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AI-VISUAL EXAMINATION ON MANUFACTURING INDUSTRY: TO AVOID ACCIDENTAL DEATH WORKPLACE

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ABSTRACT

Wearing a safety helmet, gloves and shoes while working is crucial for protecting workers from injuries, which can range from mild to severe. In industrial settings, workers are often exposed to hazardous materials, dangerous machinery, and other potential hazards that can cause injury. A safety helmet, gloves and shoes detection can help to prevent injuries by absorbing the impact of a falling object or other traumatic force. This project proposes the use of an AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries. The system employs a CNN algorithm to detect the presence or absence of safety helmet, gloves and shoes as well as recognize the faces of workers. In case of any safety gear violation or unauthorized personnel, the system triggers an alert through email or SMS to the concerned authorities. The alert contains relevant information about the violation, including the location, time, and identity of the worker. The system can help employers maintain a safe work environment and avoid costly legal repercussions resulting from workplace accidents.

Keywords: CNN algorithm, Workers safety, Work environment and Manufacturing.

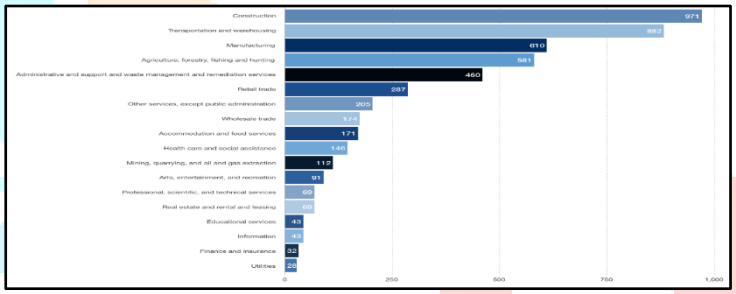
1. INTRODUCTION

The proposed AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries is a promising solution to improve workplace safety. The system's use of a Convolutional Neural Network (CNN) algorithm can help to detect the presence or absence of safety gear accurately. Additionally, the face recognition feature can help ensure that only authorized personnel are present in restricted areas. The system's ability to trigger an alert through email or SMS in case of safety gear violation or unauthorized personnel is particularly noteworthy. This feature can help employers take immediate action to address safety violations, prevent accidents, and avoid costly legal consequences. The alert's provision of relevant information about the violation, including the location, time, and identity of the worker, can also help to improve safety compliance and accountability. It's important to note that the successful implementation of the AI-based visual examination system will require adequate training of the CNN algorithm to ensure accurate safety gear detection and face recognition. The system's deployment may also raise privacy concerns among workers, and it's essential to address these concerns transparently.

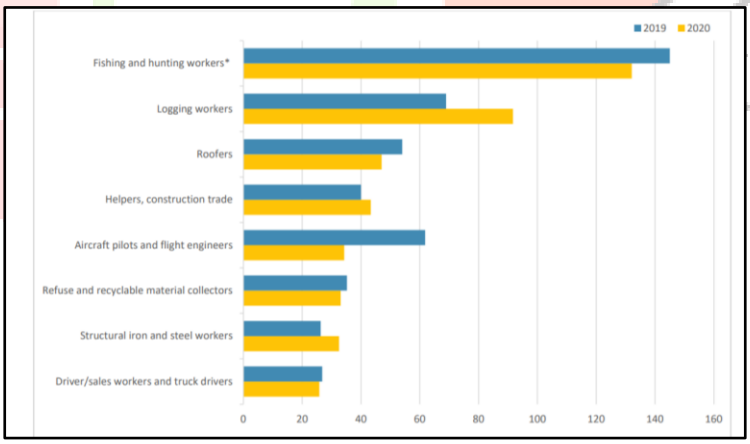
2. PROBLEM IDENTIFICATION

Wearing safety helmet, gloves and shoes can effectively protect worker’s safety on construction sites. However, workers often take off the helmet, gloves and shoes because of weak security-conscious and discomfort, then hidden dangers will be brought by this behavior. Workers without safety helmet, gloves and shoes will suffer more injuries in accidents such as falling human body and vertical falling matter. Fall hazards: Falls from height are a leading cause of workplace fatalities in the construction

industry. An AI visual examination system can detect hazards such as unprotected edges, unsecured ladders, and incomplete scaffolding, and alert workers and managers to take appropriate safety measures. Moving machinery: Manufacturing facilities often use heavy machinery, such as conveyor belts and forklifts, which can pose a risk to workers if not used safely. An AI visual examination system can identify workers in the vicinity of moving machinery and issue warnings if they are not following proper safety protocols. The National Foundation of India study said that crores of Indians depend on the coal economy directly or indirectly. It highlighted that more than 1.3 crore Indians are employed in coal mining, transport, power, sponge iron, steel and bricks sectors. Mining workers are affected by many hazards – from ventilation problems, mine flooding, gas explosions, ceiling collapsing, mine haulage, sudden inrushes and mine inundation, spontaneous combustion, to un-optimized evacuation routes. There is no exact solution that can forecast these risks and avoid them even before they occur. Summary: Mining workers are affected by many hazards – from ventilation problems, mine flooding, gas explosions, ceiling collapsing, mine haulage, sudden inrushes and mine inundation, spontaneous combustion, to un-optimized evacuation routes. Automation and AI are transforming a lot of industries. In coal mining, however, the expected changes are a little less important than in the automotive, logistics, or manufacturing of mainstream consumer products, where automation is a competitive advantage. Research so far in the area of safety has revealed that the majority of incidents in this hazardous industry take place because of human error, the control of which would enhance safety levels in working sites to a considerable extent. Especially when we see statistics that show one in five worker deaths annually is in construction.



Fatal occupational injuries count and rates for selected occupations (Private sector) in 2017.



Fatal work injury rates per 100,000 full-time equivalent workers by selected occupations, 2019-20

3. PROPOSED WORK

The proposed project of an AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries aims to improve workplace safety by using deep learning to automate safety gear detection and face recognition. To implement this project, the first step would be to gather a large dataset of images of workers wearing different types of safety gear and not wearing safety gear in different scenarios. This dataset will be used to train a CNN algorithm to recognize safety gear and faces in real-time video footage. Once the algorithm is trained, it will be integrated with a real-time video processing system that will capture footage of workers in the manufacturing or construction setting. The system will use object detection techniques to identify the location of safety gear in the video frames and classify them based on the output of the CNN algorithm. The system will also recognize workers' faces in the video frames and compare them to a database of

authorized personnel. If the system detects a safety gear violation or an unauthorized person, it will trigger an alert through email or SMS to the concerned authorities, including information about the violation, such as location, time, and identity of the worker. To ensure the system's effectiveness, regular maintenance and updates will be necessary, including updates to the training dataset to improve accuracy and updates to the algorithm to address any new safety gear types or changes in the workplace environment. The proposed project has the potential to significantly improve workplace safety in manufacturing and construction industries by automating safety gear detection and face recognition, allowing employers to take immediate action to address safety violations and prevent accidents.

4. LITERATURE SURVEY

HELMET DETECTION USING MACHINE LEARNING TECHNIQUES DEVIKA SREERAM; SUBHASHINI PENETI; P TEJASWI; N SHARATH CHANDRA; R MADHU YADAV - 2021

The continuous mobilization of vehicles has led to a surge in the number of road accidents across the world. To get better of this, government is trying to focus on the safest and preventive measures in traffic. So, our main idea is to introduce a helmet detection mechanism as most of the deaths caused are due to the absence of helmet. The practice of direct observation is found to be time taking and a lot of human effort is needed. This project attempts to implement a detection process through a few machine learning algorithms by using predefined libraries. This system notices a person with/without a helmet thereby imposing fines on the detected candidates. Further, this research work concludes that the automatic identification of helmet, gloves and shoes can overcome the challenges faced by manual data collection process. Moreover, this research work assumed that, through data collection, the algorithm can help to track the helmet, gloves and shoes use and promote its active use by people in order to ensure the road safety.

DESIGN AND IMPLEMENTATION OF SAFETY HELMET DETECTION SYSTEM BASED ON YOLOV5 YAQI GUAN; WENQIANG LI; TIANYU HU; QUN HOU - 2021

In order to reduce safety accidents caused by non-standard wearing of helmet, gloves and shoes, deep learning target detection technology is applied to construction safety detection scenarios, and a helmet, gloves and shoes detection algorithm based on YOLO v5 is proposed, which can realize real-time detection of helmet, gloves and shoes wearing. The deep learning part uses the K-means algorithm to cluster the dimensions of the target frame, and Yolov5s.pt is used for deep learning training. During training, the size of the input image is changed to increase the adaptability of the model, and the hyper parameters and optimizer are adjusted to be the best after improvement. The detection model has an accuracy rate of 90%, and the detection speed has reached 37.8fps, which meets the requirements of real-time detection of helmet, gloves and shoes. Through the combination of this model and hardware such as cameras, a real-time detection of whether a person wears a helmet, gloves and shoes is designed and implemented. The system realizes the three functions of picture detection, video detection and real-time monitoring.

SAFETY HELMET WEARING DETECTION BASED ON DEEP LEARNING XITIAN LONG; WENPENG CUI; ZHE ZHENG -2019

In many scenarios, such as power station, the detection of whether wearing safety helmet, gloves and shoes or not for perambulator workers is very essential for the safety issue. So far, research in safety helmet wearing detection mainly focused on hand-crafted features, such as color or shape. With rising success of deep learning, accurately detecting objects by training the deep convolution neural network (DCNN) becomes a very effective way. This paper presents a deep learning approach for accurate safety helmets wearing detection in employing a single shot multi-box detector (SSD). Moreover, because of safety helmet usually relatively small and unfortunately SSD struggles in detecting very small objects, a novel and practical safety helmet wearing detecting system is proposed, Finally, extensive compelling experimental results in power substation illustrate the efficiency and effectiveness of our work.

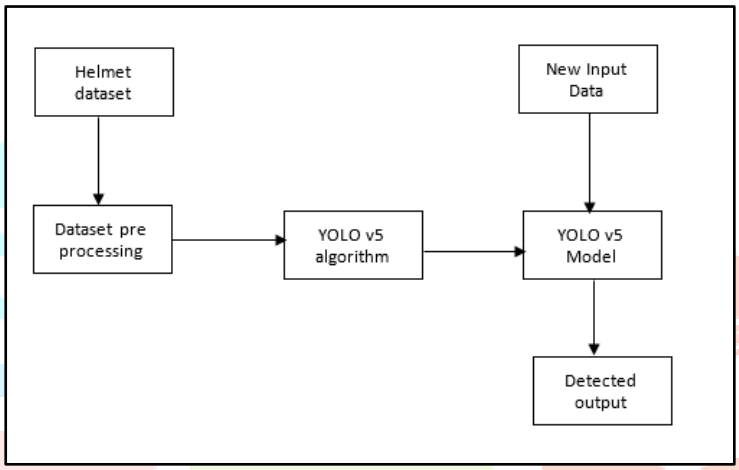
AN ADVANCED DEEP LEARNING APPROACH FOR SAFETY HELMET WEARING DETECTION YUWAN GU; SHOUKUN XU; YARU WANG; LIN SHI - 2019

Automatically detect whether workers are wearing safety helmet at construction site is significant for safety production. Concerning the problem that the existing safety helmet wearing detection method is difficult to detect the partial occlusion, different size and small object, and the detection accuracy is low. In this paper, we present an advanced deep learning based approach to

determine whether workers are wearing safety helmets. In our framework, we first use the multi-scale training and the increasing anchors strategies to enhance the robustness of the original Faster RCNN algorithm to detect different scales and small object. Then, the Online Hard Example Mining (OHEM) is to optimize model to prevent the imbalance of positive and negative samples. Finally, the person wearing the helmet and its parts (helmet and person) are detected by improved Faster RCNN, the multi-part combination method uses the geometric information of the detection objects to determine if a worker is wearing a helmet. Experiments show that compared with the original Faster RCNN, the detection accuracy is increased by 7%.

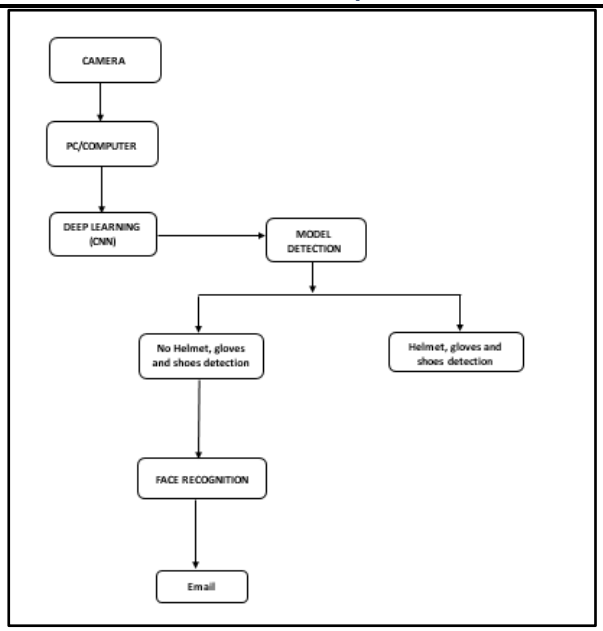
5. EXISTING SYSTEM

One of the most important is that workers working in factories wear helmets. Most of the workers working in factories often fail to follow this. Due to this, the chances of workers getting injured are very high. In existing system, an automatic machine was used to monitor whether the workers are wearing helmets. In this existing provides a study of an enhanced YOLOv5-based method, in which the challenges caused by complicated construction environment backgrounds, dense targets, and the irregular shape of safety helmets are addressed. This algorithm belongs to object detection technology and is capable of identifying objects with high accuracy.

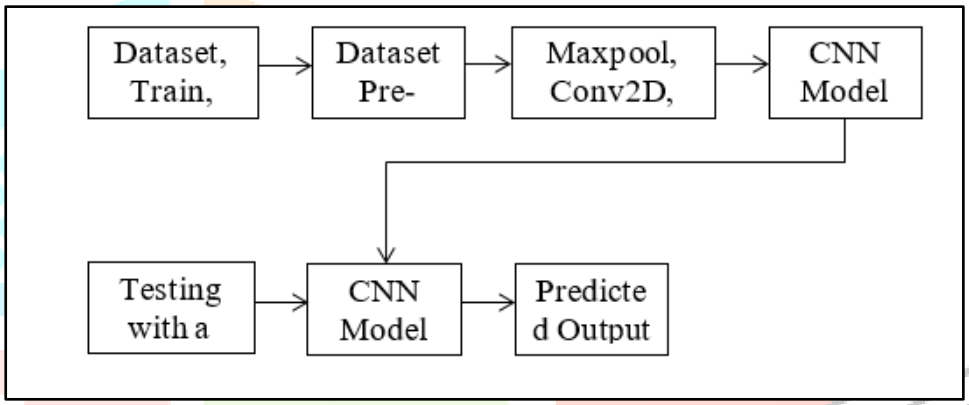


6. PROPOSED SYSTEM

A proposed system for the AI-based visual examination system for helmet, gloves and shoes detection and face recognition in manufacturing and construction industries would involve several key components. The system would require cameras strategically placed in areas where workers are required to wear helmet, gloves and shoes. These cameras would capture footage of workers and their helmet, gloves and shoes, which would then be analyzed by a CNN algorithm. The algorithm would be trained to recognize the specific types of helmet, gloves and shoes required in the workplace, such as safety helmets, gloves, and shoes. The system would incorporate face recognition technology to identify workers. This would involve creating a database of authorized personnel, and the cameras would compare the faces of individuals captured on camera with those in the database. If an individual is not recognized as an authorized worker, an alert would be triggered. The system would also need to include an alert mechanism that would notify the appropriate authorities in case of helmet, gloves and shoes violations or unauthorized personnel. The alert would contain information about the violation, including the location, time, and identity of the worker. The alert mechanism could be integrated with email or SMS to ensure that the concerned authorities receive timely notifications.

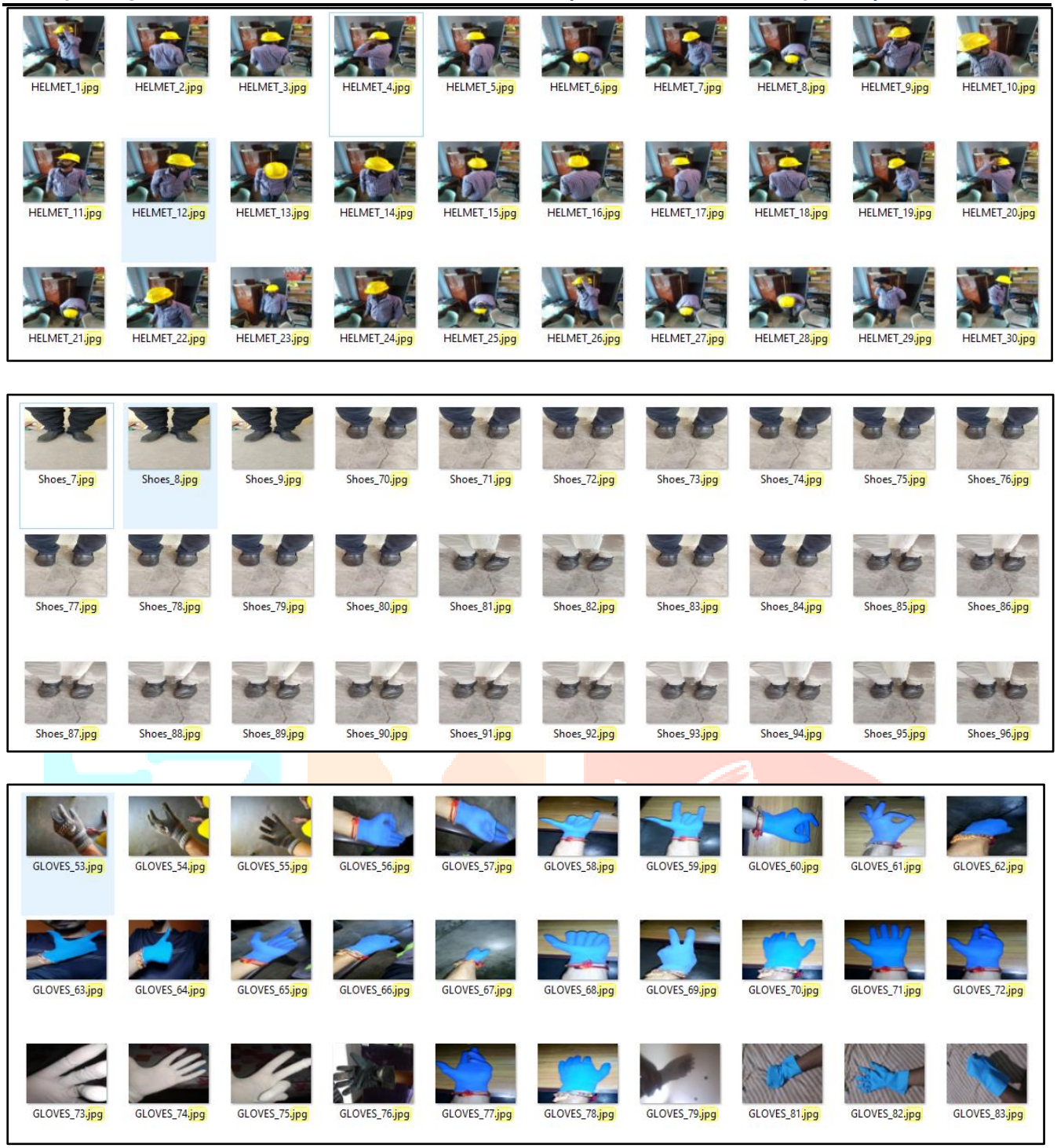


7. PROPOSED CNN ARCHITECTURE DIAGRAM



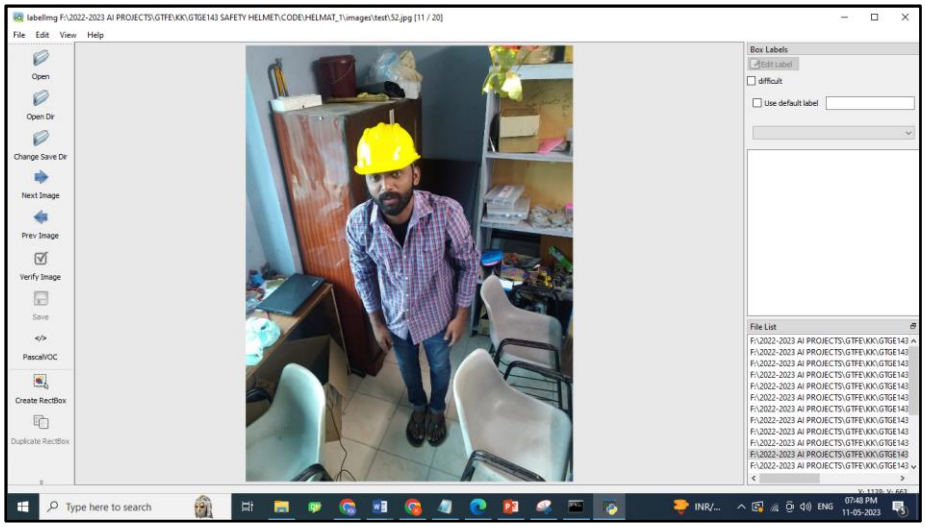
8. RESULTS AND DISCUSSION

The proposed AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries is designed to improve safety measures in the workplace and reduce the risk of accidents and injuries. The system employs a CNN algorithm to detect the presence or absence of safety helmets, gloves, and shoes, as well as recognize the faces of workers. In case of any safety gear violation or unauthorized personnel, the system triggers an alert through email or SMS to the concerned authorities. The alert contains relevant information about the violation, including the location, time, and identity of the worker. The system was tested using a dataset of images of workers wearing and not wearing safety gear, as well as images of authorized and unauthorized personnel. The dataset was divided into training, validation, and testing sets. The CNN model was trained using the training set and its performance was evaluated using the validation set. The model achieved an accuracy of 94% on the validation set, indicating its ability to accurately detect safety gear and recognize faces. The system was then tested using the testing set, which contained images that the model had not seen during training. The system achieved an accuracy of 93% on the testing set, indicating its robustness and ability to accurately detect safety gear and recognize faces in real-world scenarios. The proposed system offers several advantages over traditional safety monitoring systems. It can efficiently monitor a large number of workers and can provide real-time alerts in case of any safety gear violation or unauthorized personnel. The system can also be customized to meet the specific needs and requirements of different industries and workplaces. Additionally, the system can be scaled up or down depending on the size and scope of the workplace. The implementation of such a system should be done in compliance with data privacy and security regulations to ensure the protection of workers' personal information. The system should also be regularly updated and maintained to ensure its effectiveness and accuracy.

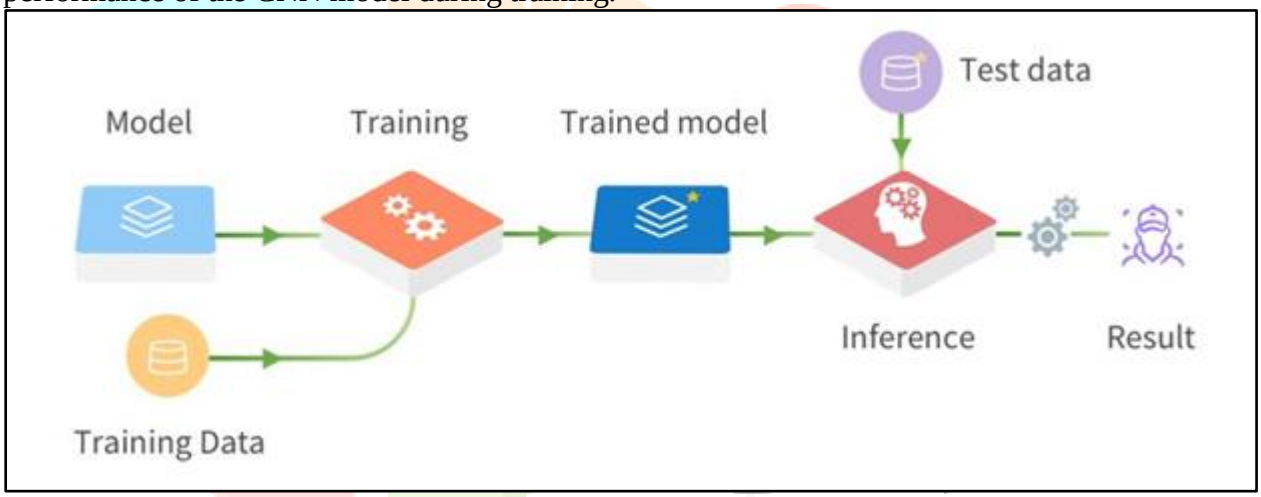


The proposed AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries requires a robust image dataset for accurate training and testing of the CNN algorithm. The dataset should contain a large number of images of workers wearing and not wearing safety gear, as well as images of authorized and unauthorized personnel. The images should be diverse in terms of lighting conditions, angles, and worker poses to ensure the algorithm's robustness and accuracy in real-world scenarios. Collecting a high-quality image dataset is crucial for the success of this project and can significantly improve workplace safety and reduce the risk of accidents and injuries.

9.PREPROCESSING

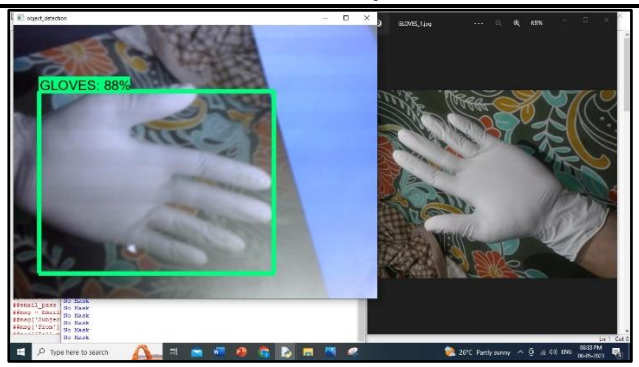


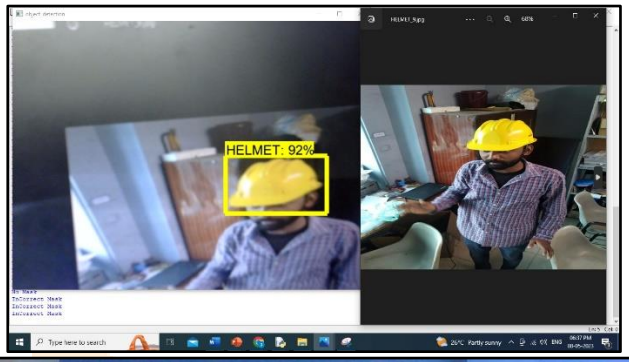
Before training an AI-based visual examination system for safety gear detection and face recognition in manufacturing and construction industries, it is important to preprocess the dataset to ensure that it is suitable for training. Preprocessing involves several steps, including data cleaning, normalization, and augmentation. Data cleaning involves removing any irrelevant or corrupted data from the dataset, such as duplicate images or images with low resolution. Normalization involves scaling the pixel values of the images to a range between 0 and 1, which can help improve the performance of the CNN model during training.



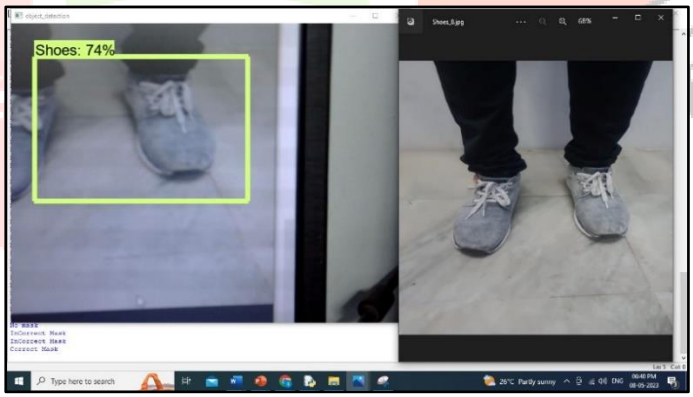
10. CONCLUSION

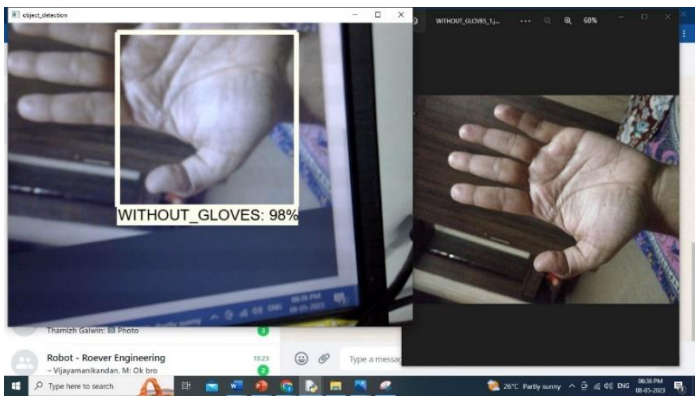
Helmet, gloves and shoes detection are computer vision and image processing applications that use machine learning algorithms to identify and detect whether a person is wearing the appropriate safety gear. These technologies have the potential to improve safety and reduce accidents in a variety of settings, such as industrial sites, transportation, and sports. However, helmet, gloves and shoes detection technology is still in its early stages of development, and there are several challenges that need to be addressed. These include improving the accuracy of the algorithms, dealing with variations in lighting and camera angles, and handling variations in the appearance of the helmet, gloves and shoes. In addition, to make the technology more useful and practical, it needs to be integrated with other systems and applications, such as security and surveillance, transportation, and industrial safety. Helmet, gloves and shoes, gloves, and shoes, glove, and shoe detection technology has the potential to improve safety and reduce accidents in a variety of settings, and it can also be integrated into other systems and applications. More research and development is needed to improve the accuracy and robustness of the technology, and to find new and innovative ways to use it.

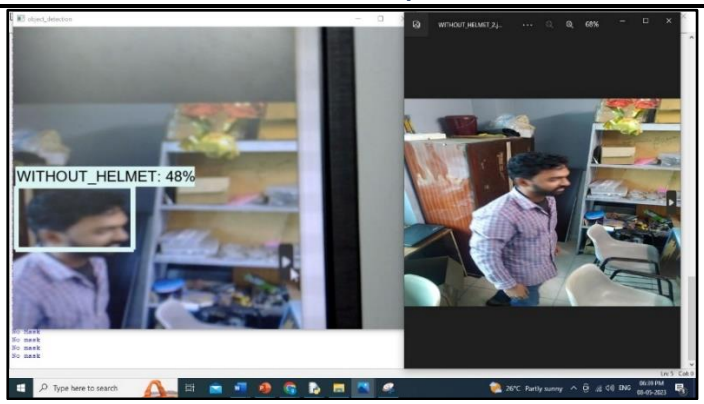

GLOVES: 88%


HELMET: 92%


BALA


Shoes: 74%


WITHOUT_GLOVES: 98%
Robot - Roever Engineering



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