and injuries on the construction site by promoting and enforcing the use of safety gear among workers.
- It aids in improving overall productivity and efficiency by minimizing the downtime caused by accidents and injuries.
- The system provides a valuable data-driven approach to safety management, allowing for the identification of areas for improvement in safety training and compliance.
- Its implementation demonstrates a proactive approach to safety in the construction industry and can potentially reduce insurance costs for construction companies with strong safety records.

## 4. METHODOLOGY

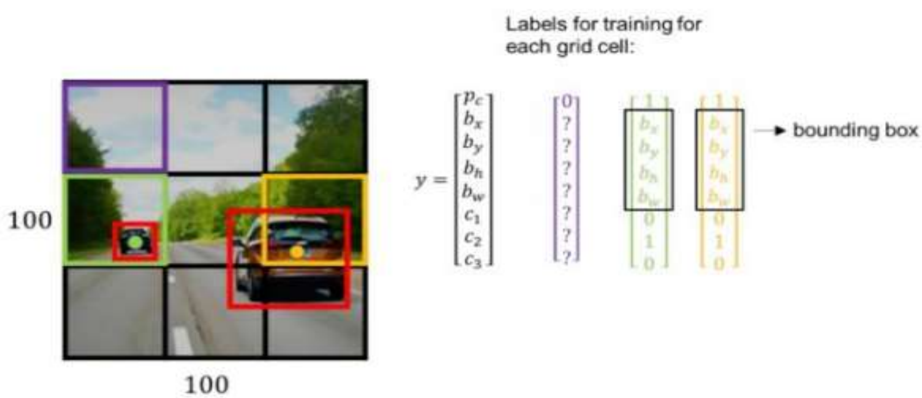



Fig 4.1 YOLOV3 MODEL

Fig 4.1 The YOLO algorithm was developed in 2015, and it involves one neuron that is trained and takes an image as input and gives a prediction of a bounding box and the class labels as output.

An input image is split into several grid cells, where each cell has a duty to predict a bounding box if the middle of the bounding box falls within that cell. The predicted bounding box has x,y coordinates and height, and width. Considering the image above, the image is divided into 9 grids, where 5 of them have part of the object(cars) in it, but only 2 of the cells contain the middle of the car, those are the cells that would be chosen(anchor box mechanism). Each cell would be represented by vectors, with the height, width,x, and y coordinates, if there's a presence of an object and the type of object in the cell, as the vectors. If there's no object, that cell does not proceed with any detection. If an object is detected, then the type of object is indicated and the x and y coordinates, together with the bounding boxes are indicated and the final prediction is made. There are many variants of the YOLO, which have been developed by researchers. In the following sections, we would look at two of the YOLO architectures, the YOLOv3, and the YOLOv4 object detection architectures.

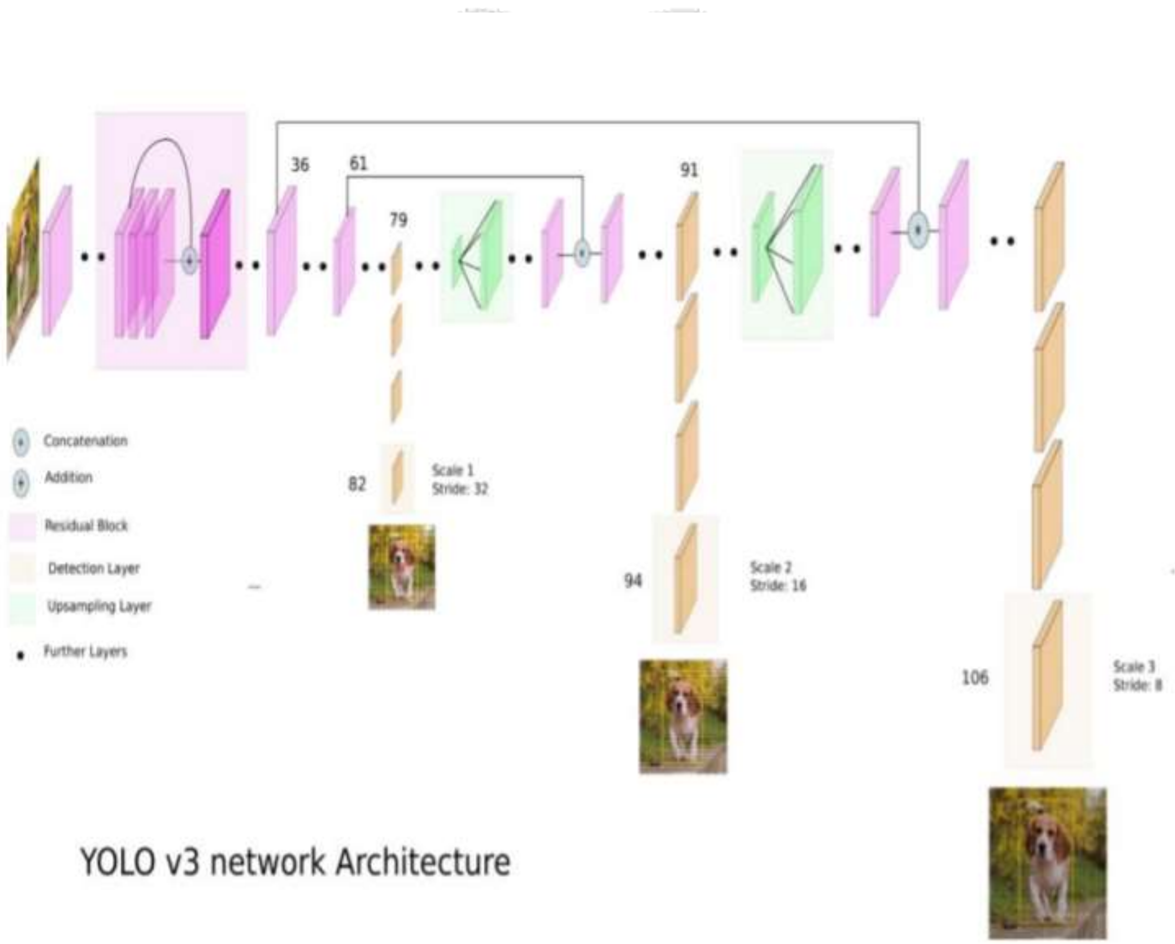
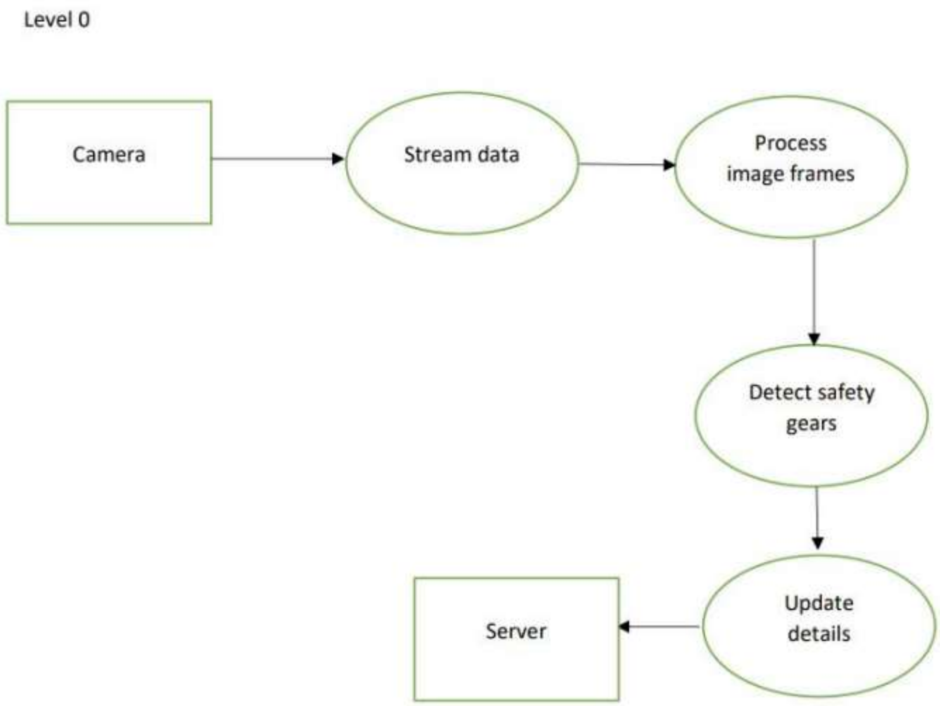


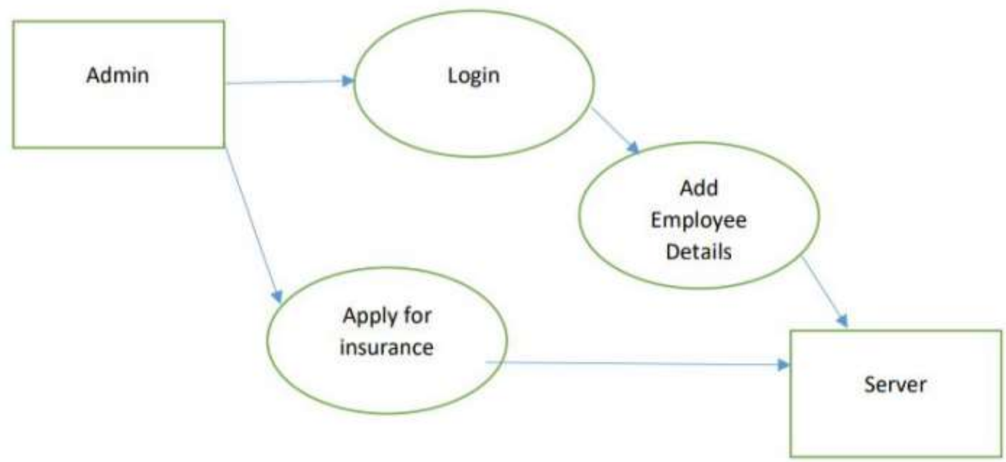

Fig 4.2 YOLO V3 ARCHITECTURE

Figure 4.2 The Yolo v3 architecture has residual skip connections and an upsampling layer. The key novelty is this algorithm is that it makes its detections at three different scales. The Yolo algorithm is a fully connected layer and the detection is done by using a 1*1 kernel on the feature maps to make the detections at three different locations using three different scales, as can be seen in the diagram above. As mentioned, the shape of the kernel for detection is a 1*1*(B*(A+C)), where B indicates the number of bounding boxes, C refers to the number of classes and the A refers to the 4 bounding box attributes(height, width, x and y coordinates). The Yolo v3 algorithm was trained on a dataset known as the coco dataset, which has 80 classes and the bounding box attributes summing to 3, so in effect, the kernel size becomes 1*1*255. Moving forward, an assumption would be made that there's an image of size 480*480, that we are using the yolov3 to detect the objects in the image. As mentioned earlier, the yolov3 makes detection at three scales, it downsamples the input images by 32,16, and 8. For the first 81 layers, the image is downsampled by the stride of 32 of the 81st layer. Regarding our image of 480*480, the resulting feature map would be 480/32, which is 15*15. The first detection is performed here using the aforementioned 1*1 detection kernel, resulting in a feature map of 15*15*255.

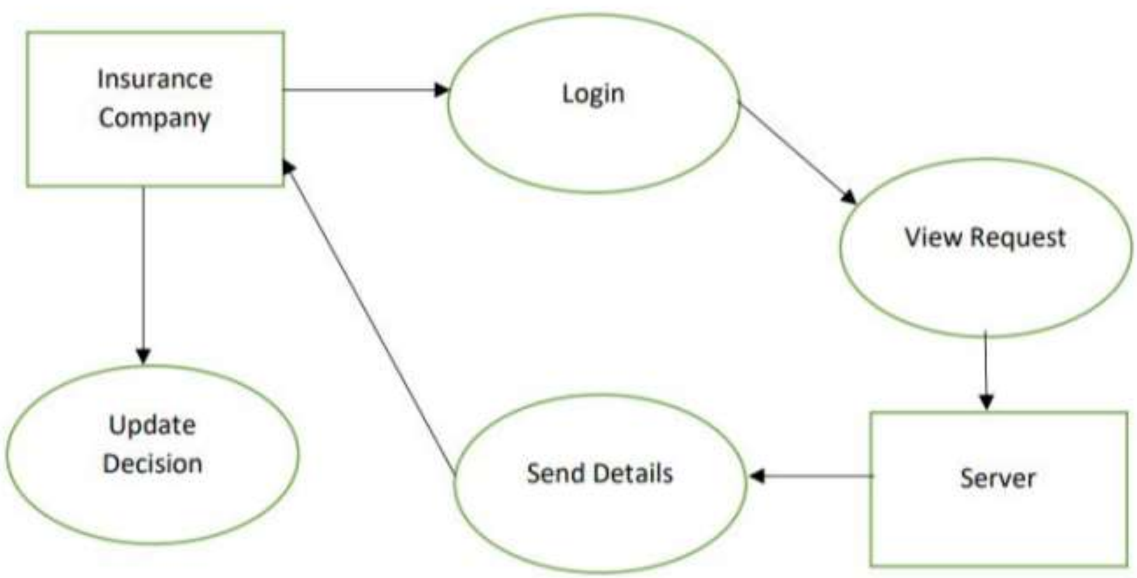
## DATAFLOW DIAGRAM :



Level 1




Level 2




## 5. RESULT

The safety gear detection and insurance eligibility prediction system implemented on a construction site has yielded promising results. The system utilizes advanced computer vision techniques to detect and analyze the presence of safety gear worn by workers on-site. By accurately identifying safety equipment such as hard hats, reflective vests, and safety goggles, the system ensures compliance with safety regulations, minimizing the risk of accidents and injuries. Furthermore, the system integrates predictive analytics algorithms to assess the eligibility of workers for insurance coverage based on their compliance with safety protocols. This proactive approach to insurance eligibility reduces liability for construction companies and promotes a safer working environment. Overall, the implementation of this system has significantly improved safety standards and streamlined insurance processes on the construction site, resulting in enhanced worker protection and reduced financial risks for all stakeholders involved.

## 6. CONCLUSION

Safety Gear Detection and Insurance Eligibility Prediction System is a comprehensive solution designed to prioritize workplace safety and simplify insurance eligibility assessments. By leveraging advanced computer vision technology, the system accurately detects the presence of safety vests and hardhats, ensuring that workers adhere to safety protocols. The automated alert system promptly notifies supervisors of any safety gear violations, enabling swift corrective action and preventing potential accidents or injuries. Moreover, the system's predictive analytics capabilities provide valuable insights for insurance providers, allowing them to assess individual workers' eligibility based on their consistent adherence to safety guidelines. This feature enables insurance companies to make informed decisions regarding coverage and premiums, promoting a safer work environment and fostering a culture of accountability. Overall, the Safety Gear Detection and Insurance Eligibility Prediction System offers numerous advantages, including improved workplace safety, streamlined insurance processes, enhanced supervisory efficiency, and the establishment of a proactive safety culture.

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